Decision Report

Application to amend licence

Part V Division 3 of the *Environmental Protection Act 1986*

Licence number	L6989/1997/13
Licence holder	Shire of Augusta Margaret River
DWER file number	2013/003284-1
Premises	Davis Road Putrescible Landfill Davis Road FOREST GROVE WA 6286 Legal description Lot 5011 on Deposited Plan 192309 Certificate of Title Volume LR3093 Folio 152
Date of report	23 October 2019
Decision	Licence granted

Table of Contents

1. Definitions

Key terms relevant to this decision report and their associated definitions are listed in Table 1.

Table 1: Definitions

Term	Definition
Applicant	Shire of Augusta Margaret River
AS1289 5.4.1	means the Australian Standard AS1289 5.4.1 *Soil compaction and density tests – compaction control test – dry density ratio, moisture variation and moisture ratio*
AS1289 5.8.1	means the Australian Standard AS1289 5.8.1 *Soil compaction and density tests – determination of field density and field moisture content of a soil using a nuclear surface moisture – density gauge – direct transmission mode*
AS1289 5.1.1	means the Australian Stanard AS1289 5.1.1 *Soil compaction and density tests – determination of the dry density/moisture content relation of a soil using standard compactive effort*
Category / categories	Categories of prescribed premises as set out in Schedule 1 of the EP Regulations.
Decision Report	refers to this document.
Delegated Officer	An officer delegated under section 20 of the EP Act.
Department	The department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation As of 1 July 2017, the Department of Environment Regulation (DER), the Office of the Environmental Protection Authority (OEPA) and the Department of Water (DoW) amalgamated to form the Department of Water and Environmental Regulation (DWER). DWER was established under section 35 of the *Public Sector Management Act 1994* and is responsible for the administration of the *Environmental Protection Act 1986* along with other legislation.
Emission	has the same meaning given to that term under the EP Act.
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
Existing Licence	The Licence issued under Part V, Division 3 of the EP Act and in force prior to the commencement of, and during this Review
GRI-GCL3	means the document titled *GRI-GCL3 Standard Specification for Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (CGLs)* published by the Geosynthetic Institute, USA

Term	Definition
GRI-GM13	means the document titled *GRI-GM13 Standard Specification for Test methods, Test Properties, and Testing Frequency for High Density Ployethylene (HDPE) Smooth and Textured Geomembranes* published by the Geosynthetic Institute, USA
GRI-GT12(a)	means the document titled *GRI-GT12(a) Standard Specification for Test methods and Properties for Nonwoven Geotextiles Used as Protection (for Cushioning) Materials* published by the Geosynthetic Institute, USA
Licence Holder	Shire of Augusta Margaret River
EP Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	has the same meaning given to that term under the EP Act.
Prescribed premises	This has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Revised Licence	the amended Licence issued under Part V, Division 3 of the EP Act following the finalisation of this Review.
Risk Event	As described in *Guidance Statement: Risk Assessment*
RL	Reduced Level which is the height above the point adopted as the site datum for the purpose of establishing survey levels.

2. Purpose and scope of assessment

An application for a licence amendment (Application) was received from the Shire of Augusta Margaret River (the Licence Holder) for the construction and operation of an additional landfill cell and leachate pond (including the associated clearing of native vegetation), and the removal of the existing leachate pond at the Davis Road Putrescible Landfill (the Premises) which currently operates under Licence L6989/1997/13.

This Decision Report presents an assessment of potential environmental and public health risks from emissions and discharges from the proposed works and operation of the new infrastructure. The closure of Cells 1 and 2 is not within the scope of this assessment.

The Application includes a proposal to replace the old landfill sump on the southern side of the landfill that collects leachate from the unlined landfill cells with a new concrete lined sump. DWER considers this work to be maintenance of existing leachate collection infrastructure and is not within the scope of this assessment.

As a result of this assessment, a Licence Amendment has been granted in the form of a Revised Licence.

3. Application details

On 26 September 2018 the Shire of Augusta Margaret River (the Licence Holder) submitted an amendment application (the Application) to the Department of Water and Environmental Regulation (DWER) for the amendment of Existing Licence L6989/1997/13 for the Davis Road Putrescible Landfill (the Premises).

The Delegated Officer determined that additional information was required to validate the Application. A request to provide further information was sent to the Applicant on 19 November 2018. On 24 January 2019 the Applicant provided the requested information.

Following the validation of the Application, an external review of the landfill stability and design basis within the Application was initiated by DWER. Further information was requested from the Licence Holder on 10 April 2019 to enable the review. On 17 April 2019 and 29 April 2019 the Applicant provided the requested information.

Based on the recommendations from the external review of the landfill stability and design basis, the Delegated Officer determined that additional information was required. A request to provide further information was sent to the Applicant on 23 May 2019. On 15 July 2019 the Applicant provided the requested information.

The documents and information submitted during the assessment process is listed in Appendix 2.

4. Overview of premises

4.1 Classification of Premises

The Prescribed Premises activity and capacity, as approved in the Existing Licence, is listed in Table 2.

Table 2: Classification of premises and assessed design capacity

Category	Description	Assessed production or design capacity or throughput
Category 64	Class II putrescible landfill site: premises on which waste (as determined by reference to the waste type set out in the document entitled "Landfill Waste Classification and Waste Definitions 1996" published by the Chief Executive Officer, as amended from time to time) is accepted for burial	20,000 tonnes per annual period

4.2 Licence and amendment history

Table 3 provides the amendment history for L6989/1997/13 and history of works approvals for the Premises for the previous five year period.

Table 3: Licence amendments

Instrument	Issued	Nature and extent of works approval, licence or amendment
W5544/2013/1	27/11/2014	Works Approval for the construction of an additional landfill cell.
	08/03/2017	Licence Holder initiated Works Approval amendment for a change to the approved liner for the new landfill cell Stage 2 construction.
L6989/1997/13	21/01/2016	Licence Holder initiated amendment to update map of active landfill area (to allow landfilling in the new cell being constructed under W5544 following completion) and operational areas.
	01/04/2016	Licence Holder initiated amendment. Clean fill removed from waste acceptance, waste processing and waste volumes monitoring conditions in the Licence. Requirement to cover green waste and inert waste was removed.
	23/10/2019	Licence Holder initiated amendment for construction of additional landfill cell (Cell 3) and new leachate pond (to replace existing leachate ponds).

4.3 Description of proposed amendment

The Application is for the following activities on the Premises:

- Clearing of 1.64 hectares of native vegetation;
- Construction of a new leachate pond (storage capacity of 23,165 KL);
- Operation of the new leachate pond including transfer of leachate from the existing leachate ponds to the new leachate pond via temporary pipeline and pump;
- Removal of existing leachate ponds (the existing pond is currently located where the new landfill cell is proposed to be located);
- Construction of a new landfill cell - Cell 3 (landfill airspace of 170,000 m^3); and
- Operation of landfill Cell 3 and leachate transfer pipeline to the new leachate pond.

The Licence Holder has submitted this Application because the existing landfill cells at the Premises (Cell 1 and Cell 2) are nearly filled to capacity. The Licence Holder has not requested any change to the approved premises production/design capacity on the Existing

Licence. The filling of Cell 3 is estimated to take approximately four years.

The assessment of the proposed clearing (Clearing Permit Decision Report) is provided within Attachment 1 to this Decision Report.

The infrastructure and equipment relevant to the Application are outlined in Table 4 and the site layout are shown in Figure 1.

The existing groundwater monitoring bores within the Premises are shown in Figure 2.

Table 4: Infrastructure and equipment

Ref	Infrastructure or Equipment	Site Layout Plan reference (Figure 1)
1	Cell 3 with liner and leachate collection system - refer to Section 4.3.1 for further details	Proposed Cell 3
2	Leachate transfer pipe - above ground HDPE pipeline for the pumping of leachate from the leachate sumps in Cell 1, Cell 2 and Cell 3 and the replacement sump servicing the old landfill to the new leachate pond.	N/A
3	Leachate pond – refer to Section 4.3.2 for further details	Proposed Leachate Pond

Figure 1: Site Layout Plan including proposed Cell 3 and new leachate pond (excerpt from the Application)

Figure 2: Location of existing groundwater monitoring bores on the Premises (excerpt from the Application)

4.3.1 Cell 3 construction and operation

The additional landfill cell proposed to be constructed (Cell 3) will include a liner system and leachate collection infrastructure. Landfill gas venting infrastructure will be installed during closure of the cell.

The proposed cell can accommodate 170,000 m^3 of airspace and is expected to take four years to fill at the current rate of landfilling at the Premises.

Landfill cell design

The proposed landfill cell design parameters are as follows:

- Maximum recorded groundwater levels will be at least two (2) metres below the base of the leachate sump within the cell;
- Internal and external batter slope gradient of 1V:3H;
- Perimeter bund five (5) metres wide; and
- External waste slope of 1V:5H and maximum landfill height of RL 89m AHD.

The proposed Cell 3 liner and leachate collection system components are described in Table 5.

Table 5: Cell 3 liner and leachate collection system components

Component	Description
Compacted subgrade	To be formed by cut and fill of the cell footprint to achieve a minimum 3% fall towards the drainage lines and minimum 1% fall towards the leachate sump. The fall directions are shown in Figure 2 in Schedule 2 of the Revised Licence. Compacted, shaped and proof rolled subgrade. Moisture content on placement to be between 3% dry and 2% wet of optimum moisture content (using standard compaction) (test method AS1289 5.4.1). Minimum standard compaction during placement of 95% (test methods AS1289 5.8.1 and AS1289 5.1.1).
Geosynthetic Clay Liner (GCL)	Hydraulic conductivity of less than $1x10^{-9}$ m/s. Base and side liner detail shown in Figure 3 in Schedule 2 of the Revised Licence. Liner will be tied into existing Cell 2 liner by overlapping the liners by 1.5m in a roof tile alignment. Detail of tie in to existing Cell 2 GCL liner shown in Figure 3 in Schedule 2 of the Revised Licence. Details of GCL material properties, storage, handling and installation requirements are provided in the Construction Specification document provided within the Application.

Cushion Geotextile	Details of cushion geotextile material properties, storage, handling and installation requirements are provided in the Construction Specification document provided within the Application.
Drainage aggregate	300mm aggregate drainage layer placed over the leachate collection pipework to act as a drainage medium, as shown in Figure 3 of Schedule 2 of the Revised Licence.
Leachate collection pipework	Positioning, perforations and pipe connection detail of leachate collection pipework shown in Figure 2 of Schedule 2 of the Revised Licence.
Leachate sump	Double lined GCL on base and sides of sump. Concrete slab positioned above the double GCL layer. Leachate sump design detail shown in Figure 4 of Schedule 2 of the Revised Licence.
Separation geotextile	Non-woven geotextile layer placed over the drainage aggregate and kept in place with sandbags prior to landfilling.
Anchor trench to secure GCL liner	Fill material to be compacted following backfilling of anchor trench. Moisture content of backfill material on placement to be between 3% dry and 2% wet of optimum moisture content (using standard compaction) (test method AS1289 5.4.1). Minimum standard compaction during placement of 95% (test methods AS1289 5.8.1 and AS1289 5.1.1). Anchor trench detail shown in Figure 3 of Schedule 2 of the Revised Licence.

A Construction Quality Assurance (CQA) Plan was provided within the Application. The purpose of the CQA Plan in relation to Cell 3 construction was to detail the testing methods and frequencies and quality assurance procedures to construct the landfill lining system. The CQA Plan includes the following components:

- Overview of the cell design;
- Overview of the construction process including delegation of responsibilities;
- Construction drawings references;
- Hold points – conditions/stages which trigger site inspections and/or document review before progression to the next stage of construction; and

- Quality assurance parameters and performance indicators for the following design components:
    - subgrade preparation;
    - geosynthetic clay liner (GCL);
    - cushion geotextile;
    - leachate collection system;
    - separation geotextile; and
    - water management.

Once the superintendent is satisfied that the liner system for Cell 3 has been constructed appropriately, a CQA Validation Report will be prepared to verify that the works have been undertaken in accordance with the Revised Licence, CQA Plan and project documents.

Landfill stability

A summary of the landfill stability assessment provided within the Application is included within Appendix 3.

Landfill capping and closure

The capping and rehabilitation of Cell 3 is proposed to be undertaken following completion of landfilling within the cell. The design of the capping is intended to reduce rainfall infiltration into the waste body of the cell to ensure that the volume of water passing through the capping into the waste body is less than the rate of leachate generation and recovery from the cell.

The capping will be installed at a gradient of no greater than 1V:5H. Rehabilitation with suitable vegetation is also intended to provide the cap with some protection against erosion.

The proposed design of the Cell 3 cap is shown in Figure 3 below.

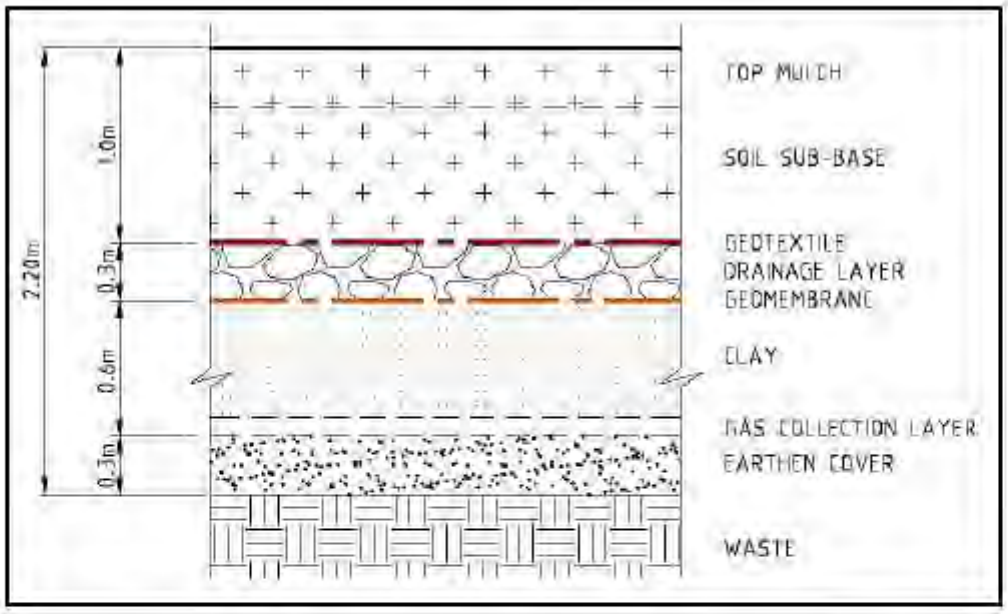


Figure 3: Cell 3 landfill cap design

Due to the relatively small volume of waste being landfilled within Cell 3, the Application states that Cell 3 is expected to produce approximately 23m^3 per hour of landfill gas, which is an insufficient quantity for capture and flaring. Landfill gas generated within Cell 3 after closure is therefore proposed to be managed by passive venting through vents that will be installed in the landfill capping. The vents are proposed to be installed in a grid layout with a spacing of 60m between each vent. Post-closure monitoring of landfill gas in various locations around the

landfill cell is proposed.

DWER notes that further consideration will be given to the proposed cap design and gas management when a Landfill Closure Plan is provided to the Department prior to the closure of Cell 3.

4.3.2 New leachate pond construction and operation

A new leachate pond is proposed to replace the three existing leachate ponds within the Premises, as these ponds are situated where landfill Cell 3 is proposed to be located.

The new leachate pond will receive leachate from all of the leachate sumps within the Premises, as listed below:

- Sump within the unlined landfill area of the Premises (proposed to be replaced)
- Cell 1
- Cell 2 (currently an active cell)
- Cell 3

Leachate pond design

The proposed leachate pond design parameters are as follows:

- Depth of 4.5 m (4 m operating depth and 0.5 m freeboard);
- Storage capacity of 23,165 KL (not including the freeboard volume of 4,193KL);
- Maximum recorded groundwater levels will be at least two (2) metres below the base level of the pond;
- Internal batter slope gradient of 1V:2H and external batter slope gradient of 1V:3H;
- Perimeter bund three (3) metres wide; and
- High density polyethylene (HDPE) liner installed on the floor and internal batters.

The proposed leachate pond components and liner design are described in Table 6.

Table 6: Leachate pond components

Component	Description
Compacted subgrade	To be formed by cut and fill of the pond footprint to achieve a grade of 1% to the south east. Compacted, shaped and proof rolled subgrade. Moisture content on placement to be between 3% dry and 2% wet of optimum moisture content (using standard compaction). Minimum standard compaction during placement of 95%.
HDPE liner	Single sheet of 2mm in thickness. Hydraulic conductivity of less than $1x10^{-9}$ m/s. Liner will be secured with an anchor trench

Component	Description
	around the leachate pond. Details of HDPE liner properties and installation requirements are provided in the Construction Specification document provided within the Application.
Anchor trench	Fill material to be compacted following backfilling of anchor trench. Moisture content of backfill material on placement to be between 3% dry and 2% wet of optimum moisture content (using standard compaction). Minimum standard compaction during placement of 95%. Anchor trench detail shown in Figure 3 in Schedule 2 of the Revised Licence.

A CQA Plan was provided within the Application. The purpose of the CQA Plan in relation to the leachate pond construction was to detail the testing methods and frequencies and quality assurance procedures to construct the pond lining system. The CQA Plan includes the following components:

- Overview of the pond design;
- Overview of the construction process including delegation of responsibilities;
- Construction drawings references;
- Hold points – conditions/stages which trigger site inspections and/or document review before progression to the next stage of construction; and
- Quality assurance parameters and performance indicators for the following design components:
    - subgrade preparation;
    - high density polyethylene (HDPE) geomembrane liner; and
    - water management.

Once the superintendent is satisfied that the liner system for the leachate pond has been constructed appropriately, a CQA Validation Report will be prepared to verify that the works have been undertaken in accordance with the Revised Licence, CQA Plan and project documents.

Water balance assessment

The Application includes a summary of water balance calculations undertaken to estimate the volume of leachate required to be stored over a three (3) year period.

The calculated inputs include rainfall directly into the pond and leachate from landfill cells, however only leachate from Cell 2 and Cell 3 is included in the calculations on the basis that the unlined landfill area and Cell 1 will both have intermediate cover applied when the operation of the new leachate pond commences.

Leachate inputs from the landfill cells have been calculated as 80% of the rainfall which falls within the catchment area of a landfill cell. The mean daily rainfall volumes have been used based on rainfall records from 1999 to 2018 for a weather station located in Witchcliffe.

DWER notes that the calculations assume that there is no leachate in the new pond immediately following construction, however in practice some leachate stored within the existing leachate ponds may need to be transferred to the new leachate pond once constructed. The Licence Holder has advised that only a small volume of leachate is expected to be transferred into the new leachate pond from the existing leachate ponds because the completion of the new leachate pond is expected to occur at the end of summer when the volume of leachate in the existing ponds is low.

The calculations include the below leachate reduction measures to manage the volume of leachate stored in the pond:

- Spray aeration/evaporation system within the pond;
- Trickling of leachate over the HDPE lined internal sides of the pond during summer;
- Returning leachate to the active areas of the landfill in summer; and
- Returning leachate to the active tipping face (10kL per day on average).

The graphs provided show the volume of leachate requiring storage within the pond over a three year period under the following two scenarios:

- Scenario 1: Leachate catchment from Cell 2 and Cell 3 during the entire three (3) year period.
- Scenario 2: Leachate catchment from Cell 2 until closure, and leachate catchment from Cell 3 during the entire three (3) year period.

The Scenario 1 calculations indicate that the volume of leachate requiring storage will reach the pond storage capacity in approximately two and a half (2.5) years after the operation of the new leachate pond commences.

The Scenario 2 calculations indicate that the volume of leachate requiring storage will reach the pond storage capacity in closer to four (4) years after the operation of the new leachate pond commences. DWER notes that the calculations provided for Scenario 2 do not clearly indicate when inputs from Cell 2 cease due to the closure of the cell. There is therefore some uncertainty regarding the Scenario 2 calculations.

Both scenarios presented in the Application indicate that additional storage capacity may be required within a period of a few years, depending on the volume of rainfall received during those years. The capping of Cell 2 as soon as possible will assist in reducing the volume of leachate requiring storage. It is also noted that the filling of Cell 3 is expected to take approximately 4 years after which point Cell 3 will also be capped.

The Application also includes calculations of the storage volume required for a 72 hour storm event and a range of Annual Exceedance Probabilities (AEP) for Scenario 2. The calculated storage requirement ranges from 1,603 KL (63% AEP) to 3,487 KL (1% AEP).

DWER notes that there are some uncertainties regarding the water balance calculations provided within the Application in regard to the volume of leachate generated from the Cells, the timing of capping of existing cells and the volume of leachate reduction that can be achieved, however it appears that the proposed pond design will provide sufficient storage capacity for at least a two year period.

4.4 2019 Compliance inspection

On 13 March 2019, DWER received a complaint from a neighbour of the Premises regarding odour, dust and conditions in the Existing Licence. The content of the complaint is summarised as follows:

- Constant terrible odour and waves of dust blowing over from the Premises;

- Odour and dust problems had occurred for approximately six to seven weeks, with the worst conditions observed during afternoons; and
- The complainant was offered the opportunity to inspect the Premises with a Shire employee. Their complaint included an expression of concern at site conditions which they believed to be in breach of the licence. This included the following items:
    - Drainage was not present between the active tipping face and contaminant ponds. A drainage channel which was present showed evidence of having had a lot of water in it but was not connected to the contaminant ponds.
    - P1 bore could not be located.
    - A portion of the eastern boundary was not fenced.
    - An evaporation dam was present on top of the south-eastern portion of a completed cell. The complainant was concerned that if this pond leaked it may cause a flushing of contaminants into the cell and underlying groundwater. No evidence of a sump or drainage from this completed cell to the contaminant dam was observed.
    - The Premises operations were within 150 m of the complainant's residence which breached the buffer distance required in a previous version of the licence.
    - Shire personnel informed the complainant that there was no maximum height specified for the landfilling activities.
    - Windblown waste was observed in the north-eastern area.

In response to this complaint, DWER conducted a targeted compliance inspection at the Premises on 19 and 20 March 2019. The inspection identified that the Licence Holder had not complied with the following conditions:

- Condition 1.2.5(a) – The current tipping face was larger than 2 m in vertical height. The Compliance Officer observed that the active landfill cell was approximately 8-11 m above ground level with the tipping face located off the top of the cell.
- Condition 1.2.5(c) – Putrescible waste (non-green waste) was not being covered by the end of the working day.
- Condition 1.2.6 – 150 mm of cover was not applied to putrescible waste (non-green waste) by the end of the working day in which it was deposited.
- Condition 1.2.7 - A section of the security fencing north of the landfill cell was missing and a small section of security fencing adjacent to the entry booth that had been cut (to force illegal entry), had not been repaired.

These findings are generally consistent with the results of previous compliance inspections conducted in 2010 and 2013 which observed that the Shire was not compliant with cover requirements and/or maximum landfilling heights.

Following the inspection, the Shire provided written and photographic evidence to DWER to confirm that the requirements of the conditions above were being met.

The inspection also identified that the permeability of the leachate evaporations ponds and storage sump were not less than $1x10^{-9}$ m/s as required by Condition 1.2.4. This includes the leachate evaporation ponds proposed to be removed as part of this licence amendment.

4.5 Groundwater

The most recent groundwater data submitted to DWER for the Premises is from 2017 and was reported in the 2017 Annual Licensing Report (Emerge, 2018). The findings of this report are

summarised in the sections below.

4.5.1 Groundwater levels and flow direction

The depth to groundwater at the Premises is strongly influenced by seasonal trends due to the reliance of the local groundwater system on rainfall recharge (DOW, 2009). Based on 2017 monitoring data, Emerge interpreted groundwater to have an overall south-easterly flow direction. However, based on the topography and surface water features in the vicinity of the Premises, DWER has determined that groundwater flow is likely to be more complex. Further discussion is provided in Section 6.3.

4.5.2 Groundwater quality

During 2017, groundwater at the Premises was generally acidic to slightly acidic (3.57 to 6.38), fresh to brackish (120 to 1,560 mg/L) and mostly recorded oxidising conditions, with the exception of P1 which recorded reducing conditions.

Emerge conducted a screening assessment against screening criteria from the DWER guideline *Assessment and management of contaminated sites* (DER, 2014). A summary of this assessment is provided below.

Ecological screening

The ecological screening was conducted against the fresh water assessment criteria (DER, 2014). Analytes which exceeded the fresh water guideline in one or more monitoring bores during at least one monitoring event include pH, metals (aluminium, copper, iron, selenium and zinc), total nitrogen, ammonia and total phosphorus.

DWER also identified that some concentrations of aluminium and selenium detected in groundwater exceeded the low risk trigger values for livestock drinking water (ANZECC and ARMCANZ, 2000).

Human health screening

The human health screening was conducted against the non-potable groundwater use guidelines, long term irrigation water guidelines and Australian Drinking Water Guidelines (DER, 2014). Analytes which recorded exceedances of the non-potable groundwater use criteria include aluminium, iron and chloride. Analytes which recorded exceedances of the long term irrigation water criteria include pH, metals (aluminium, iron, manganese and selenium), total nitrogen and total phosphorus. Analytes which recorded exceedances of the Australian Drinking Water Guidelines include manganese and selenium.

Organic compounds

Total recoverable hydrocarbons (TRH) (>C_{16}-C_{34} F3 fraction) were detected at MW2 (0.12 mg/L) and MW3 (0.13 mg/L) during 2017. Detected TRH concentrations were not screened against assessment criteria.

Benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH), phenols, organochlorine pesticides and polychlorinated biphenyls (PCB) were not detected in groundwater during 2017.

4.5.3 Historical groundwater trends

Emerge (2018) reviewed groundwater data from 2004 to 2017 to identify potential trends in contaminant concentrations. Emerge did not conduct a thorough trend analysis and generally limited their discussion of trends to contaminants which recorded a maximum historical concentration during 2017. Long term trends at the Premises are generally overprinted by seasonal concentration fluctuations in groundwater.

Increasing trends which were identified in groundwater data are summarised as follows:

- Ammonia and total nitrogen concentrations showed an increasing trend in M1 and P1.
- Total phosphorus concentrations showed an increasing trend in M1, P1, P2, MW1, MW2, MW3, MW4 and MW5.
- Aluminium concentrations showed an increasing trend at M1, MW4 and MW5.
- Copper concentrations showed an increasing trend at MW4.
- Manganese concentrations showed an increasing trend at P1.
- DWER also identified increasing trends in other potential indicators of landfill leachate including total dissolved solids (TDS) and the potassium:chloride ratio in some monitoring bores.

4.6 Surface water

The most recent surface water data submitted to DWER for the Premises is from 2017 and was reported in the 2017 Annual Licensing Report (Emerge, 2018).

Emerge (2018) reported on monitoring of two surface water monitoring locations during 2017. Both locations are located in the tributary of the Chapman Brook to the south-east (SW1) and west (SW2) of the landfill area respectively. SW2 is located where the tributary enters the Premises and SW1 is located further downstream. The stream appears to only flow at SW1 following larger rainfall events during the winter months which has limited the sampling opportunities at this location.

4.6.1 Surface water quality

Surface water was acidic to neutral (4.90 to 6.96) and fresh (178 to 276 mg/L).

Emerge conducted a screening assessment against screening criteria from the DWER guideline *Assessment and management of contaminated sites* (DER, 2014). A summary of this assessment is provided below.

Ecological screening

The ecological screening was conducted against the fresh water assessment criteria (DER, 2014). Analytes which exceeded the fresh water guideline in one or more monitoring locations during at least one monitoring event include pH and iron.

Human health screening

The human health screening was conducted against the non-potable groundwater use guidelines, long term irrigation water guidelines and Australian Drinking Water Guidelines (DER, 2014). The only analyte which recorded exceedances of the non-potable groundwater use criteria was iron. Analytes which recorded exceedances of the long term irrigation water criteria include pH, metals (iron and manganese) and total phosphorus. No exceedances of the Australian Drinking Water Guidelines were reported.

Organic compounds

TRH, BTEX, PAH, phenols, organochlorine pesticides and PCB were not detected in surface water during 2017.

4.6.2 Historical surface water trends

No significant increasing trends in contaminant concentrations were observed in surface water data collected between 2014 and 2017. A possible recent increasing trend in total phosphorus concentrations was observed at SW2, however further monitoring data would be required to verify this trend.

5. Legislative context and other approvals

Approvals relevant to the premises are outlined in Table 7 below.

Table 7: Tenure access for Shire

Legislation	Number	Approval
Shire of Augusta Margaret River Local Planning Scheme 1	N/A	The Premises is zoned as 'Public Purposes' and is vested in the interest of the Shire of Augusta Margaret River under the Certificate of Title.

5.1 *Contaminated Sites Act 2003*

The Premises was classified as 'Possibly contaminated – investigation required' under the *Contaminated Sites Act 2003* on 18 April 2011. This classification was based on the site's land use as a landfill. At the time of the classification in 2011, no contamination assessment had been carried out to determine the quality of soil and groundwater beneath the site and no risk assessment had been carried out to determine the potential risk to human health, the environment or any environmental value.

6. Emission sources, receptors and pathways

6.1 Emissions

The potential for emissions to impact on sensitive receptors has been assessed in accordance with the Department's Risk Framework. The key emissions during premises construction which have been considered in this report are dust, noise and leachate/contaminated stormwater from the earthworks, vehicle movements and relocation of waste.

The key emissions during operation of the constructed infrastructure which have been considered in this report are dust, leachate/contaminated stormwater, odour and windblown waste from vehicle movements, movement of cover material, landfilling wastes, exposure of previously landfilled wastes and leachate storage.

The Applicant has proposed measures to assist in controlling these emissions, where necessary. The control measures are outlined in Section 6.4 below and have been considered when undertaking the risk assessment detailed in Section 7.

6.2 Receptors

Risk is assessed as a combination of emission sources, the proximity and sensitivity of receptors to those emission sources and any pathways that can allow the emission to reach and potentially harm the receptor. Table 8 and Figure 4 provide a summary of human and environmental receptors in proximity to the premises which have a potential to be impacted from site activities, and the risk assessment in Section 7 considers these receptors in the context of emissions and potential pathways.

Table 8: Distance to receptors

Human receptors	Distance from activity or prescribed premises
Residence (R1 in Figure 4)	Approximately 300 m north of the Cell 3 area Approximately 40 m north of the Premises boundary
Residence (R2 in Figure 4)	Approximately 580 m west north-west of the Cell 3 area

	Approximately 100 m west of the Premises boundary
Residence (R3 in Figure 4)	Approximately 630 m north east of the new leachate pond area Approximately 510 m east of the Premises boundary
Residence (R4 in Figure 4)	Approximately 800 m east of the new leachate pond area Approximately 750 m east of the Premises boundary
Potential downgradient groundwater users	The Premises is located within the Cape to Cape South subarea of the Blackwood Groundwater Area (DOW, 2009). The main aquifer present in the vicinity of the Premises is the fractured rock aquifer comprising the granitic basement rocks of the Leeuwin Complex and its overlying weathered profile (DOW, 2009; DOW, 2015). Due to the limited extent and connectivity of fractures in the aquifer and irregular nature of rainfall recharge, there is considerable variability in the suitability of this aquifer as a sustainable resource (DOW, 2009). Groundwater yields are generally very low and conditions highly variable. The salinity may be as high as 4000 mg/L (DOW, 2009). A surficial aquifer comprising alluvial and colluvial deposits may overly the fractured rock aquifer in some areas, such as river valleys, dunes and swales. Groundwater in the surficial aquifer is generally fresh but has a thin saturated thickness. It is not known if domestic or stock groundwater bores are in place in the fractured rock or surficial aquifers downgradient of the Premises. There is the potential that groundwater may be used where local conditions are favourable.
Domestic dams (D1, D2 and D3 in Figure 4)	Approximately 300 m north of the new leachate pond area
Environmental receptors	**Distance from activity / prescribed premises**
Domestic dams (D1, D2 and D3 in Figure 4)	Approximately 300 m north of the new leachate pond area
Areas of grazing land and native vegetation	Immediately surrounding the Premises boundary in all directions
Minor watercourse (non-perennial)	Within the Premises boundary, flowing across the Premises from the north-west to the south east. Located approximately 80 m south (downgradient) of the Cell 3 area. The watercourse is a tributary of the Chapman Brook (approximately 1.4 km downstream of the Cell 3 area)
Minor watercourse/seasonally inundated slope	Approximately 130 m north (downgradient) of the new leachate pond area Approximately 350 m north-east (potentially downgradient) of the Cell 3 area
Floodplain (seasonally inundated flat)	Approximately 500 m south-east of the Cell 3 area

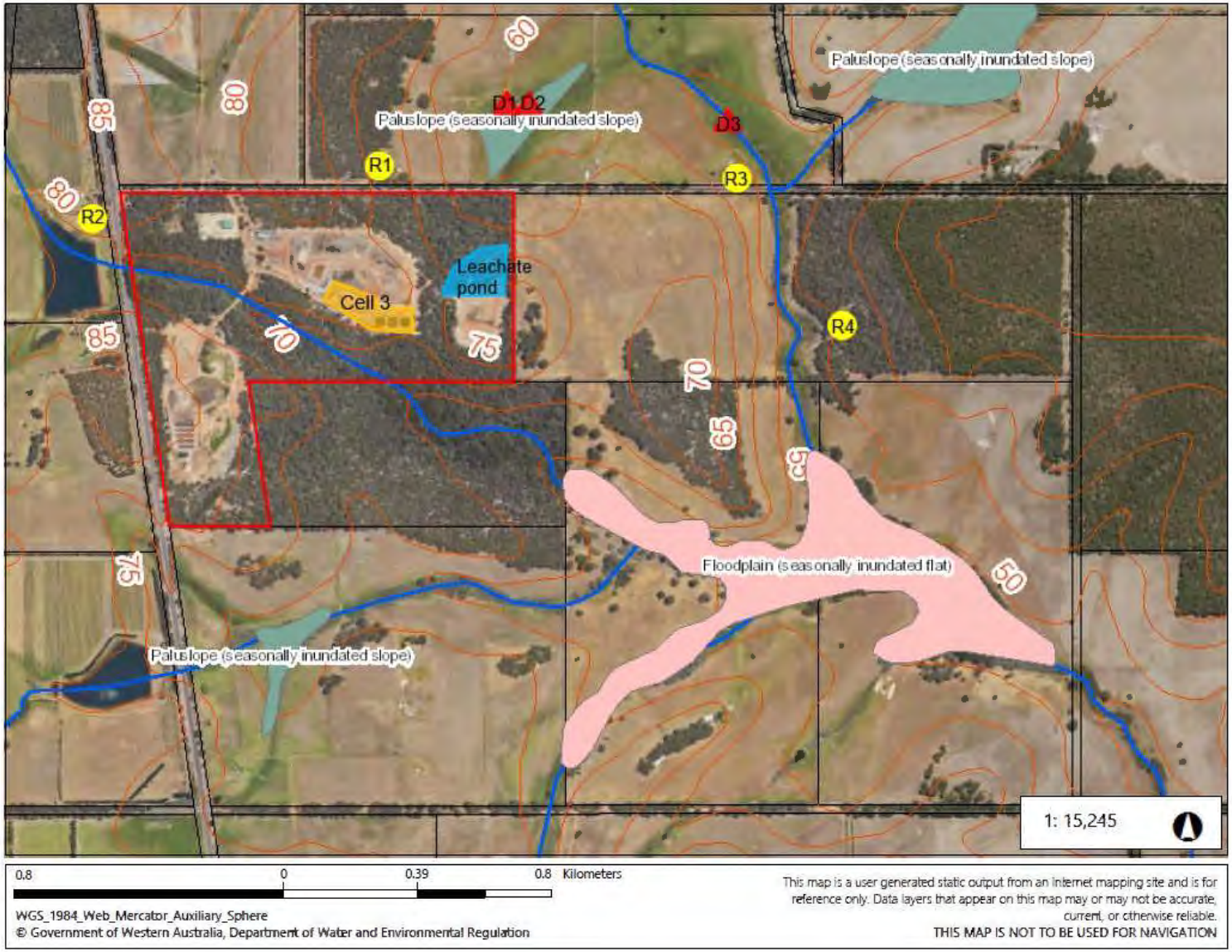


Figure 4: Map of nearby receptors (indicating approximate location of Cell 3 and new leachate pond)

6.3 Pathways

The below pathways have been considered in the risk assessment table in Section 7.

Geology

The geology of the Premises may provide a pathway for the movement of leachate or contaminated stormwater through the soil profile.

The Applicant has advised that WSP consultancy undertook an environmental assessment of the Premises in 2013, which found that the geology of the Premises was lateritic, fine grained sand overlying low plasticity, dense, tightly packed, moderately cemented clays with some thin sandy gravelly lateritic layers. These clays were found to overlie weathered granite (fine grained sandy clay), and granite bedrock which was encountered at approximately 6 to 8 m below ground level. The bore logs for MW1, MW2 and MW3 were recorded at the time and were provided within the Application.

The geological profile described above is consistent with the regional geology which comprises granitic gneiss basement rocks of the Leeuwin Complex and the overlying weathered profile.

Sampling of fill material sourced from on-site excavations was undertaken at the Premises in April 2015 by Civitest Australia Pty Ltd. One sample was taken from an unconditioned stockpile of excavated fill material, and one sample was taken from a conditioned stockpile of excavated fill material. Both samples were analysed for soil permeability in accordance with AS1289.6.7.2 *Determination of the Permeability of a Soil – Falling Head Method for a Remoulded Specimen*. The results for the coefficient of permeability were 3.5 $x10^{-9}$ m/s and 4.9$x10^{-9}$ m/s respectively.

Hydrogeology

The hydrogeology of the Premises may provide a pathway for the movement of leachate or contaminated stormwater through the soil profile and within groundwater.

The main aquifer present in the vicinity of the Premises is the fractured rock aquifer comprising the granitic gneiss basement rocks of the Leeuwin Complex and its overlying weathered profile (DOW, 2009; DOW, 2015). Groundwater flow in the weathered portion of the aquifer is expected to follow the local groundwater gradient. Based on the bore logs for MW1, MW2 and MW3, the weathered portion of the aquifer extends to approximately 6 to 8 m below ground level. In the deeper portion of the aquifer which comprises fractured basement rock, groundwater flow will be strongly influenced by the orientation and connectivity of fractures within the rock mass.

Based on the geological setting of the Premises, DWER has identified that there is the potential for a perched aquifer to form within the laterite and lateritic gravelly sand in the upper portion of the profile. Based on the bore logs of MW1, MW2 and MW3, this layer is present from the ground surface to approximately 0.8 to 1.8m below ground level and is underlain by a clay layer. The perched aquifer is expected to be a seasonal feature which occurs following rain during winter and early spring. Discharge of the perched aquifer to the ground surface in the form of seeps or springs is a potential pathway for contaminants from the Premises.

Groundwater has previously been interpreted to flow in a south-easterly direction within the Premises. However, based on the topography and surface water features in the vicinity of the Premises, DWER has determined that groundwater flow is likely to be more complex. The topography of the Premises indicates that a groundwater divide may be present through the central part of the landfill area. Groundwater flow in the north-east of the landfill area is likely to comprise a significant north-easterly component towards the seasonally inundated slope (Figure 4). Groundwater flow in the south-west of the landfill area, including Cell 3, is likely to

comprise a significant south-westerly component towards the tributary of the Chapman Brook (Figure 4). Based on the location of the proposed leachate pond near a topographic mound, groundwater flow may be in any direction in this area.

Groundwater at the Premises is expected to discharge to surface water features including the tributary of the Chapman Brook to the south of the landfill area and the seasonally inundated slope to the north-east of the Premises. These surface water features are part of the lower Blackwood River catchment (DOW, 2015).

Based on the previous groundwater monitoring undertaken at the Premises, depth to groundwater measurements were provided in the Application and are shown in Figure 5. The depth to groundwater measurements are provided as metres below top of casing rather than metres below ground level. The depth measurements indicate that groundwater may be very shallow in some parts of the Premises during winter and early spring. Groundwater levels within 1 m of the top of casing have been recorded at P1, MW2 and MW3 during September monitoring events (Emerge, 2018). The shallow nature of groundwater at the Premises increases its susceptibility to contamination from landfilling and leachate management activities.

Bore	Easting	Northing	Depth to Water (mBTOC)	Date of Observation
M1	325260	6232043	2.34	5.6.17
MW1	325115	6232143	3.40	6.9.17
MW2	325345	6232009	0.52	5.9.18
MW3	325463	6231974	0.90	5.9.18
MW4	324918	6231970	7.90	5.9.18
MW5	325782	6231856	5.94	5.9.18
P1	325462	6232195	2.71	5.9.17
P2	325170	6232229	3.94	4.12.12

Figure 5: Depth to groundwater measurements for groundwater monitoring bores (excerpt from the Application)

6.4 Applicant controls

The Applicant has proposed the following controls as part of the application:

Table 9: Applicant control measures

Source	Emission (as identified above)	Proposed controls
Construction		
Excavation and movement of soils Vehicle/machinery movements	Dust	Unsealed roads, exposed areas and earthworks to be watered down regularly/as needed. Vehicle speed limit of 40 km/hr. Additional measures for dust suppression (mulching, hydro seeding, chemical crusting agents or additional

		use of water trackers/sprays) may be adopted if on site observations and complaints indicate dust emissions are occurring.
Vehicle/machinery movements	Noise	Construction work undertaken between 7am to 5pm Monday to Saturday. Generally, only one earth moving vehicle will be operated at a single point in time, due to the compact nature of the Cell 3 area. Vehicle speed limit of 40 km/hr. Machinery is regularly maintained including exhaust mufflers.
Excavation and movement of soils	Sediment laden stormwater	Stormwater channels constructed and existing channels utilised to direct stormwater runoff to infiltration drains (unspecified location).
Movement of approximately 50m^3 of waste at western boundary of proposed Cell 3 (as depicted in drawing C3-005 provided within the Application)	Leachate and contaminated stormwater	Any leachate encountered within the works area will firstly be confirmed as leachate by the Superintendent. Leachate shall be transported to the leachate ponds onsite or otherwise as advised by the Licence Holder.
Operation		
Movement of cover material Vehicle/machinery movements	Dust	Unsealed roads, exposed areas and earthworks to be watered down regularly/as needed. Vehicle speed limit of 40 km/hr. Additional measures for dust suppression (mulching, hydro seeding, chemical crusting agents or additional use of water trackers/sprays) may be adopted if on site observations and complaints indicate dust emissions are occurring. Cell capping and closure as soon as possible.
Vehicle/machinery movements and use of compactor on tipped waste	Noise	The use of large earthmoving equipment will only occur between 7am to 5pm Monday to Saturday. Vehicle speed limit of 40 km/hr. Machinery is regularly maintained including exhaust mufflers.
Relocation of any leachate from the existing leachate ponds to the new leachate pond to allow excavation of Cell 3	Leachate and contaminated stormwater	None proposed
Landfilling of waste Progressive exposure of previously landfilled	Odour	Waste received at the Premises and transported to the tipping area in covered vehicles. Tipping area restricted to a maximum linear length of

waste due to removing temporary cover and cutting benches into existing waste body for placement of new waste		30 m and 2 m in height. Waste in the tipping area is covered daily with 150mm of soil. Putrescible waste covered as soon as practicable. An intermediate cap (thickened daily cover material) will be placed over waste that will be left for extended periods of time (e.g. in excess of 90 days), however this will be removed prior to placement of waste over these areas to prevent stratification within waste body.
	Dust	Waste received at the Premises and transported to the tipping area in covered vehicles. Active tipping area kept damp by watering during dry and windy conditions.
	Windblown waste	Tipping area restricted to a maximum linear length of 30m and 2m in height. Waste is compacted as soon as practicable following unloading at the tipping area. Waste in the tipping area is covered daily with 150mm of soil. A 2m high fence is installed around the active landfill area. Windblown waste is collected and returned to the tipping area on at least a monthly basis.
	Vermin and pathogens	Tipping area restricted to a maximum linear length of 30m and 2 m in height. Waste is compacted as soon as practicable following unloading at the tipping area. Waste in the tipping area is covered daily with 150mm of soil. An intermediate cap (thickened daily cover material) will be placed over waste that will be left for extended periods of time (e.g. in excess of 90 days), however this will be removed prior to placement of waste over these areas to prevent stratification within waste body.
	Leachate and contaminated stormwater	Fill material will be laid in the construction phase to achieve a separation distance of at least 2m between: 1. the base of the leachate sump within the landfill cell and the maximum groundwater level; and 2. the base of the leachate pond and the maximum groundwater level. <u>Stormwater management:</u> Stormwater channels and external batters constructed around the new landfill cell and existing channels utilised to direct uncontaminated stormwater runoff around the Cell perimeter to infiltration drains (unspecified location).

		Contaminated stormwater will be retained within the landfill cell. <u>Lining and leachate collection:</u> Landfill liner and leachate collection system proposed (refer to Section 4.3.1 for design and construction details). Leachate head within the leachate sump maintained below 1m. Note: A 1m leachate head within the sump is equivalent to approximately 300mm leachate head over the landfill base liner in the vicinity of the sump. <u>Stability:</u> Designed to meet recommended minimum factors or safety. Refer to Section 4.3.1 for design and construction details. Waste placed against the existing internal waste batters is stepped into the existing waste with benches cut into the existing waste.
	Landfill gas	Engineered landfill cell lining. Capping of landfill surface upon closure of the cell. Passive gas venting infrastructure to be installed at the landfill capping stage. Landfill gas monitoring following closure of the cell.
	Smoke (fire incident)	Waste in the tipping area is covered daily with 150mm of soil. An intermediate cap (thickened daily cover material) will be placed over waste that will be left for extended periods of time (e.g. in excess of 90 days), however this will be removed prior to placement of waste over these areas to prevent stratification within waste body. Cover material sufficient for two weeks of operations is always stockpiled on the Premises and can be used for fire suppression. Fencing and gates are maintained to prevent unauthorised access.
Returning leachate onto landfill tipping face to increase leachate evaporation during summer months	Odour	None proposed
Storage of leachate in leachate pond Spray evaporation system used in leachate pond to increase evaporation (specifications of	Odour	Spray in leachate pond to increase evaporation will achieve some aeration of the leachate. Spray would only be used on days with little or no wind.

system not provided)		
Storage of leachate in leachate pond	Leachate	HDPE liner for proposed leachate pond (refer to Section 4.3.2 for design and construction details). Several leachate reduction measures proposed to manage the leachate volume requiring storage. Maintenance of 500mm freeboard within the leachate pond. A small overflow pond currently exists and may be used for additional evaporation area or as additional storage in an emergency.
Progressive exposure of previously landfilled waste due to removing temporary cover and cutting benches into existing waste body for placement of new waste	Release of asbestos fibres	Landfilled asbestos is located within a designated asbestos disposal area which is not located within area of waste that will be disturbed.

7. Risk assessment

Risk ratings have been assessed for each key emission source and takes into account potential source-pathway-receptor linkages. The mitigation measures / controls proposed by the Applicant have been considered in determining the risk rating.

7.1 Risk assessment – construction

Table 10: Identification of emissions, pathway and receptors during construction

Risk Event				Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors, pathway and impact**	**Applicant controls**					
Excavation and movement of soils Vehicle/machinery movements	Dust	Air/windborne pathway causing impacts to health and amenity of closest human receptors (closest residence located 300m north of the Cell 3 area).	Refer to section 6.4	Minor	Possible	Medium	The extent of earthworks is significant considering the need to excavate and fill large areas. The nearby residents may experience amenity impacts during the construction period.	Condition 1.2.17 has been added to the Licence requiring that no visible dust emissions generated by the activities on the Premises crosses the boundary of the Premises.
Vehicle/machinery movements	Noise	Air/windborne pathway causing impacts to amenity of closest human receptors (closest residence located 300m north of the Cell 3 area).	Refer to section 6.4	Minor	Possible	Medium	See Appendix 4 for the summary and consideration of the acoustic assessment provided within the Application. The acoustic assessment indicates that noise emissions during the construction period may exceed the assigned levels, however in accordance with Regulation 13 of the EP Noise Regulations emissions from the construction activities are exempt from meeting the prescribed standard for noise emissions (Regulation 7).	No specific regulatory controls (licence conditions) are considered necessary. Construction works will be subject to the EP Noise Regulations.
Excavation and movement of soils	Sediment laden stormwater	Overland flow causing increased load of sediment into the minor watercourse that flows across the Premises, with potential impacts to the aquatic ecosystem.	Refer to section 6.4	Minor	Rare	Low	It is expected that a relatively high rainfall event would be needed to generate sufficient sediment runoff to have an impact on the health of the aquatic ecosystem of the stream within the Premises or the downstream Chapman Brook.	No specific regulatory controls are considered necessary.
Movement of approximately 50 m^3 of waste at western boundary of proposed Cell 3	Leachate Contaminated stormwater	Overland flow or seepage through soil and lateral movement causing a discharge of contaminated water to the ground surface or the minor watercourse that flows across the Premises, causing impacts to flora and fauna health and downgradient groundwater users.	Refer to section 6.4	Moderate	Unlikely	Medium	It is expected that if leachate is encountered during the relocation of this waste, the volume of leachate requiring management is likely to be small. For this reason it is considered that potential leachate/contaminated stormwater emissions during this activity is not expected to cause a moderate impact in most circumstances.	Condition 1.2.4 of the Existing Licence has been amended to state that leachate shall be directed to and stored within the leachate ponds within the Premises.

**Consequence ratings, likelihood ratings and risk descriptions are detailed in the Department's Guidance Statement: Risk Assessments (February 2017)*

7.2 Risk assessment – operation

Table 11: Identification of emissions, pathway and receptors during operation

Risk Event				Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	Potential emissions	Potential receptors, pathway and impact	Applicant controls					
Movement of cover material Vehicle/machinery movements	Dust	Air/windborne pathway causing impacts to health and amenity of closest human receptors (closest residence located 300m north of the Cell 3 area).	Refer to section 6.4	Minor	Unlikely	Medium	The Applicant's proposed dust mitigation controls are likely to be sufficient at mitigating dust emissions during operation.	Condition 1.2.17 has been included on the Licence requiring that no visible dust emissions generated by the activities on the Premises crosses the boundary of the Premises.
Vehicle/machinery movements and use of compactor on tipped waste	Noise	Air/windborne pathway causing impacts to amenity of closest human receptors (closest residence located 300m north of the Cell 3 area).	Refer to section 6.4	Minor	Unlikely	Medium	See Appendix 4 for the summary and consideration of the acoustic assessment provided within the Application. The operation of Cell 3 will not introduce any additional noise emissions from the Premises, considering that landfilling is currently being undertaken within Cell 2 at the Premises and that the operation of Cell 2 will cease when the operation of Cell 3 commences. The acoustic assessment provided in the Application indicates that noise emissions during operation of Cell 3 will comply with the assigned levels specified in the EP Noise Regulations.	No specific regulatory controls (licence conditions) are considered necessary. Operational activities will be subject to the EP Noise Regulations.
Relocation of any leachate from the existing leachate ponds to the new leachate pond to allow excavation of Cell 3	Leachate Contaminated stormwater	Overland flow or seepage through soil and lateral movement causing a discharge of contaminated water to the ground surface, the minor watercourse that flows across the Premises or the minor watercourse/seasonally inundated slope north-east of the Premises, causing impacts to flora and fauna health, domestic dam water quality and potential downgradient groundwater users.	Refer to section 6.4	Moderate	Unlikely	Medium	The Licence Holder has not specified any controls in regards to this activity, however has indicated that the volume of leachate to be transferred it likely to be small. For this reason it is considered that spills or leaks during this activity is not expected to cause a moderate impact in most circumstances and does not require specific regulatory controls.	Condition 1.2.4 of the Existing Licence has been amended to allow for the operation of the new leachate pond following construction and submission of the Critical Containment Infrastructure Report.

Risk Event				Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors, pathway and impact**	**Applicant controls**					
Landfilling of waste Progressive exposure of previously landfilled waste due to removing temporary cover and cutting benches into existing waste body for placement of new waste	Odour	Air/windborne pathway causing impacts amenity of closest human receptors (closest residence located 300m north of the Cell 3 area).	Refer to section 6.4	Moderate	Possible	Medium	The process of cutting benches into the Cell 2 waste body will only occur when the active landfilling in Cell 3 is along the boundary between Cell 2 and Cell 3, however during this process the source of odour emissions will be increased. The Applicants proposed odour controls are likely to be sufficient at mitigating odour emissions during operation, with the exception of the management of the bench cutting process for which controls have not been clearly stated.	Condition 1.2.5 of the Existing Licence (now condition 1.2.9) requires that waste is covered and Condition 1.2.6 of the Existing Licence (now condition 1.2.10) specifies the depth of cover material that must be applied. These conditions have been retained within the amended Licence. Condition 1.2.5(a) of the Existing Licence (now condition 1.2.9(a)) has been amended to specify that the size of the tipping face is kept to a maximum length of 30m. Condition 1.2.9(e) has been added to the Licence requiring that waste material that is exposed during the process of cutting benches into the existing waste body is also covered as soon as possible after it has been exposed and not later than by the end of the working day. Condition 1.2.5(c) (now condition 1.2.9(d)) and 1.2.6 (now condition 1.2.10) have been amended to require that intermediate cover is applied to waste surfaces which will not receive active waste for more than 90 consecutive calendar days. This requirement is consistent with the Licence Holder's use of intermediate cover as a control for odour.
	Dust	Air/windborne pathway causing impacts to health and amenity of closest human receptors (closest residence located 300m north of the Cell 3 area).	Refer to section 6.4	Minor	Unlikely	Medium	The Applicant's proposed dust mitigation controls are likely to be sufficient at mitigating dust emissions during operation.	Condition 1.2.17 has been added to the Licence requiring that no visible dust emissions generated by the activities on the Premises crosses the boundary of the Premises.
	Windblown waste	Air/windborne pathway causing impacts to health and amenity of closest human receptors (closest residence located 300m north of the Cell 3 area) and harm to local fauna.	Refer to section 6.4	Minor	Unlikely	Medium	The Applicant's proposed controls are likely to be sufficient at mitigating impacts from windblown waste emissions during operation, with the exception that the frequency of the collection of windblown waste is not sufficient.	Condition 1.2.9 of the Existing Licence (now condition 1.2.12) requires that the Licence Holder ensure that windblown waste is contained within the boundary of the Premises and that windblown waste is returned to the tipping area on at least a weekly basis. This condition has been retained within the amended Licence. It is noted that the Licence Holder proposed to collect this waste on a monthly basis, however the Delegated Officer considers that this would not be frequent enough. Condition 1.2.10 of the Existing Licence was duplicating the requirement to manage windblown waste, however included a monthly collection frequency. This condition has been removed. Condition 1.2.5 of the Existing Licence (now condition 1.2.9) requires that waste is covered and Condition 1.2.6 of the Existing Licence (now condition 1.2.10) specifies the depth of cover material that must be applied. These conditions have been retained within the amended Licence. Condition 1.2.13 has been added to the Licence to implement the Licence Holders proposed control regarding the installation of temporary 2m high fencing around the active tipping area has been added to the Licence.
	Vermin and pathogens	Air and land pathways via insects, birds and rodents causing amenity impacts and health impacts to closest human receptors (closest residence located 300m north of the Cell 3 area) and may result in harm to the local ecosystem.	Refer to section 6.4	Minor	Possible	Medium	The Applicant's proposed controls are likely to be sufficient at mitigating vermin and pathogen related impacts during operation.	Condition 1.2.12 of the Existing Licence (now condition 1.2.15) requires the Licence Holder to ensure that vermin, birds, flies and other inspects do not give rise to nuisance at the Premises or in the immediate area of the Premises. This condition has been retained within the amended Licence. This condition has been retained within the amended Licence. Conditions 1.2.9 and 1.2.10 specify daily and intermediate cover requirements as discussed in regards to odour emissions above.
	Leachate	Overland flow or seepage through soil and lateral movement causing a discharge of contaminated water to the ground surface, the minor	Refer to section 6.4	Major	Unlikely	Medium	Considering the close proximity of the neighbouring property and the areas of shallow groundwater within and nearby the Premises, there is the potential for	Condition 2.2.1 has been added to the Licence to require that Cell 3 is constructed and installed in accordance with the proposed specifications including:

Risk Event				Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors, pathway and impact**	**Applicant controls**					
	Contaminated stormwater	watercourse that flows across the Premises, or the minor watercourse/seasonally inundated slope north-east of the Premises, causing impacts to flora and fauna health, domestic dam water quality and potential downgradient groundwater users.					major impacts from leachate/contaminated stormwater. However, the Applicant's infrastructure controls are likely to be sufficient to contain these emissions and prevent a major impact in most circumstances. Additional groundwater monitoring bores are considered necessary for the detection of any impacts from the new and existing infrastructure.	- Preparation of compacted subgrade - Liner hydraulic conductivity - Separation distance between infrastructure and maximum groundwater elevation - Leachate collection pipework specifications - Leachate sump lining An additional specification has been added in regards to the construction of stormwater channels and infiltration drains requiring the consideration of peak flow rate and erosion protection measures where necessary. Conditions 2.2.3, 2.2.4 and 2.2.5 have been added to the Licence to require a Critical Containment Infrastructure (CCI) Report to be provided to the CEO following the completion of construction and 60 working days prior to operating the infrastructure, to provide the Department with an opportunity to review the report prior to operation of the infrastructure. The CCI Report is required to include the Construction Quality Assurance Validation Report as proposed by the Licence Holder to verify that the construction and installation has been completed as proposed. Condition 1.2.6 has been added to the Licence to require that the head of leachate in the Cell 3 leachate sump is maintained below 1m. Condition 1.2.9(b) has been added to the Licence to specify that benches of 2m height and 2m depth are cut into the existing waste batter slope of Cell 2 where waste received in Cell 3 is to be placed against the existing Cell 2 waste batter. Condition 1.2.18 has been added to the Licence to require a Closure Plan for Cell 1 and Cell 2 to be submitted by 23 January 2020 as the closure of these cells is critical in minimizing leachate inputs to the pond. The groundwater monitoring conditions in Section 3 of the Existing Licence have been amended to include additional groundwater monitoring requirements including the expansion of the monitoring network to include all existing on-site bores and the installation of new bores in the fractured rock and perched aquifers in the vicinity of the new leachate pond and existing landfill cell 1 and 2. New groundwater bores will be required to be sampled prior to commencement of operations.

Risk Event				Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors, pathway and impact**	**Applicant controls**					
	Landfill gas	Build-up of gas and migration through landfill cover or embankments exposing closest human receptors (closest residence located 300m north of the Cell 3 area) to health impacts and potential explosion risk from high methane concentration.	Refer to section 6.4	Major	Rare	Medium	The Application states that the estimated volume of landfill gas generation for this cell will be insufficient to allow for the capture and flaring of landfill gas after closure of the landfill cell. The risk of harm presented by landfill gas is likely to be localised to the Premises and the immediate surrounds. The Applicant's proposed controls are likely to be sufficient at mitigating the risk of impact from landfill gas emissions after closure of the landfill cell. Specific controls are not considered necessary during operation as the gas is not likely to be accumulative in potentially dangerous quantities prior to capping being applied. Further assessment of the proposed landfill capping system and passive venting infrastructure will be required prior to closure and capping of the landfill cell.	Condition 2.2.1 has been included in the Revised Licence requiring that Cell 3 is installed in accordance with the proposed specifications as described in the leachate risk assessment above. Condition 1.2.5(e) of the Existing Licence (now condition 1.2.9(f)) requires that rehabilitation of a cell of phase takes place within 6 months after disposal in that cell or phase has been completed. 'Rehabilitation' is defined in the Existing Licence as the completion of the engineering of a landfill cell and includes capping and/or final cover. This requirement has been retained within the Revised Licence. Condition 1.2.19 has been added to the Licence requiring that a closure plan is provided to the Department for approval between 6 to 12 months prior to undertaking capping of Cell 3.
	Smoke (fire incident)	Air/windborne pathway causing impacts to health and amenity of closest human receptors (closest residence located 300m north of the Cell 3 area) and harm to local fauna in adjacent bushland.	Refer to section 6.4	Moderate	Unlikely	Medium	A fire incident caused by the operation of the landfill is not likely to occur in most circumstances. The Applicant's proposed controls are generally suitable.	Condition 1.2.7 of the Existing Licence (now condition 1.2.11) requires that security measures are implemented at the Premises to prevent unauthorised access to the Premises. This condition has been retained within the Revised Licence. Conditions 1.2.9 and 1.2.10 require that cover is applied to the landfilled waste by the end of the working day.
Returning leachate onto landfill tipping face to increase leachate evaporation during summer months	Odour	Air/windborne pathway causing impacts amenity of closest human receptors (closest residence located 300m north of the Cell 3 area).	Refer to section 6.4	Moderate	Unlikely	Medium	The area of application of leachate in the active landfill area would be relatively small compared to the leachate pond surface area. For this reason it is considered that this activity causing amenity impacts is not expected to occur in most circumstances and does not require any specific regulatory controls.	Condition 1.2.8 has been added to the Licence requiring that any equipment used for the purpose of evaporation or aeration of leachate does not generate spray drift beyond the perimeter of the leachate pond.
Storage of leachate in leachate pond Spray used in leachate pond to increase evaporation				Moderate	Possible	Medium	An amenity impact could occur at some time due to the storage and spray of leachate if the leachate is anaerobic and therefore may potentially be highly odourous. An additional regulatory control is considered necessary to ensure that the equipment used to increase leachate evaporation or aeration does not create spray drift which can exacerbate odour emissions.	

Risk Event				Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors, pathway and impact**	**Applicant controls**					
Storage of leachate in leachate pond	Leachate	Overland flow or seepage through soil and lateral movement causing a discharge of contaminated water to the ground surface, the minor watercourse that flows across the Premises, or the minor watercourse north-east of the Premises, causing impacts to flora and fauna health, domestic dam water quality and potential downgradient groundwater users.	Refer to section 6.4	Major	Unlikely	Medium	Considering the close proximity of the neighbouring property and the areas of shallow groundwater within and nearby the Premises, there is the potential for major impacts from leachate/ contaminated stormwater. However, the Applicant's infrastructure controls are likely to be sufficient to contain these emissions and prevent a major impact in most circumstances, with the exception that additional leachate pond storage capacity may be required within the next 2-3 years to prevent leachate needing to be removed from the Premises via a licensed liquid waste carrier. Additional groundwater monitoring bores are considered necessary for the detection of any impacts from the new infrastructure.	Condition 2.2.1 has been added to the Licence to require that the Leachate Pond is constructed and installed in accordance with the proposed specifications including: - Preparation of compacted subgrade - Liner hydraulic conductivity - Separation distance between infrastructure and maximum groundwater elevation An additional specification has been added requiring that stormwater channels and infiltration drains are installed around the Leachate Pond consistent with the stormwater management proposed for Cell 3 with the exception of additional specifications requiring the consideration of peak flow rate and erosion protection measures where necessary. Conditions 2.2.3, 2.2.4 and 2.2.5 have been added to the Licence to require a Critical Containment Infrastructure (CCI) Report to be provided to the CEO following the completion of construction and 60 calendar days prior to operating the infrastructure, to provide the Department with an opportunity to review the report prior to operation of the infrastructure. The CCI Report is required to include the Construction Quality Assurance Validation Report as proposed by the Licence Holder to verify that the construction and installation has been completed as proposed. Condition 1.2.5 has been added to the Licence requiring that a freeboard of 500mm is maintained within the leachate pond at all times. A definition for 'freeboard' added to the definitions under Condition 1.1.2 of the Existing Licence. Condition 1.2.7 has been added to the Licence requiring that the leachate transfer pipeline is inspected on at least a weekly basis and that any leaks detected are repaired as soon as practicable. The groundwater monitoring conditions in Section 3 of the Existing Licence have been amended to include additional groundwater monitoring requirements including the expansion of the monitoring network to include all existing on-site bores and the installation of new bores in the fractured rock and perched aquifers in the vicinity of the new leachate pond and existing landfill cells 1 and 2. New groundwater bores will be required to be sampled prior to commencement of operations.
Progressive exposure of previously landfilled waste due to removing temporary cover and cutting benches into existing waste body for placement of new waste	Release of asbestos fibres	Air/windborne pathway causing impacts to health of closest human receptors (closest residence located 300m north of the Cell 3 area).	Refer to section 6.4	Severe	Rare	High	Considering that the disposal of asbestos waste has occurred within a designated area which will not be disturbed, it is considered that the release of asbestos fibres may only occur in exceptional circumstances.	Condition 1.2.3 of the Existing Licence (condition number unchanged) requires that no works are carried out on the landfill that could lead to the release of asbestos fibres. This condition has been retained within the amended Licence.

**Consequence ratings, likelihood ratings and risk descriptions are detailed in the Department's Guidance Statement: Risk Assessments (February 2017)*

8. Redundant conditions

The following conditions have been removed from the Revised Licence as DWER no longer uses these types of conditions as the enforcement of these conditions is problematic. The conditions on the Revised Licence are considered sufficient to cover the intent of the below conditions.

- Condition 1.2.12 of the Existing Licence requiring the Licensee to undertake activities in accordance with the Environmental Improvement Plan, which shall be updated on an annual basis with amendments being submitted to the Department for its agreement.
- Condition 2.2.1 of the Existing Licence requiring that the Licence Holder ensures that odour emitted from the Premises does not unreasonably interfere with the health, welfare, convenience, comfort or amenity of any person who is not on the Premises.

9. Clearing assessment

The Clearing Permit Assessment Report, which provides the assessment and decision making regarding the proposed clearing and the conditions for clearing, is included as Attachment 1 of this Decision Report. The recommended conditions within the Clearing Permit Assessment Report are included within the Revised Licence.

10. Consultation

Method	Comments received	DWER response
Application advertised on DWER website on 21 February 2019 (for 14 days) and 14 March 2019 (for 8 days)	Summary of comments received 19 March 2019 (Stakeholder 1): Advise that the nearby residents are adversely affected by noise, windblown litter, odour, potential water contamination, vehicle traffic, vermin and scavengers. Do not support the proposal to construct a new landfill cell and construct a new leachate pond, based on the following: 1. Clearing of a large area of native vegetation. 2. Large reduction of buffer between the premises and Davis Road. 3. Changing from a three pond system to a single pond system, without the 'safety net' of containing overflow or leakage. 4. Increased groundwater contamination. 5. The application did not discuss groundwater testing results in the context of historical baseline testing results from 1996. 6. The proposed location of the leachate pond is within a watershed and within 100m from the Chapman Brook creek line, increasing the risk of surface water contamination. 7. Organic Farmers in the area may be impacted by loss of organic certification if contamination occurs. 8. The proposed pond is outside the current licensed area. 9. The proposed leachate sumps are inadequate for the size of the proposed pond. 10. The water balance calculations appear to be inadequate. The mean average over the three wettest months over a 25 year period and a 1 in 100 year storm event should have been considered. 11. The current management of the premises is not in accordance with licence conditions in regards to leachate containment (clay and membrane failure continues to contaminate groundwater), covering tipped waste and progressive rehabilitation of the cells.	DWER notes the issues raised, and provides the following responses. The clearing area has been considered within the Clearing Permit Assessment report provided as an attachment to this Decision Report. The Licence Holder has not proposed to change the distance between the operations at the Premises and Davis Road, considering the location of the currently active landfill cells within the Premises. The Licence Holder will be required to maintain a freeboard of 500mm within the new pond. In the case where that freeboard is reached or any integrity issue is detected within the pond, the Licence Holder has the option of removing leachate from the Premises by a controlled waste carrier. DWER considers the proposed lining of the pond system and Cell 3 to be sufficient, however is requiring that additional groundwater bores are installed to better detect impacts from the new cell and leachate pond. DWER notes that there are closed unlined landfill cells within the Premises however consideration of the potential impacts from the existing infrastructure is not within the scope of this assessment for new infrastructure (note: related issues will be considered when reviewing closure plans for Cell 1 and 2 which are requirements of the Revised Licence). The siting of the new cell and leachate pond in regards to surface water has been considered within the risk assessment and the condition setting. The Licence Holder will be required to install shallow bores within the perched aquifer to detect impacts in this aquifer which presents a risk of discharge to downgradient surface water receptors. The proposed leachate pond is within the existing Prescribed Premises boundary as defined in the Existing Licence. There has been no change to the Premises boundary as a result of this amendment. DWER agrees that the water balance calculations provided within the Application contained some uncertainty, however the Licence Holder will be required to maintain the freeboard within the pond to prevent overflows. If leachate is required to be removed from the Premises to achieve this prior to the closure of Cell 3 then this can be done by removal by a controlled waste carrier.

Method	Comments received	DWER response
	12. The site should be working towards imminent closure, final capping and rehabilitation.	DWER recognises that the Licence Holder has been found to be non-compliant with some requirements of the Existing Licence in the past, including the requirement for daily cover. Following the most recent inspection in March 2019 the Licence Holder rectified the inadequate cover on the waste within the Premises. The ongoing compliance with the cover requirements of the Licence will be managed by DWER through compliance inspections. The Licence Holder will also be required to provide closure plans for Cell 1 and Cell 2 as set out in the Revised Licence.
	Summary of comments received 20 March 2019 (Stakeholder 2): Do not support the proposal to construct a new landfill cell and construct a new leachate pond, based on the following: 1. The proposed ponds are only 620m from the Chapman Brook. The licence regulations require a 150mt buffer to a watercourse and this should be maintained. 2. Leakage of contaminates into the ground water and creek system. Groundwater monitoring results around the premises have already shown that there appears to be leachate in the ground water system.	DWER notes the issues raised, and provides the following responses. There is currently no buffer distance specified within the within the Existing Licence. As stated above, DWER considers the proposed lining of the pond system and Cell 3 to be sufficient, however is requiring that additional groundwater bores are installed to better detect impacts from the new cell and leachate pond. DWER notes that there are closed unlined landfill cells within the Premises however consideration of the potential impacts from the existing infrastructure is not within the scope of this assessment for new infrastructure (note: related issues will be considered when reviewing closure plans for Cell 1 and 2 which are requirements of the Revised Licence).
Residents listed as Direct Interest Stakeholders in DWER Licensing System notified in writing	Summary of comments received 14 March 2019 (Stakeholder 3): 1. Do not support the proposal to construct a new landfill cell and construct a new leachate pond, as the proposal is not best practice. The site should be working towards imminent closure, final capping and rehabilitation. 2. Extension of the operating life of this landfill presents environmental costs. 3. First preference is to retain the existing leachate ponds but for these to be emptied and pond liners installed, with the view that this would remove the need for sumps and pumps as the existing leachate ponds are at the lowest point on the site. 4. Second preference is for a new leachate pond to be built in addition to the existing ponds and directly north of the existing 3rd pond to provide a second pond system and a contingency plan. 5. Third preference is for the new leachate pond to be located on the south side of the reserve at the furthest possible location (or at least minimum required setback) from the creek line running west to east through the	DWER notes the issues raised, and provides the following responses. DWER undertakes risk assessments for works and changes to operations on a case by case basis, and does not require all landfills to meet a specific standard. As stated above, DWER considers the proposed lining of the pond system and Cell 3 to be sufficient, however is requiring that additional groundwater bores are installed to better detect impacts from the new cell and leachate pond. DWER notes that there are closed unlined landfill cells within the Premises however consideration of the potential impacts from the existing infrastructure is not within the scope of this assessment for new infrastructure (note: related issues will be considered when reviewing closure plans for Cell 1 and 2 which are requirements of the Revised Licence). The Licence Holder will also be required to provide closure plans for Cell 1 and Cell 2 as set out in the Revised Licence.

Method	Comments received	DWER response
	reserve. This would have less of an impact on the townsite, neighbours, and the creek line that runs through the site. 6. Note that the proposed location of the new leachate pond is within the catchment area and downgradient of the creek line which is located north of the premises. Three domestic water supplies for the residents of the neighbouring property are also in the catchment area and downgradient of the proposed pond location. 7. Request that if the proposed leachate pond is approved, it is required to be located within the area of the premises which is already cleared, rather than requiring further clearing of native vegetation. The native vegetation should be retained at all costs as a natural buffer and to help with erosion and regeneration. The area that is already cleared is also further from the creek line that is located north of the premises. 8. Note that the neighbouring farm is used to produce livestock which is certified organic. Contamination of water supplies caused by the landfill operation would impact the land value and livelihoods of three families. 9. Note that the application includes information which states that there are concentrations of some metals in the groundwater downgradient from the landfill. Also note that the creek line located north of the premises which flows into the neighbouring property and the domestic water supplies of this property are also downgradient of some of the landfilled area. Note that water test results demonstrate that the operational construction has been insufficient and contaminants from the site have leached into the surrounding groundwater system. 10. Request that the latest groundwater monitoring results for the 2018 period is considered in the assessment, noting that the 2017 Annual Report states that the monitoring undertaken in 2018 will determine if there are significant and ongoing trends in regards to contaminant concentrations. 11. Note that the proposed plan of having only one leachate pond does not provide for a contingency plan, as there is no second pond into which to transfer leachate if there is a failure in the pond lining. 12. Note the application does not provide any information regarding the land directly north of the proposed leachate pond location, and does not mention the Chapman Brook creek line that comes into the neighbouring property from the landfill premises, and believe the proposed location of the pond is within the required setback distance of 100m to the winter creek line.	DWER acknowledges that the ongoing operation of the landfill presents risks to nearby receptors, however regulatory controls as specific within Section 7.2 of this Decision Report are considered sufficient to mitigate those risks. DWER notes the creek located north of the Premises, and the topography which results in the creek being downgradient of the leachate pond and the new landfill cell. DWER considered the siting of the Premises, the new infrastructure and the layout proposed by the Licence Holder, and determined that the risks are not sufficient to conclude that the proposed location would not be acceptable. The 2018 Annual Report had not yet been provided by the Licence Holder at the time of this assessment. As stated above, DWER considers the proposed lining of the pond system and Cell 3 to be sufficient, however is requiring that additional groundwater bores are installed to better detect impacts from the new cell and leachate pond. DWER notes that there are closed unlined landfill cells within the Premises however consideration of the potential impacts from the existing infrastructure is not within the scope of this assessment for new infrastructure. As stated above, the Licence Holder will be required to maintain a freeboard of 500mm within the new pond. In the case where that freeboard is reached or any integrity issue is detected within the pond, the Licence Holder has the option of removing leachate from the Premises by a controlled waste carrier. There is no specific setback or separation distance required within the Existing Licence. As stated above the creek located north of the Premises has been considered within the Department's assessment. Additional groundwater bores will be required to be installed to better detect impacts from the new cell and leachate pond, including an additional bore to be installed in the north east corner of the Premises. The Licence Holder will be required to sample the new bores prior to the operation of Cell 3 of the new leachate pond. The Licence Holder will also be required to install some shallow bores within the perched aquifer to detect impacts in this aquifer which presents a risk of discharge to downgradient surface water. The Licence Holder will be required to maintain the head of leachate within the sump of Cell 3 below 1m. As stated above, DWER agrees that the water balance calculations provided within the Application contained some uncertainty, however the Licence Holder will be required to maintain the freeboard within the pond to prevent overflows. If leachate is required to be removed from the Premises to achieve this prior to the closure of Cell 3 then this can be done by removal by a

Method	Comments received	DWER response
	13. Request that at least two new bores are constructed along the northern boundary between the current bore P1 and the north east corner of the reserve (parallel to Davis Road), and that these bores are sampled prior to operating a pond in the proposed location (for historical records). 14. Request that a new bore is placed lower in the gradient of the current operating cell on the eastern boundary in the watershed of the creek line that crosses Davis Road and request that surface water monitoring is commenced immediately. 15. Note that the proposed leachate sumps appear to be inadequate in size in the event of prolonged heavy rainfall or a pump failure event. 16. Note that the water balance calculations appear to be inadequate due to the use of mean rainfall, rather than data for high rainfall periods and storm events, indicating that the proposed leachate pond may not be a sufficient size to prevent overtopping during a storm event. 17. Note concerns regarding the proposed capping of the cell at closure, as the clay sourced from on site is not considered sufficient due to being prone to small fissures after compacting, and the roots of vegetation planted above the capping layer may puncture the synthetic polyethylene which will allow water into the cell and increase leachate volumes. 18. Note that the application indicates that the existing completed landfill cells have not yet been capped, which presents an ongoing increased risk of groundwater contamination and contravenes the existing licence condition that the Licensee shall undertake rehabilitation of a cell or phase within 6 months after disposal in that cell or phase has been completed. It is considered unacceptable to allow the existing completed landfill cells to remain uncapped until 2022 as stated in the application. 19. Advise that they have been told by the Shire that the daily cover material that is spread on the active tipping face at the end of each day is removed the next day prior to adding further waste to the tipping face. By removing the cover material the Licensee is in breach of the licence condition requiring the covering of putrescible waste by the end of the working day in which it was deposited. 20. Constant daily odour and dust were experienced for a period of approximately 6 to 7 weeks, resulting in a complaint to the Shire on 7 February 2019. Suspect that the waste was not being covered during this time or that the cover was being removed each day before depositing new waste.	controlled waste carrier. It also appears that the freeboard capacity should be sufficient to prevent overflows during a storm event. As stated above, the Licence Holder will be required to provide closure plans for Cell 1 and Cell 2 as set out in the Revised Licence. The material specifications of the proposed capping material will be required to be provided to the Department for consideration prior to capping of Cells 1, 2 and 3. Further consideration of the suitability of the proposed capping will be undertaken at that time. It is typical in landfill operation that the working face of the tipping area is opened each day by stripping back the daily cover in that area. This is not considered to be non-compliant with the cover requirements on the existing licence. As stated above, DWER recognises that the Licence Holder has been found to be non-compliant with some requirements of the Existing Licence in the past, including the requirement for daily cover. Following the most recent inspection in March 2019 the Licence Holder rectified the inadequate cover on the waste within the Premises. The ongoing compliance with the cover requirements of the Licence will be managed by DWER through compliance inspections. A residential receptor was not discussed specifically in the acoustic assessment in regards to the assigned levels for that residence, however it was identified within the noise modelling contour plans provided (as discussed within Appendix 4 of this Decision Document). The stability analysis provided within the Application indicates that the proposed height and design will meet the recommended factors of safety. The Existing Licence includes a condition which requires that leachate is only stored and/or treated within vessels or compounds provided with the infrastructure specified within the associated table, which lists the existing leachate ponds. This condition has been retained within the Revised Licence and updated to include the new leachate ponds and additional wording specifying that leachate is to be directed to the ponds. A new condition has also been included on the Revised Licence requiring that the leachate transfer pipeline is inspected weekly and any damage is repaired.

Method	Comments received	DWER response
	21. Note the requirement of the current licence for surface and groundwater sampling. The application only provides an analysis of samples from 2016-2017, and does not consider historical data including sampling undertaken in 1996 (prior to the landfill operations commencing). 22. Consider that there is sufficient evidence to indicate that the landfilling operations at the premises have caused contamination of the surface and groundwater, and an additional cell will only compound the problem. 23. The acoustic assessment provided in the application does not acknowledge the second residence on the neighbouring property. 24. Question the a height of the existing landfill cells, as the landfill was originally approved for the cells to be up to 3 metres above the natural ground level only. Maps were also provided indicating topographic contours, creek to the north of the premises, and the alternative preferences for the location of the proposed leachate pond as stated above. Summary of comments received 23 March 2019 (Stakeholder 3): 25. Note that up until 2011 the following condition was on the licence – 'direct runoff from the disposal cell area to the leachate ponds'. The licence granted in 2013 did not include this condition. 26. Request that the above condition be placed on all future licences approved for this landfill.	
Licence Holder referred draft documents 19 September 2019	Summary of comments received from the Licence Holder on 8 October 2019: 1. Agreement with the changes to the following licence conditions wording within the Decision Report: - Table 1.2.2, Table 1.2.3, Condition 1.2.5, Condition 1.2.7, Condition 1.2.8, Table 1.2.4, Condition 1.2.12, Condition 1.2.16, Condition 1.2.17, Condition 2.2.1, Condition 2.2.2, Condition 2.2.3, Condition 2.2.4, Condition 2.2.6. 2. Condition 1.2.6 (DWER requested confirmation of maximum head of leachate within the leachate sump): The RL of the leachate sump in at RL72.2m. The adjacent base of the landfill is at RL72.9m. There is a 300mm drainage layer over the liner. At the sump the top of the drainage layer is at RL73.2m.	1. Agreement noted. 2. Licence and Decision Report updated to require that the head of leachate within the sump is maintained below 1m (noting that a 1m head of leachate above the base of the sump is equivalent to approximately 300mm of leachate over the landfill base liner in the vicinity of the sump). 3. This condition (now condition 1.2.19) has not been changed because DWER requires the closure plan for Cell 3 to be provided closer to the completion of landfilling in Cell 3 as the plan is likely to be more accurate and any responses from DWER in regards to the plan will be more relevant and consider industry standards at that time. The condition requiring the submission of a closure plan for Cell 3 has been amended to require the plan to be submitted between 1 year to 6 months prior to the completion of waste disposal in that cell. Notwithstanding this position, the Licence Holder can still prepare a closure plan for the entire

Method	Comments received	DWER response
	The leachate level within the Cell 3 landfill will not be more than 300mm above the base of the landfill liner (i.e. leachate will be maintained within the drainage layer). 3. Condition 1.2.18 requiring a closure plan for Cell 3 six months prior to completion of landfilling in that cell: Details for the closure and capping of Cell 3 will be included in the overall Closure Plan that will be submitted to DWER within three months of the amendment being issued. 4. Condition 2.2.5 requiring that the critical containment infrastructure (CCI) is not operated until either 60 business days after submission of the CCI Report has been submitted or a lesser date as specified by the CEO: It is critical that landfilling occurs following the submission and approval of the Compliance Report. The Licence Holder respectfully requests the DWER to access the Compliance Report and issue the amended Licence with urgency. 5. Condition 3.1.1 specifying ongoing groundwater monitoring requirements: The Licence Holder agrees with this requirement. The Licence Holder considers that the existing locations of the groundwater monitoring bores are more than adequate to assess groundwater condition and levels beneath the landfill. The Licence Holder is not intending to install any more groundwater monitoring wells. 6. Provided confirmation of total Cell 3 airspace. 7. DWER requested confirmation that the maximum recorded groundwater levels will be at least two 2m below the base of the leachate sump within Cell 3. Provided confirmation that based on the historical information regarding groundwater monitoring held by the Licence Holder, the design provides an unsaturated zone of at least 2m above the highest recorded groundwater level. 8. DWER requested confirmation of minimum subgrade depth to be used in Cell 3 construction: Advised that the contractor shall carry out the works in accordance with the drawings, adhering to the slopes, levels, depths and heights shown in the drawings. The redesign of the landfill provided in July 2019 includes fill over the entire Cell 3 area. Prior to the subgrade being approved by the	site in the first instance then review it (and update it if necessary) closer to the closure of Cell 3 and resubmit any revised version to comply with the condition. 4. The comment provided has been interpreted as acceptance of condition 2.2.5, DWER intends to consider the Critical Containment Infrastructure Report and provide written notification as soon as possible following its submission. 5. The comment provided in regards to condition 3.1.1 has also been interpreted as a response to conditions 3.1.5 and 3.1.6 which require the installation of additional groundwater monitoring wells. The Licence Holder's views are noted, however the comments provided do not justify a change to DWER's risk assessment and decision in regards to the need for additional groundwater monitoring bores. These conditions have not been changed. 6. Noted and included within this Decision Report. 7. Noted and the requirement to achieve a 2m separation distance between the base of the leachate sump and the maximum groundwater table elevation has been retained within the Decision Report and Licence. 8. Noted that a minimum subgrade depth is not specified and that the natural ground may form the subgrade. As the draft Licence conditions require that a minimum standard compaction is achieved, and that construction must meet the requirements of the Construction Quality Assurance Plan provided within the Application (which includes inspection and testing of the subgrade surface), no additional conditions are required to be included within the final Licence in regards to the subgrade. 9. Noted and references to the groundwater relief drains have been removed from the Decision Report and Licence. Due to the redesign of the landfill incorporating a sufficient separation distance between the base of the leachate sump with Cell 3 and the highest recorded groundwater level, the removal of the groundwater relief drains as a proposed control does not affect the outcome of the risk assessment or the proposed regulatory controls. 10. Noted and the requirement to achieve this separation distance has been retained within the Decision Report and the Licence. 11. Noted and the Decision Report amended to state that the location of the channels/drains is unspecified. No specific regulatory controls are

Method	Comments received	DWER response
	Superintendent the Contractor (in accordance with section 4.10 of the Construction Specification) must verify the stability of the subgrade by proof rolling the subgrade. This includes natural ground and fill material. 9. Provided confirmation that groundwater relief drains (as proposed in the initial Cell 3 design are not part of the revised design because the revised design increased the separation distance between the cell and the highest groundwater level to include a 2m unsaturated zone beneath the landfill. 10. Provided confirmation that the Contractor shall verify to the Superintendent that the base of the leachate pond has an unsaturated zone of at least 2.0m beneath the HDPE liner. 11. DWER requested that the Licence holder advise the proposed location of stormwater runoff channels and infiltration drains for preventing the movement of sediment laden stormwater off the Premises during construction: Advised that the location of soil stockpiles and surface water drains will be agreed between the Licence Holder, Superintendent and the Contractor prior to the commencement of works. 12. DWER requested clarification on how waste will be handled and how leachate will be managed from an area where existing waste needs to be relocated prior to Cell 3 construction: Provided confirmation that any leachate encountered within the works area will firstly be confirmed as leachate by the Superintendent, and that leachate will be transported to the leachate ponds onsite or otherwise as advised by the Licence Holder. 13. DWER requested that the Licence Holder advise the proposed location of stormwater channels around Cell 3 and the associated infiltration drains for directing uncomtaminated stormwater during operation. Advised that the location of soil stockpiles and surface water drains will be agreed between the Licence Holder, Superintendent and the Contractor prior to the commencement of works. 14. DWER requested that the Licence Holder advise whether the Premises has a water tank for fire suppression. Fire services are provided by the Volunteer Fire Brigade located at Witchcliffe. The services at Witchcliffe include both bush fire and urban firefighting equipment; this includes breathing apparatus. The response	considered necessary to address this potential emission, therefore no change has been made to the Licence conditions. 12. Noted and the Decision Report has been amended to state this within Table 9. The risk assessment relating to the potential leachate emissions from this activity has been updated in Table 11 and has not resulted in any changes to the Licence conditions. 13. The response provided relates to the construction stage, however the information requested by DWER relates to stormwater management during the operational stage. The Decision Report has been amended to state that the location of the channels and drains is unspecified. Specifications for the construction of stormwater channels and infiltration drains have been included within Table 1 and 2 of Schedule 2 of the Licence. The layout of the drains has not been specified within the Licence. 14. Noted. No changes have been made to the Licence or Decision Report in response to this information. 15. The Decision Report has been updated to state that the specifications of the spray system have not been provided. An additional condition has been added to the Licence requiring that equipment used for the evaporation or aeration of leachate does not generate spray drift beyond the perimeter of the leachate pond. 16. The response provided is unclear in regards to how long the temporary pond will be retained, stating both that it will remain until Cell 3 is constructed and that it will be removed from the Premises during closure operations. It is unknown to DWER whether the pond is lined, and appears to be in a location above a potentially unlined landfill area. DWER also notes that the Applicant previously advised (on 26 July 2019) that the pond is unlikely to be required for emergency storage. The Licence Holder's comments regarding Table 1.2.3 have been interpreted as an acceptance of the changes to this condition, and therefore did not indicate that this temporary pond is expected to be used for leachate storage. The draft Licence conditions do not allow the use of this pond for the storage of leachate and no change has been made in regards to this. 17. Noted. No changed have been made to the Licence or Decision Report in response to this confirmation.

Method	Comments received	DWER response
	time from Witchcliffe is 2 minutes. There are 12 volunteer fire fighting services within the Shire with 4 of those within 15km of the landfill. 15. DWER requested that the Licence Holder advise the proposed spray infrastructure to be used for leachate evaporation (including the diameter of the spray field) and confirm whether it's currently in use on the Premises. The spraying of leachate on the leachate pond liner has not occurred in the past. Once the leachate pond is constructed spray infrastructure will be sourced and fitted around the leachate pond. The design will be similar to that installed at the City of Busselton Dunsborough Landfill Facility. 16. DWER requested clarification regarding a small overflow pond on the Premises and whether this will be retained during the operation of Cell 3 and the new leachate pond. There is a temporary leachate pond constructed on top of the existing landfill. The temporary leachate pond will remain until Cell 3 and the new leachate pond are constructed. During the closure operations this leachate pond shall be removed from the facility. [map provided showing location of temporary pond] 17. Provided confirmation that asbestos is located within a designated asbestos disposal area which is not located within an area of waste that will be disturbed during construction.	

11. Conclusion

Based on the assessment in this decision report, the Delegated Officer has determined that an amendment will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Jarrod Abrahams 2019.10.23 16:10:41 +08'00'

Jarrod Abrahams
A/MANAGER WASTE INDUSTRIES
REGULATORY SERVICES
An officer delegated by the CEO under section 20 of the EP Act

Appendix 1: Key documents

Document title	Availability
DER, 2014. *Assessment and management of contaminated sites.* Department of Environment Regulation, Perth.	accessed at www.dwer.wa.gov.au
DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	
DER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.	
DER, February 2017 *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	
DWER, June 2019. *Guidance Statement: Decision Making*. Department of Environment Regulation, Perth.	
DER, December 2014. *Assessment and management of contaminated sites*. Department of Environment Regulation, Perth.	
DOW, 2009. *Blackwood groundwater area subarea reference sheets – plan companion for the South West groundwater areas allocation plan.* Department of Water, Perth.	
DOW, 2015. *River health assessment in the lower catchment of the Blackwood River*. Department of Water, Perth.	
ANZECC and ARMCANZ, 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* National Water Quality Management Strategy, Canberra.	accessed at www.waterquality.gov.au
Dixon, N and Jones, DRV, 2004. 'Engineering properties of municipal solid waste', *Geotextiles and Geomembranes*, vol. 23, iss. 3, pp. 205-233.	-
Emerge Associates, 2018. *Annual licensing report (2017) – Davis Road putrescible landfill.* Ref EP15-050(05).	DWER records (A1758942)

Appendix 2: Application documents

The following table lists the documents and information submitted by the Applicant during the assessment process.

Document/information description	Date received
Application Form	26 September 2018
Attachment 1A: Certificate of Title	
Attachment 2: Diagrams	
Attachment 3A: Supporting document *Davis Road Waste Management and Recycling Facility – Licence Amendment*	
Attachment 3B: Map of native vegetation clearing area	
Additional information – Letter *Application for Licence Amendment – Request for Further Information*, Bruce Bowman, Bowman & Associates Pty Ltd, 23 January 2019.	24 January 2019
Attachment A: *Seismic Design Parameters – Davis Road Landfill, Technical Memorandum*, CMW Geosciences, 14 December 2018	
Attachment B: Drawing schedule – construction plans, Bowman and Associates, 18 January 2019.	
Attachment C: *Environmental Noise Report, Waste and Recycling Facility, Davis Road Construction and Operation of Cell 3*, Gabriels Hearne Farrell, 14 January 2019.	
Attachment D: Monitoring well logs for MW1, MW2 and MW3	
Attachment E: *Annual Licensing Report 2017, Davis Road Putrescible Landfill*, Emerge, January 2018	
Additional information – Cell 3 Leachate Model (Excel spreadsheet)	
Attachment: AMRS Fauna Management report	15 February 2019
Attachment: Vegetation Survey	15 February 2019
DWER Site Inspection report	9 April 2019
Additional information – Geotechnical modelling files	17 April 2019

Additional information – Digital survey information (dxf files)	29 April 2019
Attachment: Fauna habitat assessment of Proposed Clearing area	10 July 2019
Attachment: Davis Rd Clearing Area Footprint - Map	10 July 2019
Additional information – Letter *Application for an Amendment to Licence L6989/1997/13 under the Environmental Protection Act 1986 – Request for Further Information*, Ruth Levitt, Shire of Augusta Margaret River, 11 July 2019.	15 July 2019
Attachment: Drawing schedule – construction plans, Bowman and Associates, 26 June 2019	
Attachment: *Construction Specification – Cell 3 and Leachate Pond – Davis Road Waste Management and Recycling Facility*, Bowman & Associates Pty Ltd, 28 June 2019.	
Attachment: *Construction Quality Assurance Plan – Cell 3 and Leachate Pond – Davis Road Waste Management and Recycling Facility*, Bowman & Associates Pty Ltd, 28 June 2019.	
Attachment: Revised Bill of Quantities - Landfill Cell 3 and Leachate Pond – Earthworks and Liner Construction (Excel spreadsheet)	
Attachment: Site Instruction – Davis Road Waste Management and Recycling Facility – Tie in of Cell 3 Waste to Existing Waste	
Attachment: *Response to DWER Queries – Slope Stability Assessment*, Louise Thomas, GHD, 11 July 2019.	
Additional information – Email *Licence amendment*, Ruth Levitt, 26 July 2019.	26 July 2019

Appendix 3: Landfill Stability

The final landfill stability analysis for Cell 3 provided within the Application was carried out using the stability modelling package Slope/W.

The material properties used within the stability analysis are shown in Figure 6. The landfill was assumed to have a moisture content of approximately 30-40%. The material properties used in the analysis for the undrained landfill were based on a literature review of *Engineering properties of municipal solid waste* by N. Dixon and R. Jones (2004), and the properties for the foundation and embankment material were derived from geotechnical data held by the Licence Holder.

Material	Unit Weight (kN/m³)	Cohesion, c (kPa)	Angle of Friction, φ (°)
Foundation (first layer)	20	10	30
Foundation (clay layer)	20	10	30
Foundation (weathered granite)	22	0	36
Embankment (clay)	20	10	30
Existing Landfill	11	5	30
New Landfill (drained)	11	5	30
New landfill (undrained)	Undrained shear strength, $C_u = 20 + 0.5\ \sigma_v'$		
Capping	20	10	30

Figure 6: Material properties (excerpt from Application)

All factors of safety were assessed against criteria outlined in *ANCOLD Guidelines on trailings dams* (2012) as shown in Figure 7.

Loading condition	(FoS)	Shear strength
Long term drained (potential loss of containment)	1.5	Effective strength
Short term undrained (potential loss of containment)	1.5	Consolidated undrained strength
Short term undrained (no potential loss of containment)	1.3	Consolidated undrained strength
Post-seismic (potential loss of containment)	1.1	Post seismic shear strength

Figure 7: Recommended factors of safety (excerpt from Application)

Stability analysis was undertaken for the existing landfill (Cell 2) based on survey data available and design drawings. Analysis was undertaken for Cell 3 based on the drawings and earthworks model prepared for the Application.

Modelling was undertaken for the critical sections of the landfill shown as Sections A and B in Figure 8, Figure 9 and Figure 10. These sections have the highest embankments and were therefore considered to have the highest risk of instability.

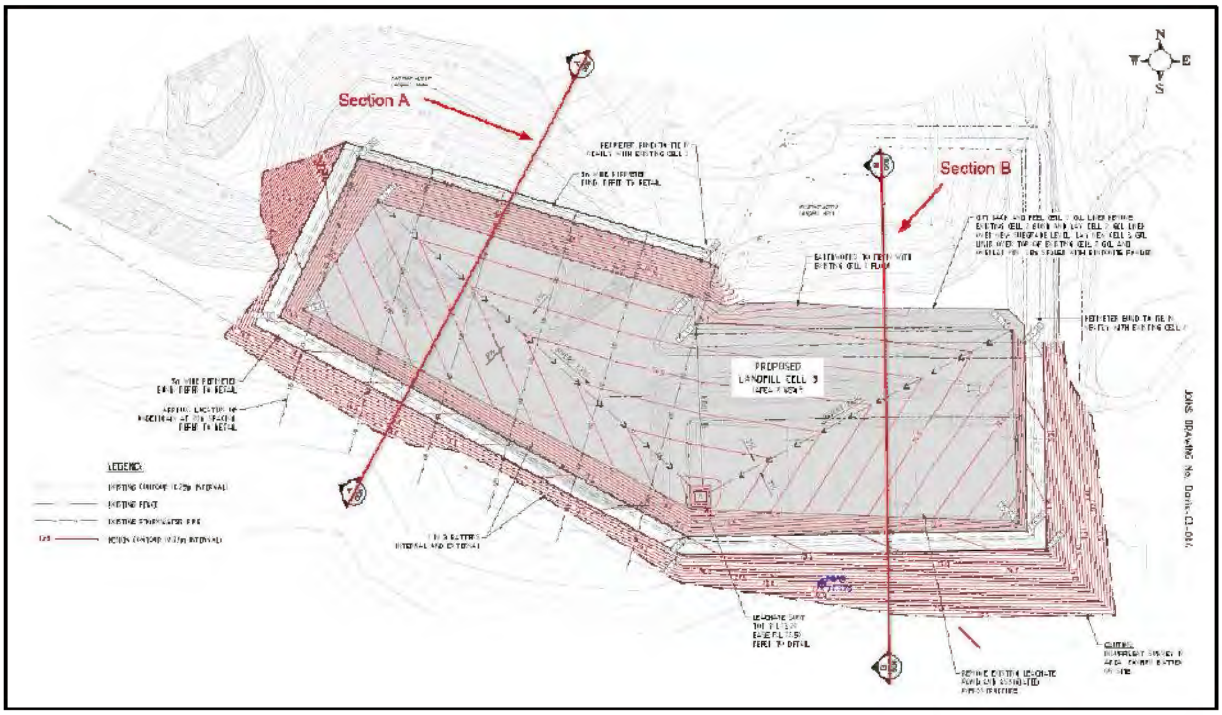


Figure 8: Critical sections within the landfill (excerpt from Application)

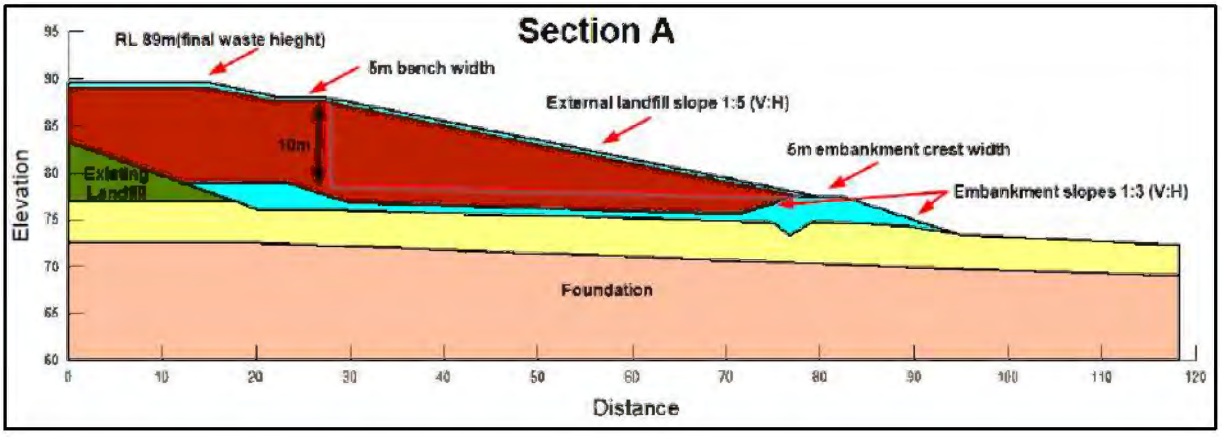


Figure 9: Section A (excerpt from Application)

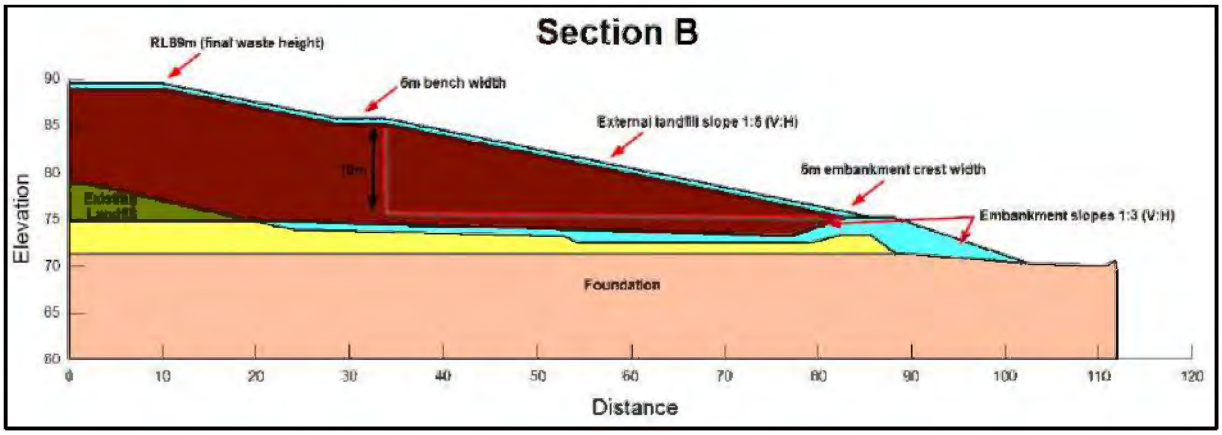


Figure 10: Section B (excerpt from Application)

The modelling results for the existing landfill slope (Cell 2) indicate a factor of safety (FoS) of 2.7 and 4.3 for Section A and Section B respectively which are both above the recommended minimum FoS.

The modelling results for an interim construction/filling stage in which the landfill is half of the final height indicate a FoS of 3 and 3.1 for Sections A and B respectively, which are both above the recommended minimum factors of safety.

Three load cases for static condition were analysed (long term, short term – after construction, and short term – during construction). Each load case was also analysed for three different phreatic surface scenarios (no phreatic line, elevated phreatic line and high phreatic line). The modelling results for these scenarios indicate that the recommended minimum FoS will be satisfied as shown in Figure 11 and Figure 12.

One seismic load case was analysed for pseudo static conditions. The modelling results for this scenario indicate that the recommended minimum FoS will be satisfied as shown in Figure 13.

Load case	No phreatic line	Elevated phreatic line	High phreatic line	Recommended minimum FOS (ANCOLD, 2012)
Long term	3.7	2.7	1.7	1.5
Short term – after construction	3.7	2.1	1.5	1.3
Short term – during operation	4.2	3.0	1.6	1.3

Figure 11: Section A load case scenarios and stability results (excerpt from Application)

Load case	No phreatic line	Elevated phreatic line	High phreatic line	Recommended minimum FOS (ANCOLD, 2012)
Long term	3.7	3.4	1.8	1.5
Short term – after construction	3.7	2.8	1.3	1.3
Short term – during operation	3.9	3.1	1.5	1.3

Figure 12: Section B load case scenarios and stability results (excerpt from Application)

	Kh = 0.06g	Recommended minimum FOS[1] (ANCOLD, 2012)
Section A	1.2	1.1
Section B	1.1	1.1

Figure 13: Seismic stability results (excerpt from Application)

Appendix 4: Noise emissions assessment

An acoustic assessment based on modelled noise emissions from the construction and operation of Cell 3 and the leachate pond was provided within the Application as an Environmental Noise Report.

The assessment identified three existing residential receptors, shown as R1, R2 and R4 in Figure 14. The residential receptor shown as R3 was not discussed specifically in the assessment in regards to the assigned levels for that residence, however R3 is identified within the noise modelling contour plans provided.

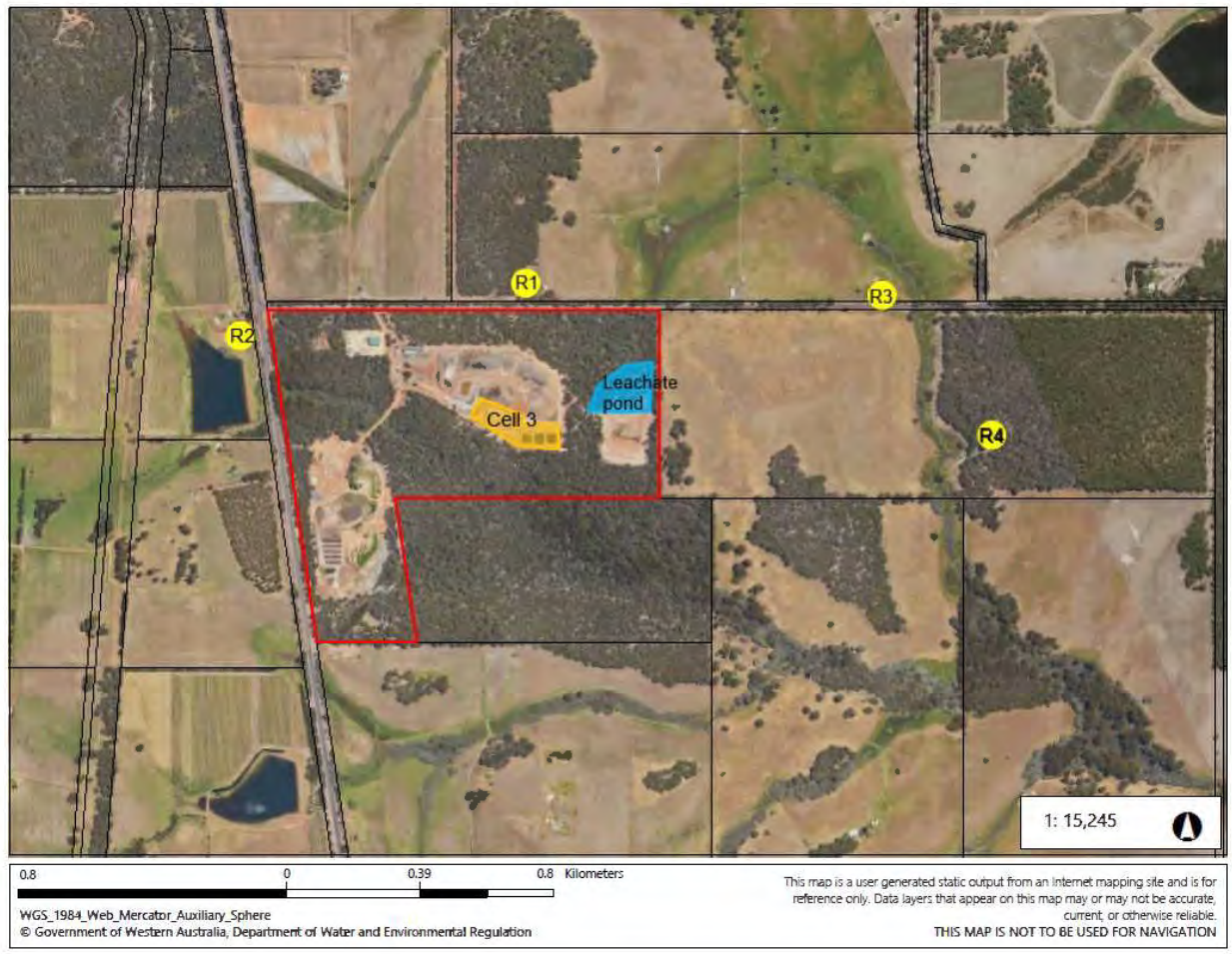


Figure 14: Location of surrounding residences (noise sensitive premises)

Regulations 7 and 8 within the EP Noise Regulations set out assigned levels (at the premises receiving the noise) which the Premises must not cause or significantly contribute to. The assigned levels which apply to the receptors identified in Figure 14, during the Premises operating hours are shown in Table 12. However, Regulation 13 provides for an exemption from the assigned levels for noise from construction work.

Table 12: Assigned noise levels residential receptors

Type of premises receiving noise	Time of day	Assigned level (dB)		
		$L_{A\ 10}$	$L_{A\ 1}$	$L_{A\ max}$
Noise sensitive premises: highly sensitive area	0700 to 1900 hours Monday to Saturday	45 + influencing factor	55 + influencing factor	65 + influencing factor

Influencing factors, which attempt to estimate background noise levels, have been applied due to the Premises being an industrial land use. The adjusted assigned levels as stated in the acoustic assessment provided to DWER are shown in Table 13.

Table 13: Assigned noise levels including adjustment for the influencing factor

Receptor location	Assigned level	Assigned level (including adjustment for the IF) (dB)		
		$L_{A\ 10}$	$L_{A\ 1}$	$L_{A\ max}$
R1	51	49	59	69
R2	47	47	57	67
R4	47	45	55	65

Construction noise modelling

Noise modelling was undertaken for the construction and operation of Cell 3 and the leachate pond. The calculated noise levels at the residences (within 15 metres of the house) were adjusted by +5dB for the tonality of the expected noise emissions.

The modelling indicates that noise levels during construction will generally meet the assigned levels, with a potential exceedance of the adjusted assigned levels by 2dB at R1. DWER notes that the noise from the construction activities are exempt from meeting the assigned levels.

Operation noise modelling

The Applicant advised that there will be no new landfill equipment used in Cell 3 that is not already used at the Premises. The calculated noise levels at the residences are provided within Table 14.

Table 14: Calculated noise levels at residential receptors during operation

Receptor location	Calculated noise level (L_{A10} dB(A))	Adjusted noise level (tonality adjustment +5dB)	Assigned level (L_{A10} dB(A))
R1	41	46	49
R2	36	41	47
R4	36	41	45

The acoustic assessment concludes that the noise emissions associated with the operation of Cell 3 have been calculated to comply with the assigned noise levels, given the proposed hours of operation. However, as the calculated and adjusted noise level was not provided for receptor R3, DWER has inferred from the simulation output shown in Figure 15 that the noise

emissions during operation are expected to comply with the assigned levels at R3 (indicated by the labelling of 38 dB(A) within the figure).

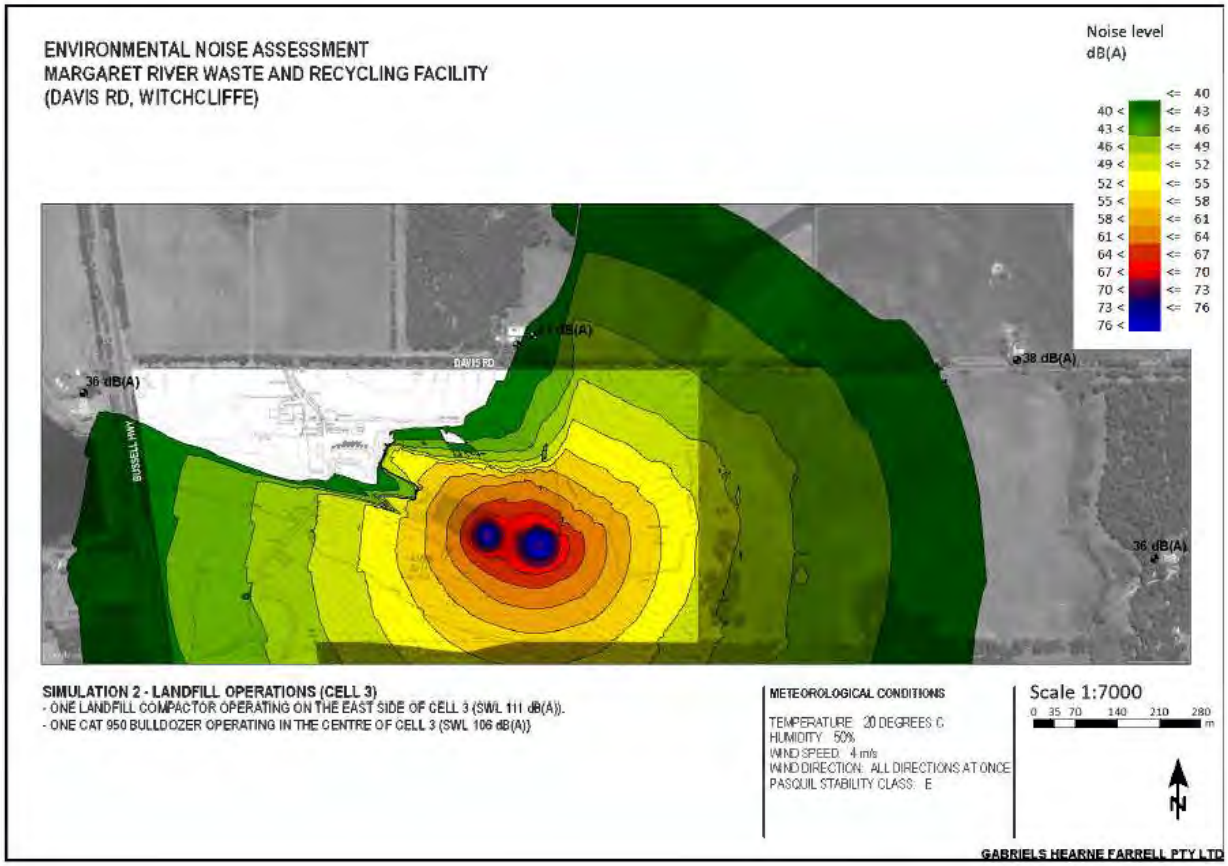


Figure 15: Landfill operation noise simulation

Attachment 1: Clearing Permit Assessment Report

Government of Western Australia
Department of Water and Environmental Regulation

Assessment Report

1. Application details

1.1. Permit application details

Permit application No.: 8228/1
Permit type: Works Approval / Licence Assessment

1.2. Applicant details

Applicant's name: Shire of Augusta-Margaret River

1.3. Property details

Property: Lot 5011 on Deposited Plan 192309, Forest Grove
Local Government Authority: Augusta-Margaret River, Shire of
Localities: Forest Grove

1.4. Application

Clearing Area (ha)	No. Trees	Method of Clearing	For the purpose of:
1.64	-	Mechanical Removal	Waste disposal/management

1.5. Site Information

Clearing Description

The application is to clear 1.64 hectares of native vegetation within Lot 5011 on Deposited Plan 192309, Forest Grove, for the purpose of extending the refuse site. The Shire of Augusta-Margaret River (the Shire) will be constructing a new landfill cell, leachate pond and associated access track.

Vegetation Description

The application area is mapped as the Wilyabrup (W1) vegetation complex. This complex is described as a tall open forest of *Eucalyptus diversicolor-Corymbia calophylla-Allocasuarina decussata-Agonis flexuosa* on deeply incised valleys in the hyperhumid zone (Heddle et al., 1980).

The application area contains an open forest of *Corymbia calophylla* (Marri) and *Eucalyptus marginata* (Jarrah) over an open to closed shrubland on sandy gravel (Nicole Siemon and Associates PL, 2016; Department of Water and Environmental Regulation (DWER), 2019; Harewood, 2019). The majority of the Eucalyptus trees observed within the over-storey of the application area were regrowth or non-mature trees, with few large trees present (DWER, 2019). The middlestorey contained a mixture of *Acacia* species, *Bossiaea linophylla,* and *Macrozamia riedlei.* The understorey included *Hibbertia hypericoides, Johnsonia pubescens, Lepidosperma pubisquameum, Bossiaea eriocarpa, Hakea lissocarpha* and *Xanthorrhoea preissii* (Nicole Siemon and Associates PL, 2016; Harewood, 2019).

Vegetation Condition

The application area is considered to range from a good to degraded (Keighery, 1994) condition (DWER, 2019). Keighery (1994) vegetation condition ratings are defined as follows:

- Pristine: Pristine or nearly so, no obvious signs of disturbance.
- Excellent: Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
- Very Good: Vegetation structure altered; obvious signs of disturbance.
- Good: Vegetation structure significantly altered by very obvious signs of multiple disturbance; retains basic structure or ability to regenerate.
- Degraded: Basic vegetation structure severely impacted by disturbance; scope for regeneration but not to a state approaching Good condition without intensive management.
- Completely Degraded: The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

The south western portion of the application area is regrowth vegetation in a degraded (Keighery, 1994) condition. This area has been impacted by historic logging and edge effects from the adjacent land fill facility. Exotic weeds dominates the understorey (Nicole Siemon and Associates PL, 2016).

The north eastern portion of the application area ranges from a degraded to good (Keighery, 1994) condition. The majority of this area is in a degraded (Keighery, 1994) condition, given its location being adjacent to a cleared area for the landfill site. A small portion is considered to be in a good (Keighery, 1994) condition. This area contained a more diverse mid-storey and understorey and less weed invasion (DWER, 2019).

Soil type

One soil type has been mapped within the application area, the Wilyabrup land subsystem (Department of Primary Industries and Regional Development (DPIRD), 2019). This subsystem is described as slopes with gradients generally 5-15%, but ranging from 2-30%, and gravelly soils (i.e. Forest Grove and Keenan Soils).

Comment

The local area is defined as a 10 kilometre radius measured from the perimeter of the application area.

The vegetation condition and description was determined via a site inspection of the application area and surveys provided by the applicant (Nicole Siemon and Associates PL, 2016; DWER, 2019; Harewood, 2019).

Figure 1: Area applied to clear.

2. Avoidance and minimisation

During the black cockatoo habitat tree assessment of the eastern portion of the application area (Harewood, 2019), three trees with hollows possibly suitable for black cockatoos were identified. The Shire advised that one of the trees is well outside of the proposed clearing area and will not be impacted upon by the construction of the leachate pond (tree number 25). The second tree is located on the edge of the proposed clearing area which has allowed for a small buffer but is not critical to be removed for the construction (tree number 48). This tree will be fenced off and adequately protected from damage during the construction phase. The third tree is located within the batter area of the proposed leachate pond and is unlikely to be able to be preserved (tree number 24) (Shire of Augusta-Margaret River, 2019).

The Shire advises that the preservation of native habitat is a priority and is careful to ensure that as much native vegetation is maintained and protected at all times. The area proposed for clearing to accommodate the final stage of the landfill prior to closure has been kept to an absolute minimum in order that the maximum amount of old growth vegetation can be preserved (Shire of Augusta-Margaret River, 2019).

3. Assessment of application against clearing principles

(a) Native vegetation should not be cleared if it comprises a high level of biodiversity.

Proposed clearing is not likely to be at variance to this Principle

A total of 21 priority flora species have been recorded in the local area (10 kilometre radius). The closest record is a priority 1 flora species (*Synaphea* sp. Redgate Road (J. Scott 16)) that has been mapped approximately 964 metres north east from the application area on the same soil and vegetation type. A site inspection of the application area did not identify any species resembling *Synaphea* as occurring within the eastern portion of the application area (DWER, 2019). The south western portion and associated access track is considered to mainly comprise of regrowth vegetation in a degraded (Keighery, 1994) condition that has been impacted by historic logging and edge effects from the adjacent landfill facility. Exotic weeds dominate the understorey in these areas (DWER, 2019). Noting the above, the application area is not considered likely to contain priority flora.

As discussed under Principle (c), the application area is not likely to contain threatened flora. Advice from the former Department of Parks and Wildlife (Parks and Wildlife), for an adjacent application (CPS 7146/1) considered that the area is not likely to support any threatened flora or vegetation community (Parks and Wildlife, 2016).

As discussed under Principle (b), the proposed clearing may impact habitat suitable for the Carnaby's cockatoo (*Calyptorhynchus latirostris*), forest red-tailed black cockatoo (*Calyptorhynchus banksii* subsp. *naso*) and Baudin's cockatoo (*Calyptorynchus baudinii*) (Nicole Siemon and Associates PL, 2016; DWER, 2019; Harewood, 2019).

No threatened or priority ecological communities have been mapped within the application area. As discussed under Principle (d), the vegetation within the application area does not resemble the Threatened Ecological Community (TEC) mapped within the local area.

The disturbance caused by the proposed clearing will increase the risk of weeds and dieback being introduced into adjacent areas of remnant vegetation. Weed and dieback management practices will assist in mitigating this risk.

Given the above, it is considered that the application area is not likely to comprise a high level of biodiversity. The proposed clearing is not likely to be at variance to this principle

(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna.

Proposed clearing may be at variance to this Principle

As discussed within Section 1, the application area contains an open forest of *Corymbia calophylla* (Marri) and *Eucalyptus marginata* (Jarrah) over an open to closed shrubland on sandy gravel (Nicole Siemon and Associates PL, 2016; DWER, 2019; Harewood, 2019).

Seventeen fauna species, listed as Threatened under the *Biodiversity Conservation Act 2016* (BC Act) within the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and 10 other species of conservation importance have been recorded within the local area (DBCA, 2007-).

Three of these species are migratory birds recorded in nearby wetland environments. Therefore, habitat for these species is not considered to occur within the application area.

A further six species (one amphibian, one mammal, three fish and one crustacean) are associated with rivers and wetland habitats. These habitat types do not occur within the application area and therefore it is not likely for the proposed clearing to impact habitat for these species.

Based on the site inspection conducted within the application area (DWER, 2019), it is considered that the application area may contain breeding habitat for a number of conservation significant fauna species, including Carnaby's cockatoo (*Calyptorhynchus latirostris*), Baudin's cockatoo (*Calyptorhynchus baudinii*), forest red-tailed black cockatoo (*Calyptorhynchus banksii* subsp. *naso*) (collectively known as black cockatoos) and south-western brush-tailed phascogale (*Phascogale tapoatafa* subsp. *wambenger*).

Black Cockatoos breed in large hollow-bearing trees, generally within woodlands or forests or in isolated trees (Commonwealth of Australia, 2012). These species nest in hollows in live or dead trees of karri, marri, wandoo, tuart, salmon gum, jarrah, flooded gum, York gum, powder bark, bullich and blackbutt (Commonwealth of Australia, 2012). Breeding habitat is described as trees of species known to support breeding within the range of black cockatoos, which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most tree species, suitable DBH is 500 millimetres (Commonwealth of Australia, 2012).

A high proportion of younger trees occur throughout the majority of the application area. However, large mature growth trees were littered throughout the application area comprising of a few isolated *Eucalyptus marginata* and *Corymbia calophylla* (DWER, 2019). The targeted black cockatoo habitat assessment identified 31 potential black cockatoo breeding trees occuring within the eastern portion of the application area, with three containing hollows suitable to be used by black cockatoos (Harewood, 2019). As discussed within Section 2 of this report, the Shire will be avoiding two of the three trees.

Within the western portion of the application area, along the access road to the new cells, five potential black cockatoo breeding trees were identified. Of the five trees identified, one contained a hollow of suitable size and orientation to be utilised by black cockatoos (Litoria Ecoservices, 2019). Whilst other trees within the survey area contained hollows, they were either being occupied by Western Ringnecks or not of a suitable size and orientation to be utilised by black cockatoos (Litoria Ecoservices, 2019). The Shire have advised that the tree with a suitable hollow within this area is not able to be avoided.

To mitigate the potential impacts to black cockatoo breeding habitat, two artificial hollows will be installed adjacent to the application area.

Black cockatoos forage on the seeds, flowers and nectar of native proteaceous plant species (e.g. *Banksia*, *Hakea* and *Grevillea* species), eucalypts and *Callistemon* species. The species also forages on seeds of introduced species (e.g. *Pinus* and *Erodium* species, canola and almonds), insects and insect larvae (Commonwealth of Australia, 2012). Whilst foraging habitat is observed within the application area, noting the application area is part of a larger remnant that contains suitable foraging habitat, the proposed clearing is not likely to impact significant foraging habitat.

The south-western brush-tailed phascogale is observed within dry sclerophyll forests and open woodlands that contain hollow bearing trees but a sparse ground cover (DBCA, 2019). The targeted phascogale habitat assessment identified 21 trees containing actual or potential hollows of various sizes that may be suitable for phascogales to use for daytime refuge within the eastern portion of the application area. The targeted habitat assessment did not identify any evidence of phascogale activity within the development footprint (Nicole Siemon and Associates PL, 2016; Harewood, 2019). Noting no evidence of phascogale activity was observed, no significant impacts to phascogales is likely to occur.

Noting the habitat requirements of the remaining conservation significant fauna recorded within the local area, and that the local area contains approximately 60 per cent remnant native vegetation, largely within conservation estate, the proposed clearing is not likely to impact additional fauna species. No signs or observations of other conservation significant fauna species were present within the application area (Nicole Siemon and Associates PL, 2016; Harewood, 2019; Litoria Ecoservices, 2019).

Given the potential impacts to black cockatoo breeding habitat, the proposed clearing may be at variance to this principle.

(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, threatened flora.

Proposed clearing is not likely to be at variance to this Principle

One threatened flora species, *Caladenia excelsa*, has been recorded within the local area (10 kilometre radius). This species is a tuberous perennial herb that grows from 0.45-0.9 metres high that flowers from September to October. The species is known to occur with, grey or brown sandy soils, with the nearest record approximately 8.1 kilometres from the application area (WA Herbarium, 1998-). Noting the soil type observed during the site inspection, *Caladenia excelsa* is not likely to occur within the application area.

Given the above, the proposed clearing is not likely to be at variance to this principle.

(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

Proposed clearing is not likely to be at variance to this Principle

One TEC has been recorded within 10 kilometres of the application area. This TEC is referred to as aquatic root mat community number two of caves of the Leeuwin Naturaliste ridge, with the closest record mapped approximately 4.2 kilometres from the application area. The site inspection and flora survey did not identify this TEC within the application area (Nicole Siemon and Associates PL, 2016; DWER, 2019). Given the distance to the mapped TEC, it's not likely that the proposed clearing will impact on this community.

The proposed clearing is not likely to be at variance to this principle.

(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Proposed clearing is not likely to be at variance to this Principle

The national objectives and targets for biodiversity conservation in Australia has a target to prevent clearance of ecological communities with an extent below 30 per cent of that present pre-1750, below which species loss appears to accelerate exponentially at an ecosystem level (Commonwealth of Australia, 2001).

The application area is located within the Warren Interim Biogeographic Regionalisation of Australia (IBRA) bioregion. This IBRA bioregion has approximately 79 per cent of its pre-European vegetation extent remaining (Government of Western Australia, 2018) (Table 1).

The application area is mapped as vegetation complex 'W1' which retains approximately 54 per cent of its pre-European extent (Government of Western Australia, 2018)

Aerial imagery indicates that the local area (10 kilometre radius) retains approximately 60 per cent native vegetation cover.

Noting the application area does not contain significant habitat for flora or conservation significant communities and is not within an extensively cleared landscape, the application area is not considered a significant remnant. The proposed clearing is not likely to be at variance to this principle.

Table 1: Remnant vegetation extents

	Pre-European (ha)	Current Extent (ha)	Remaining (%)	Current extent in all DBCA managed lands (ha)	Extent remaining in all DBCA managed lands (proportion of Pre-European extent) (%)
IBRA Bioregion*					
Warren	833,985.6	659,438.6	79.1	557,850.1	66.9
Swan Coastal Plain vegetation complex*					
Wilyabrup (W1):	7,296.2	3,915.6	53.7	1,881.5	25.8

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

Proposed clearing is not at variance to this Principle

No watercourses are located within the application area. No riparian vegetation was observed within the application area (Nicole Siemon and Associates PL, 2016; DWER, 2019; Harewood, 2019). Noting the above, the proposed clearing is not at variance to this principle.

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Proposed clearing is not likely to be at variance to this Principle

The application area is mapped as the Wilyabrup land subsystem (DPIRD, 2019). This landsystem is characterised by gravelly soils on slopes. Based on the mapped land degradation risk outlined below (Table 2), the proposed clearing has a low likelihood of causing land degradation (DPIRD, 2019). Whilst the mapped salinity risk is 30-50%, given that the clearing occurs within a larger remnant and ranges in condition from good to degraded, the proposed clearing is not likely to contribute to the rise of groundwater causing land degradation due to increased salinity at the surface.

Table 2: Land degradation risk of Wilyabrup soil sub-system.

Risk categories	Wilyabrup soil sub-system
Wind erosion	<3% of map unit has a high to extreme wind erosion risk
Water erosion	10-30% of map unit has a high to extreme water erosion risk
Salinity	30-50% of map unit has a moderate to high salinity risk or is presently saline
Subsurface Acidification	<3% of map unit has a high subsurface acidification risk or is presently acid
Flood risk	<3% of the map unit has a moderate to high flood risk
Water logging	3-10% of map unit has a moderate to very high waterlogging risk
Phosphorus export risk	10-30% of map unit has a high to extreme phosphorus export risk

Given the above, the proposed clearing is not likely to be at variance to this principle.

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

Proposed clearing is not likely to be at variance to this Principle

A number of conservation areas have been recorded within the local area (10 kilometre radius), the closest being Forest Grove National Park located approximately 4.4 kilometres south of the application area.

No ecological linkages are expected to be disrupted as a result of the proposed clearing.

Given the distance between the application area and National Park, it is unlikely that the proposed clearing will impact on the conservation values of the National Park.

The proposed clearing is not likely to be at variance to this principle.

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

Proposed clearing is not likely to be at variance to this Principle

No watercourses are located within the application area. Groundwater salinity is mapped between 1000-3000 total dissolved solids (milligrams per litres). Given that the clearing occurs within a larger remnant and ranges in condition from good to degraded, along with the current land use for the property (waste facility), the proposed clearing is not likely to contribute to the rise of groundwater causing land degradation due to increased salinity at the surface.

Given the above, the proposed clearing is not likely to be at variance to this principle.

(j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

Proposed clearing is not likely to be at variance to this Principle

Given the absence of watercourses, the relatively flat profile of the local landscape and the predominance of well drained gravel soils, the proposed clearing is not likely to cause, or exacerbate, the incidence or intensity of flooding.

Therefore the clearing as proposed is not likely to be at variance to this principle.

Other relevant matters.

There are no Aboriginal Sites of Significance recorded in the application area.

4. Recommendation

Recommendation

An assessment of the environmental impacts of the proposed clearing has been undertaken in accordance with DWER's Regulatory Principles, taking into consideration the clearing principles contained in Schedule 5 of the EP Act. Noting the assessment against the clearing principles above, the proposed clearing is determined to may be at variance to principle (b), and is not likely to be at variance to the remaining principles. Section 62(1) of the EP Act provides for conditions to be placed on a works approval to prevent, control, abate or mitigate pollution or environmental harm. Recommended conditions are as follows:

1. Clearing authorised

The works approval holder shall not clear more than 1.64 hectares of native vegetation within the area cross-hatched yellow on attached Plan 8228/1.

2. Avoid, minimise and reduce the impacts and extent of clearing

In determining the amount of native vegetation to be cleared authorised under this Permit, the Permit Holder must have regard to the following principles, set out in order of preference:

(a) avoid the clearing of native vegetation;
(b) minimise the amount of native vegetation to be cleared; and
(c) reduce the impact of clearing on any environmental value.

3. Dieback and weed control

When undertaking any clearing or other activity authorised under this Permit, the Permit Holder must take the following steps to minimise the risk of the introduction and spread of *weeds* and *dieback*:

a. clean earth-moving machinery of soil and vegetation prior to entering and leaving the area to be cleared;
b. ensure that no known *dieback* or *weed*-affected soil, *mulch*, *fill* or other material is brought into the area to be cleared; and
c. restrict the movement of machines and other vehicles to the limits of the areas to be cleared.

4. **Fauna management – direction of clearing**

The Permit Holder shall conduct clearing in a slow progressive manner towards surrounding remnant vegetation to allow fauna to escape the clearing activity.

5. Fauna management – breeding habitat

Prior to undertaking any clearing or other activity authorised under this Permit, the Permit Holder must install two artificial black cockatoo nesting hollows within the area hatched red on attached CPS 8228/1. The artificial black cockatoo nest hollows of this Permit must:

a. be designed and placed in accordance with the guidelines provided in Schedule 1 to this Permit; and
b. be monitored and maintained in accordance with the guidelines provided in Schedule 2 to this Permit, for a period of at least 10 years.

6. Records must be kept

The Permit Holder must maintain the following records for activities done in pursuant to this Permit:

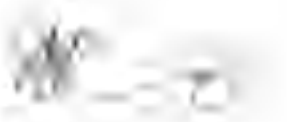
a. In relation to the clearing of native vegetation authorised under this Permit:
   i. the location where the clearing occurred, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings;
   ii. the date that the area was cleared;
   iii. the size of the area cleared (in hectares);
   iv. actions taken to avoid, minimise and reduce the impacts and extent of clearing in accordance with condition 2 of the Permit;
   v. actions taken to minimise the risk of the introduction and spread of *weeds* and *dieback* in accordance with condition 3 of the Permit; and
   vi. actions taken in accordance with condition 4 of this Permit.
b. In relation to fauna management pursuant to condition 5 of this Permit:
   (i) the date each artificial black cockatoo nest hollow was installed;
   (ii) the location of each artificial black cockatoo nest hollow installed, recorded using a GPS unit set to GDA94, expressing the geographical coordinates in Eastings and Northings or decimal degrees;
   (iii) a photo of each artificial black cockatoo nest hollow installed;
   (iv) the dates each artificial black cockatoo nest hollow installed was monitored;
   (v) a description of the monitoring methodology employed for each artificial black cockatoo nest hollow installed;
   (vi) a description of the monitoring observations for each artificial black cockatoo nest hollow installed;
   (vii) the date(s) each artificial black cockatoo nest hollow installed was maintained; and
   (viii) a description of the maintenance activities undertaken for each artificial black cockatoo nest hollow installed.

7. Reporting

a. The Permit Holder must provide to the *CEO* on or before 30 June of each year, a written report:
   (i) of records required under condition 6 of this Permit; and
   (ii) concerning activities done by the Permit Holder under this Permit between 1 January to 31 December of the preceding calendar year.

b. If no clearing authorised under this Permit was undertaken between 1 January to 31 December of the preceding calendar, a written report confirming that no clearing under this permit has been carried out, must be provided to the *CEO* on or before 30 June of each year.
c. Prior to 25 June 2029, the Permit Holder must provide to the *CEO* a written report of records required under condition 6 of this Permit where these records have not already been provided under condition 7(a) of this Permit.

Definitions
The following meanings are given to terms used in this Permit:
CEO means the Chief Executive Officer of the Department responsible for the administration of the clearing provisions under the *Environmental Protection Act 1986*;
dieback means the effect of Phytophthora species on native vegetation;
fill means material used to increase the ground level, or fill a hollow;
mulch means the use of organic matter, wood chips or rocks to slow the movement of water across the soil surface and to reduce evaporation;
weed*/s* means any plant –
a. that is a declared pest under section 22 of the *Biosecurity and Agriculture Management Act 2007*;
b. published in a Department of Biodiversity, Conservation and Attractions Regional Weed Rankings Summary, regardless of ranking; or not indigenous to the area concerned.



Mathew Gannaway
MANAGER
NATIVE VEGETATION REGULATION

Officer delegated under Section 20 of the Environmental Protection Act 1986

25 September 2019

5. References

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Commonwealth of Australia (2012). EPBC Act referral guidelines for three threatened black cockatoo species. Department of Sustainability, Environment, Water, Populations and Communities, Canberra.

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Keighery, B.J. (1994) Bushland Plant Survey: A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc). Nedlands, Western Australia.

Littoria Ecoservices (2019) Drone Assisted Tree Hollow Assessment – Davis Road Landfill Facility (CPS 8228/1). DWER Ref: A1826137.

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Shire of Augusta-Margaret River (2019) Supporting information for clearing assessment CPS 8228/1. DWER Ref: A1805527.

WA Herbarium (1998-) FloraBase - The Western Australian Flora. Department of Parks and Wildlife. http://florabase.dpaw.wa.gov.au/ (Accessed 01/09/2019).

GIS databases:

- CPS Areas applied to clear
- NatureMap (conservation significant fauna)
- DAFWA Subsystems V5
- Soils of WA
- Vegetation Complexes
- Managed Tenure
- Environmentally Sensitive Areas
- TPFL Data July 2019
- WAHerb Data July 2019
- Aboriginal Sites Register
- IBRA Vegetation WA
- WA TECPEC
- Land Degradation Hazards

SCHEDULE 1

How to design and place artificial hollows for Carnaby's cockatoo

Department of Parks and Wildlife

Fauna notes

Artificial hollows for Carnaby's cockatoo






birdlife AUSTRALIA

WATER CORPORATION

Western Australian museum

How to design and place artificial hollows for Carnaby's cockatoo

Artificial hollows can be used to help conserve the threatened Carnaby's cockatoo by enabling the cockatoos to breed in areas where natural hollows are limited.

A wide variety of artificial hollow designs have been used with mixed success. Evidence suggests that, while the hollow must meet some basic requirements, other factors such as proximity to existing breeding areas may be more important in determining the success of artificial hollows. Before using this information sheet to construct or install an artificial hollow, you should refer to the criteria listed in the separate information sheet; *When to use artificial hollows for Carnaby's cockatoo*.

This information sheet contains broad guidelines for the design and placement of artificial hollows for Carnaby's cockatoo.

Below are three examples of successful artificial hollows used by Carnaby's cockatoo for nesting. Artificial hollows made from a natural log with cut side entrance (left), white industrial pipe with top entrance (centre) and natural log with natural side entrance (right).



Photos by Christine Groom (left and right) and Rick Dawson (centre)

Walls

The walls of the artificial hollow need to be constructed from a material that is;

- Durable enough to withstand exposure to elements for an extended period of time (i.e. 20+ years).
- Able to simulate the thermal properties of a natural tree hollow.
- Not less than 380 mm in internal diameter.
- Preferably 1.2 m deep overall and 1m deep to top of substrate/nesting material.

Successful artificial hollows have been constructed from sections of salvaged natural hollow, black and white industrial pipe. When using non-natural materials care must be taken to ensure there are no toxic residues and that the materials are safe to ingest.

Base

The base of the artificial hollow must be;

- Able to support the adult and nestling(s).
- Durable enough to last the life of the nest.
- Free draining.
- At least 380 mm in diameter.
- Covered with 200 mm of sterile, dry, free draining material such as charcoal, hardwood woodchips or wood debris.

  Do not use:

  - Saw dust or fibre products that will retain moisture.

Example materials that could be used for artificial hollow bases include heavy duty stainless steel, galvanised or treated metal (e.g. Zincalume ®), thick hardwood timber slab or marine ply (not chipboard or MDF). The base material must be cut to size to fit internally with sharp or rough edges ground away or curled inwards and fixed securely to the walls.

Carnaby's cockatoo eggs in an artificial hollow.
Photo by Rick Dawson

Entrance

The entrance of the artificial hollow must;

- Have a diameter of at least 270 mm).
- Preferably be top entry which will minimise use by non-target species.

Top entry hollows are unattractive to nest competitors such as feral bees, galahs and corellas. Side entry hollows have been successful in areas where feral bees are not a problem and where galahs and corellas are deterred.

Ladder

For artificial hollows made of non-natural materials, or of processed boards, it is necessary to provide a ladder to enable the birds to climb in and out of the hollow easily.

The ladder must be;

- Securely mounted to the inside of the hollow.
- Made from an open heavy wire mesh such as WeldMesh™ with mesh size of 30 - 50 mm, or heavy chain.

Do not use:

- A material that the birds can chew.
- Galvanized because the birds may grip or chew the ladder and ingest harmful compounds.

If using mesh for the ladder, the width will depend on the curvature of the nest walls. A minimum width of about 60 - 100 mm is recommended.

Sacrificial chewing posts

For artificial hollows made of non-natural materials, or of processed boards, it is necessary to provide sacrificial chewing posts. The birds chew material to prepare a dry base on which to lay their egg(s).

The sacrificial chewing posts must:

- Be made of untreated hardwood such as jarrah, marri or wandoo
- Be thick enough to satisfy the birds' needs between maintenance visits.
- Extend beyond the top of the hollow as an aid to see whether the nest is being used.
- Be placed on the inside of the hollow.
- Be attached in such a way that they are easy to replace e.g. hook over the top of hollow or can slide in/out of a pair of U bolts fitted to the side of the hollow.

It is recommended that at least two posts are provided. Posts 70 x 50 mm have been used, but require replacing at least every second breeding season when the nest is active. Birds do vary in their chewing habits and therefore the frequency at which the chewing posts require replacement will also vary.

Bottom of an artificial hollow showing ladder that is fixed to the wall and a chewed sacrificial post which is 200 mm from the floor.

Photo by Rick Dawson

Mountings

The artificial hollows must be mounted such that:

- The fixings used will last the duration of the nest e.g. galvanized bracket or chain fixed with galvanized coach screws.
- It is secured by more than one anchor for security and stability.
- It is positioned vertically or near vertically.

Placement

Sites should be chosen within current breeding areas and where they can be monitored, but preferably not conspicuous to the general public. It is important that artificial hollows are placed where they will be accessible for future monitoring and maintenance. For more detail refer to the separate information sheet; *When to use artificial hollows for Carnaby's cockatoo*.

The height at which artificial hollows should be placed is variable. The average height of natural hollows in dominant tree species in the area is a good guide. Natural hollows used by Carnaby's cockatoos have been recorded as low as 2 m above the ground. If located on private property the hollows can be placed lower to the ground so they are accessible by ladder or a rope and pulley system can be used. Where public access is possible artificial hollows should be placed at least 7 m high (i.e. higher than most ladders) and on the side of the tree away from public view to reduce the chance of interference or poaching.

Carnaby's cockatoo show no preference for aspect of natural hollows, however, it may still be beneficial to place artificial hollows facing away from prevailing weather and where they receive the most shade and protection.

Artificial hollows to be placed in trees require:

- Accessibility of the tree for a vehicle, elevated work platform or cherry picker.
- A section of trunk 2-3 m long suitable for attaching the hollow

If necessary, artificial hollows may be placed on poles, but this may result in excessive exposure to sun during very hot weather. When erected on poles there should be"

- A hinge at the bottom of the pole that can be secured when the pole is in the upright position.
- Access for a vehicle to assist raising the pole.

Safety

Care needs to be taken when placing artificial hollows to ensure safety is considered at all times. Artificial hollows are heavy and require lifting and manoeuvring into position up to 7 m above the ground.

Maintenance and monitoring

Once artificial hollows have been placed they require monitoring and maintenance to ensure they continue to be useful for nesting by Carnaby's cockatoo. It is important to monitor artificial hollows to determine use by Carnaby's cockatoo, other native species as well as pest species. By undertaking monitoring the success of the design and placement of artificial hollows can be determined and areas for improvement identified for future placement of artificial hollows.

Monitoring can also assess whether any maintenance is required. Without regular maintenance artificial hollows are unlikely to achieve their objective (that is, they will fail to provide nesting opportunities for threatened cockatoos). Therefore it is important to continue a regime of regular maintenance while the artificial hollow is required. It may be several (to many) decades until a natural replacement hollow is available.

For further advice on monitoring and maintenance of artificial hollows please refer to the separate information sheet; *How to monitor and maintain artificial hollows for Carnaby's cockatoo*.

Carnaby's cockatoo female prospecting an artificial hollow.
Photo by Rick Dawson

Example fixing for artificial hollow
Photo by Christine Groom

Acknowledgements

This information sheet is a joint initiative of Birdlife Australia, the Western Australian Museum and the Department of Parks and Wildlife. Many individuals have contributed to its preparation. Special acknowledgement is made for the contributions of Ron Johnstone from the WA Museum, Alan Elliott from the Serpentine-Jarrahdale Land care Centre and Denis Saunders. This updated version was compiled by Rick Dawson Department of Parks and Wildlife).

Other information sheets in the series: Artificial hollows for Carnaby's cockatoo

- *How to design and place artificial hollows for Carnaby's cockatoo*
- *How to monitor and maintain artificial hollows for Carnaby's cockatoo*

Information sheets available on the *Saving Carnaby's cockatoo* webpage:
http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals/208-saving-carnaby-s-cockatoo

SCHEDULE 2

How to monitor and maintain artificial hollows for Carnaby's cockatoo






birdlife AUSTRALIA · WATER CORPORATION · WESTERN AUSTRALIAN museum

How to monitor and maintain artificial hollows for Carnaby's cockatoo

It is important to monitor and maintain artificial hollows after they have been erected. Monitoring ensures that the effectiveness of the artificial hollow can be determined. It also means that problems with pest species or any maintenance requirements can be identified and resolved.

Without regular maintenance, artificial hollows are likely to fail to achieve their objective (that is, they will fail to provide nesting opportunities for threatened cockatoos). Therefore it is important to continue a regime of regular maintenance while the artificial hollow is required. It may be several (to many) decades until a natural replacement hollow is available.

Monitoring should be undertaken in order to detect:

- Use by Carnaby's cockatoo
- Maintenance requirements
- Use by other native species
- Use by pest species (e.g. feral bees, galahs, corellas etc.)

Carnaby's cockatoo female prospecting an artificial hollow.
Photo by Rick Dawson

How do I monitor artificial hollows?

Before undertaking monitoring of artificial hollows for Carnaby's cockatoo it is recommended that you seek advice from BirdLife Australia, the WA Museum or the Department of Parks and Wildlife. It is also important to contact Parks and Wildlife, Wildlife Licensing Section, to determine if a scientific licence is required (wildlifelicensing@dpaw.wa.gov.au).

Monitoring artificial hollows requires keen observation and naturalist skills. It is often not possible to observe evidence of breeding directly (i.e. nestlings or eggs) and inferences must be made based on observation. There are many techniques available to monitor artificial hollows. A combination of several is likely to achieve the best results.

Looking for signs of use

Cobwebs covering the entrance to the hollow will indicate that the hollow has not been used recently. This would also apply to other light debris that may have fallen to cover the opening partially. Signs of recent use or interest in the hollow include evidence of chewing.

Observing parent behaviour around the hollow

The behaviour of parent birds around a hollow will indicate an approximate age of young in the nest.

Parent behaviour	**Approximate age/stage of young**
Prospecting for hollow	Unborn
Male only seen out of hollow	Egg or very young nestling (< 3 - 4 weeks)
Both parents seen entering/exiting the hollow	Nestling(s) have hatched (> 3 - 4 weeks)

Observing feeding flocks

Flocks of all male birds indicate that the females are incubating eggs. When flocks are mixed it suggests the birds have either not laid yet or that the nestlings have hatched and no longer require brooding (approximately 3 - 4 weeks old).

Tapping

When females are sitting on eggs they will usually respond to tapping at the base of their tree (or pole) by appearing at the entrance or flying from the hollow opening. This is not a guarantee of breeding activity, but an indication that it is possibly occurring in the hollow.

Observing insect activity around nest

The faecal matter produced by nestlings in a nest attracts insects, especially flies and ants. The type and number of these insects will help indicate how old any nestlings present may be. Factors such as temperature and humidity will also affect insect activity and so observations of insect activity should only be used as supporting evidence for other indications of age/use. Blowflies around a nest usually indicate that a death has occurred.

Listening for nestlings

With experience it is possible to determine if one or two nestlings are present and a broad estimate of age based on the type and loudness of noises they make.

Looking inside the nest

This can be achieved either with the aid of a telescopic pole and camera or mirror, or with the use of a ladder or other climbing equipment. This method can obtain the most detailed monitoring information for artificial hollows. However it is also the most time consuming and difficult to organise. Special equipment is likely to be needed depending on the height and positioning of artificial hollows. There are also safety issues associated with ladder or rope climbing options to reach nests to undertake observations.

How often should I monitor artificial hollows?

The minimum frequency of monitoring and the techniques used will be determined by the aims of the monitoring and the resources available. It is important to limit disturbance to breeding birds and this should be considered when determining the techniques used and frequency.

How do I maintain artificial hollows?

Artificial hollows require maintenance to ensure they continue to have the greatest chance of them being used by Carnaby's cockatoos. Periodic maintenance checks should be undertaken at least every two years, preferably annually. These checks should be undertaken prior to the breeding season which is between July and January with breeding occurring later in this period in southern areas. It is important to maintain a regime of regular maintenance as long as the artificial hollow is required. It may take several (to many) decades until a natural replacement hollow is available.

Maintenance checks should assess the following as a minimum:

- Condition of chewing posts (if present)
- Condition of attachment points
- Condition of hollow bases
- Stability of tree or pole used to mount the artificial hollow

Artificial hollow base needing repair.
Photo by Christine Groom

Repairing hollows

Any problems identified during maintenance checks should be addressed, and any repairs required done, as soon as possible. If breeding is currently occurring, maintenance may need to be delayed if it is likely to disturb the parents or nestling. Likely maintenance needs include replacement of chewing posts (frequently) or nest bases (occasionally) and repairing of any cracks (infrequently). Maintenance concerns regarding the security of attachment points or the stability of the tree or pole should be addressed as a priority for safety reasons.

For artificial hollows known to be used, spare chewing posts should be taken into the field when undertaking maintenance checks.

Monitoring of artificial hollows:

Monitoring aim	Frequency of visits	Monitoring techniques
To determine possible use by Carnaby's cockatoo	At least once during peak breeding season (i.e. between September and December)	• Observing behaviour of adults around hollow • Tapping to see if female will flush from hollow (best undertaken between 10am and 3pm when females most likely to be sitting) • Listening for nestlings • Looking for evidence of chewing • Looking inside nest
To confirm use by Carnaby's cockatoo	At least two visits during peak breeding season (i.e. between September and December)	To observe at least two of the following: • Breeding behaviour of adults around hollow or evidence of chewing • Female flushed from hollow • Noises from nestlings in hollow Or to observe: • Nestlings or eggs in nest
To determine nesting success by Carnaby's cockatoo	The more visits, the better. Preferably fortnightly visits between July and December. As a minimum, at least 3 visits spread throughout breeding season.	• Looking inside nest to observe eggs or nestlings.
To determine use by any species	As often as possible.	• Inspection from ground as a minimum. • Looking inside nest for detailed observations.
To determine maintenance requirements	At least every two years and preferably annually if hollow fitted with sacrificial chewing posts, can be longer if without.	• A basic maintenance check can be undertaken from the ground. A ladder or elevated work platform will be required for a comprehensive check and to replace sacrificial chewing posts

Acknowledgements

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Further information **Last updated 28/04/2015**

Contact fauna@dpaw.wa.gov.au or your local office of the Department of Parks and Wildlife

See the department's website for the latest information: www.dpaw.wa.gov.au