Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Review of Existing Premises

Division 3, Part V *Environmental Protection Act 1986*

Licence Number: L7210/1997/10

Applicant: MushroomExchange Pty Ltd

ACN: 004 527 440

File Number: 2010/010225

Premises: MushroomExchange Pty Ltd

230 Gull Road

NAMBEELUP WA 6207

Part Lot 89 on Plan 741
Certificate of Title Volume 1112 Folio 243

Bound by the coordinates:

	Easting	Northing
1	390978.80	6404489.63
2	390953.40	6404377.67
3	390980.97	6404369.87
4	390979.68	6404362.15
5	390895.00	6404377.44
6	390872.11	6404365.44
7	390905.79	6404300.95
8	391082.22	6404252.00
9	391122.85	6404464.50

Date of report: Thursday, 16 August 2018

Status of Report Final

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Definitions of terms and acronyms

Term	Definition
AACR	Annual Audit Compliance Report
Action Criteria/Action Criterion	Trigger value/s defined in the Licence that require the Licence Holder to take action
AER	Annual Environment Report
AS 4454	Australian Standard AS 4454:2012: *Composts, soil conditioners and mulches*
AS/NZS 5667.1	Australian Standard AS/NZS 5667.1 Water Quality – Sampling – Guidance of the Design of sampling programs, sampling techniques and the preservation and handling of samples
AS/NZS 5667.11	Australian Standard AS/NZS 5667.11 Water Quality – Sampling – Guidance on sampling of waste waters
BoM	Bureau of Meteorology, Australian Government
ASTM	Refers to international standards (originally American Society for Testing and Materials). In this document refers to standards for electrical liner testing ASTM D6747, D7007, D7003, D7002 and D7703)
Category/Categories (Cat.)	Categories of prescribed premises as set out in Schedule 1 of the EP Regulations
CEO	Chief Executive Officer of the Department of Water and Environmental Regulation
CM Farms	Derby Industries Pty Ltd trading as CM Farms
CS Act	*Contaminated Sites Act 2003* (WA)
C-Wise	WA Composts Pty Ltd trading as C-Wise
DER	Department of Environment Regulation
Decision Report	This document
Delegated Officer	An officer delegated under section 20 of the EP Act.
DoW	Department of Water, Western Australia
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.
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
EPP	*Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992*
Hardstand	The hardstand surface described in Table 3 of this Decision Report and indicated by the yellow line in Figure 1.
HDPE	High Density Polyethylene
Hydraulic Conductivity	Describes the ease with which a fluid (usually water) can move through the pore spaces or fractures. It depends upon the intrinsic permeability of the material and the density and viscosity of the fluid. Hydraulic conductivity is expressed as metres per second (m/s).
ICMS	DWER's Incident and Complaints Management System
Licence Holder	MushroomExchange Pty Ltd
mV	In the measurement of Oxidation Reduction Potential, mV means millivolts.
Nambeelup Farm	Nambeelup Farm is a term used to refer to the three licensed premises, CM Farms (Licence L6932/1988/11), WA Composts Pty Ltd trading as C-Wise (Licence L8410/2009/2) and Mushroom Exchange Pty Ltd (Licence L7210/1997/10).
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	Is defined in the EP Act to mean a person who is in occupation or control of a premises, or part of a premises, whether or not that person is the owner of the premises or part of the premises.
Premises	MushroomExchange Pty Ltd as specified on page i of this Decision Report
Prescribed Premises	Premises prescribed under Schedule 1 to the EP Regulations
Previous Licence	The licence version in force prior to this review
Review	A risk based licence review conducted in line with DWER published Guidance Statements
Revised Licence	Licence issued following this licence review

1. Purpose and scope of assessment

On 3 October 2016, the Licence Holder was notified that the CEO of the former Department of Environment Regulation (DER) determined that a risk-based Review of Licence L7210/1997/10 for the composting facility at the Premises was required. Following the Department's investigations of odour complaints in the Mandurah area, the Department identified that the premises situated at Nambeelup Farm were likely to be the cause of odour experienced in the Mandurah area.

This Review is documented through this Decision Report.

This Review has been undertaken in accordance with DWER's published regulatory risk-based framework, including *Guidance Statement: Decision Making* and *Guidance Statement: Risk Assessment.*

2. Background

Table 1 details the Prescribed Premises Categories that are held by the Licence Holder for the Premises. The Premises are a composting facility operated under Licence L7210/1997/10 by the Licence Holder.

Table 1: Prescribed Premises Categories

Classification of Premises	Description	Approved premises production or design capacity or throughput
Category 67A	Compost manufacturing and soil blending: premises on which organic material (excluding silage) or waste is stored pending processing, mixing, drying or composting to produce commercial quantities of compost or blended soils.	37,000 tonnes per annual period

The Premises is one of three premises which make up Nambeelup Farm. Table 2 details the current operations within Nambeelup Farm.

Table 2: Nambeelup Farm premises

Operator	Prescribed Premises Category	Design Capacity
WA Composts Pty Ltd (C-Wise)	67A: Compost manufacturing and soil blending	90,000 tonnes per year
	61: Liquid waste facility	60,000 tonnes per year
Derby Industries Pty Ltd (CM Farms)	2: Intensive Piggery	22,000 animals
MushroomExchange Pty Ltd	67A: Compost manufacturing and soil blending	37,000 tonnes per annual period

DWER has also reviewed the licences held by C-Wise and CM Farms.

3. Overview of Premises

3.1 Infrastructure

The composting facility infrastructure, as it relates to Category 67A activities, is detailed in Table 3 and with reference to the Site Plan shown in Figure 1.

Table 3: Premises category 67A infrastructure

	Infrastructure
	Prescribed Activity Infrastructure Category 67A
1	Hardstand area (approximately 10,500m^2) with curbing on all boundaries and drain along northern boundary.
2	Storage area (bunkers) consisting of: • 4 x 250-300m^3 bunkers • 3 x 150m^3 bunkers
3	Straw bale storage area (bare ground)
4	Mobile spray irrigating equipment
5	3 x 1mm HDPE lined ponds for the collection of leachate • Pond 1 - approximately 450m^3 capacity • Pond 2 - approximately 450m^3 capacity • Pond 3 - approximately 1000m^3 capacity
6	1 x agitator
7	2 x front end loader
8	2 x Pannell turners
9	1 x pump
10	Groundwater monitoring bores – MB1S, MB2, MB3, MB4, MB5S

Figure 1: Premises Infrastructure (yellow line depicts the Hardstand boundary)

3.2 Operational aspects

The Licence Holder produces approximately 600 to 700 tonnes per week of compost (mushroom growing substrate) which is then transported to a related facility in Casuarina for further treatment and growing mushrooms. Photographs of the operations are included in Appendix 3.

The Premises operates during the following hours:

- 6am to 5pm Monday to Friday, with Wednesday operations starting at 3am.
- Occasional weekend work may occur to carry out time sensitive steps of the process if work is delayed due to public holidays.

3.2.1 Acceptance of materials

The primary feedstocks accepted at the Premises are wheat straw bales, poultry manure, and gypsum. Other feedstocks including legumes, urea/other nitrogen based fertilisers and straw substitutions are accepted intermittently where required.

The straw bales are stored in piles in the southern portion of the Premises.

The chicken manure is supplied by the neighbouring premises C-Wise. The chicken manure and gypsum are stored in three-sided bunkers on the Hardstand. Between 600m^3 to 1200m^3 of chicken manure is stored at any one time, and the Licence Holder aims to limit the height of feedstock in the bunkers to below the bunker wall to prevent lift-off of feedstock.

Urea or other nitrogen based fertilisers are sourced in bag form and stored undercover. Approximately 200 to 250kg may be used per week.

3.2.2 Process

The composting process involves the partial decomposition of straw and chicken manure combined with water and gypsum. The process cycle takes approximately 22 days to complete. Typically, three crops are processed at any one time at different stages of the process with each cycle beginning on a Wednesday. A cycle involves the following steps:

Pre-treatment

- Straw bales are placed down on Wednesday (Day 1).
- Straw bales are wet with recycled leachate from 9am to 4pm on Thursday and Friday (Days 2/3). This occurs with a number of mobile sprinklers on top of the bales which reach approximately half the bale stacks and are moved around during the day.
- On Saturday and Sunday (Days 4/5) no activities occur.
- On Monday (Day 6) additional bale wetting occurs from 6am.
- On Tuesday (Day 7) between 6am to 1:30pm the saturated straw bales are put through a bale line on which the bales are broken open by a bale breaker machine, poultry manure and additional recycled leachate is added to blend, and mixed material is stacked in a pile.
- Spraying of the bales and breaking of the bales always occurs on separate days to avoid carrying out two odour generating activities at the same time.

Composting process

- The pile of mixed feedstocks is left to sit on Wednesday (Day 8).
- On Thursday and Friday (Days 9 and 10) the pile is flipped with a front end loader and bore water is added as needed to achieve the necessary moisture content.
- On Saturday and Sunday (Days 11 and 12) no activities occur.
- On Monday (Day 13) the material is stacked into four or five windrows using a Pannell Turner and additional bore water may be added if necessary.
- The windrows are turned again on Wednesday (Day 15) where more poultry manure and bore water is added if necessary. Gypsum may also be added to manage the pH of the material.
- The windrows are turned two more times on Friday (Day 17) and Monday (Day 20) and more water may be added.

Monitoring of composting process

The windrows are monitored for temperature, moisture and nitrogen content. The target temperature and nitrogen content were provided by the Licence Holder and considered by DWER.

Samples of material are taken on a weekly basis from two difference stages; the bale break (straw and poultry manure) and compost ready for dispatch. These samples undergo laboratory analysis for pH, moisture, organic nitrogen, ammonium nitrogen, total nitrogen, ash, carbon and the carbon to nitrogen (C:N) ratio.

3.2.3 Storage of compost ready for dispatch

The compost that is ready for dispatch is collected on Wednesday (Day 22) via trucks and transported to the Licence Holder's Casuarina site. As the compost is removed directly from the windrow stage, no long term storage of compost occurs at the Premises. Any excess compost is fed back into the composting piles.

3.2.4 Composting Hardstand

All composting occurs on a Hardstand area. Material testing of a section of the Hardstand was undertaken by the Licence Holder in October 2014, and the test results indicated that the material achieved a hydraulic conductivity of 2.3 x 10^{-11} m/s.

The majority of leachate from the bale wetting area is directed to an engineered drainage channel of an unknown hydraulic conductivity, with the rest of the Hardstand draining along the edge of the Hardstand to a spillway and pump area.

3.2.5 Leachate ponds

Leachate and run-off from the Hardstand are directed to Pond 1 via a direct channel or captured near the spillway where the solids (straw) are filtered out back onto the Hardstand and water directed to Pond 1 using a pump. The pond system is designed to flow from Pond 1 into Pond 2, and from Pond 2 into Pond 3. Ponds 2 and 3 provide additional storage capacity during high rainfall events, but are frequently empty. No treatment of the leachate occurs in any of the ponds.

The leachate from Pond 1 is fed into the pre-treatment process of the compost via sprinklers. Any leachate within Ponds 2 and 3 is pumped into Pond 1 for re-use as required.

4. Legislative context

4.1 Contaminated sites

Lots 89 and 109 on Plan 741 were classified as *contaminated – restricted use* under the *Contaminated Sites Act 2003* on 19 March 2010. The classification was based on the identification of elevated levels of nutrients in groundwater beneath the site. At the time of classification, available monitoring data suggested that the contaminant plume was stable and was unlikely to migrate beyond the property boundary due to natural attenuation processes. Ongoing periodic groundwater monitoring was noted to be required in accordance with relevant licence conditions under the *Environmental Protection Act 1986*.

DWER undertook a review of the site's classification under the CS Act during early 2018, this review included the assessment of groundwater data resulting from routine licence monitoring, and the results of detailed site investigations undertaken during 2016 and 2017. Upon completion of the review, DWER concluded that the classification remains appropriate. However, several uncertainties and data gaps were identified that require further action to be taken to address the contamination status of the site. The classification remains *contaminated – restricted use*, however the 'nature and extent', 'reasons for classification' and 'restrictions on use' were updated on 1 June 2018 to reflect the additional technical information that has become available since the site was originally classified in 2010. Formal notices of the update to the site classification were issued to all relevant parties, including the licensees, on 11 June 2018.

4.2 Lease agreement

The Licence Holder has an agreement in place to sublease from CM Farms who lease the Premises from George Weston Foods Limited. The agreement expires on 5 November 2018,

with an option to extend to 5 November 2022.

4.3 Planning approvals

The Premises received planning approval on the 8 October 2009 from the Shire of Murray under the Shire of Murray Town Planning Scheme No. 4 for a rural industry (compost processing facility). The facility had already been operating for approximately 10 years prior to the issue of this planning approval. The planning approval does not permit direct public sales, requires a fire management plan to be prepared, firebreaks to be installed, and a works approval to be obtained from DWER prior to commencement of works. DWER has no records of a works approval application made at this time.

4.4 Groundwater Licence

The Licence Holder sources bore water from CM Farms under their Groundwater Licence No. GWL96250, issued by DWER under the *Rights in Water and Irrigation Act 1914*.

4.5 Department of Primary Industries and Regional Development

The Premises is located within the area to which the *Biosecurity and Agriculture Management (Stable Fly) Management Plan 2016* applies. This plan prohibits the storage and transport of commercially derived poultry manure which has not been treated by composting to AS 4454, or by means of a measure approved under the *Biosecurity and Agriculture Management Act 2007,* without the prior approval of the Department of Primary Industries and Regional Development (DPIRD).

The Licence Holder receives chicken manure via C-Wise, and C-Wise has advised that an application for 'Prior Approval of the Director General under the Biosecurity and Agriculture Management (Stable Fly) Management Plan' is currently being considered by DPIRD.

4.6 Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992

Section 60(1) of the EP Act states that '*The CEO shall in considering an amendment of a licence or an application for a works approval or a licence for the transfer thereof ensure that the works approval or licence or amendment or transfer thereof is consistent with any approved policy*'. The Premises is located with the boundary of the *Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992* (EPP) and therefore the Delegated Officer must consider the requirements of this policy.

The EPP sets environmental quality objectives for the Estuary to help rehabilitate and protect it from degradation. The EPP states the use and values of the Estuary as:

- For studying the natural environment;
- Habitat for a diverse range of fauna and flora;
- Commercial and amateur fishery;
- Recreation, tourism and landscape amenity; and
- A focus for residential development.

The basis for protection of the Estuary as stated in the EPP is:

- *Nutrient enrichment of the Estuary has been caused by the clearing of native vegetation in the policy area and by land uses that result in nutrients, especially phosphorus, leaching into waterways in the policy area and then flowing into the Estuary.*

- *Nutrient enrichment in the Estuary has stimulated the excessive growth of algae, causing the degradation of the Estuary and creating a serious public nuisance.*

The objectives of the EPP include a median load of phosphorus flowing into the estuary of less than 75 tonnes, with the median load of phosphorus from the Serpentine River being less than 21 tonnes.

The Policy states that its objectives are to be achieved and maintained through:

- Implementation of planning policy including Metropolitan Regional Scheme;
- Appropriate land management by landholders and management authorities in the Policy area;
- Advice from government services to land holders in the area;
- Local and State Government authorities ensuring that decisions and actions are compatible with the objectives and maintenance of Policy's objectives.

4.7 Part V of the EP Act

This section covers Works Approvals and Licences issued under Part V of the EP Act and compliance with the conditions of those instruments.

4.7.1 Guidance Statements

The overarching legislative framework of this assessment is the EP Act and EP Regulations.

DWER Guidance Statements which inform this assessment are:

- *Guidance Statement: Regulatory Principles (July 2015)*
- *Guidance Statement: Risk Assessments (February 2017)*
- *Guidance Statement: Decision Making (February 2017)*
- *Guidance Statement: Setting Conditions (October 2015)*
- *Guidance Statement: Land Use Planning (February 2017)*
- *Guidance Statement: Licence duration (August 2016)*

4.7.2 Works approvals and licence amendments

Table 4 provides a list of works approvals and licences granted for the Premises since 1997. Each works approval and licence amendment is further detailed in the table below.

Table 4: Instrument log

Instrument	Issued	Description
W1855/1997/1	03/01/1997	Issued to Chiquita Mushrooms Pty Ltd for the Premises.
L7210/1997/3	26/04/2000	Licence issued to Chiquita Mushrooms Pty Ltd for the Premises with operational control held by Custom Composts Pty Ltd.
L7210/1997/4	26/04/2001	Licence reissue.
L7210/1997/5	07/05/2002	Licence reissue and operational control held by Chiquita Mushrooms Pty Ltd.

Instrument	Issued	Description
L7210/1997/6	28/04/2003	Licence reissue.
L7210/1997/7	14/06/2004	Licence reissue. Application states throughput is 15,000 tonnes per year.
L7210/1997/8	28/04/2005	Licence reissue.
L7210/1997/9	28/04/2008	Licence reissue. Licence Holder name change to MushroomExchange Pty Ltd.
L7210/1997/10	28/04/2011	Licence reissue.

The Premises have never had a throughput limit on a licence. The applicant has stated that currently the Premises produce between 600 to 700 tonnes of compost per week, as measured via truck scales. A throughput of 31,000 to 36,400 tonnes per annual period has been derived from these figures. During a site inspection in December 2015 it was confirmed that at least two upgrades have occurred at the Premises to allow for this increase in production however no approvals were sought for these works.

4.7.3 Compliance inspections

The following compliance inspections were conducted by the then DER between 8 April 2013 and 8 March 2016.

Compliance inspection 8 April 2013

The Department conducted a compliance inspection on the 8 April 2013. It was found that the Licence Holder was non-compliant with the requirement to submit an Annual Audit Compliance Report by 1 August each year. The report was subsequently submitted and no further action was required. The report noted that there were ongoing odour issues at the Premises.

Table 5: Issues raised at 8 April 2013 inspection

Issue raised	How issue was addressed
Non-compliance with requirement to submit an Annual Audit Compliance Report by 1 August each year	Annual Audit Compliance Report was submitted.

Compliance inspection 22 July 2014

The Department conducted a licence compliance inspection on 22 July 2014. It was found that the Licence Holder was non-compliant with water monitoring requirements in the Previous Licence and that the hydraulic conductivity of the Hardstand had not been appropriately demonstrated to the Department.

Table 6: Issues raised at 22 July 2014 inspection

Issue raised	How issue was addressed
The Licence Holder was non-compliant with water monitoring requirements	The Licence Holder provided copies of hydraulic conductivity testing of Hardstand material and confirmed future monitoring would be undertaken as specified in the Previous Licence. No further action was required.
The permeability of the Hardstand had not been appropriately demonstrated to the Department	

Compliance inspection 8 March 2016

The Department conducted a licence compliance inspection on 8 March 2016. This inspection focused on the use of leachate to pre-wet the straw bales prior to making compost which was identified as being a major source of odour.

Table 7: Issues raised at 8 March 2016 inspection

Issue raised	How issue was addressed
Leachate ponds were identified as major source of odour, particularly due to suspected anaerobic conditions	The Licence Holder was required to submit monitoring data for Pond 1 and outline further actions to be taken to ensure an aerobic environment in the ponds is maintained. The Licence Holder provided the requested information.

Compliance inspection 9 December 2016

The Department conducted a licence compliance inspection on 9 December 2016. The inspection identified that the screen filter pump for the leachate pond had been replaced. DWER officers identified that the aeration of the ponds at the time of inspection was inadequate, and the colour of the water indicated a high nutrient level. Run-off from the wetting of the compost was pooling on the Hardstand resulting in a large surface area of leachate being exposed to air. No actions were required to be undertaken by the Licence Holder as a result of the inspection.

4.7.4 Site visit 27 May 2016

A DWER Officer attended the Premises on 27 May 2016, in response to odour complaints received that day. The wetting of straw bales with recycled leachate from Pond 1 (via sprinklers) and the composting windrows were identified as potential sources of the odours which had been observed off-site that day.

4.7.5 Site visit 13 October 2016

To inform the licence review, DWER officers attended the Premises on 13 October 2016. Appendix 3 contains photographs from the site visit, and the following observations were noted:

Odour

- At the time of the site visit (a Thursday) the straw bales were being sprayed and the compost piles were being turned.
- There was a general compost/chicken manure odour observed from the car park. When walking past the chicken manure and gypsum stockpiles, there was no noticeably strong odour. Similarly when walking past the compost piles being turned, there was no strong odour above the general background odour.
- There was a very strong odour of chicken manure/rotting smell when walking past the straw bales and pond towards the site office. On both occasions walking past the bale spraying area and pond a very strong odour was detected.
- Later in the afternoon during a visit to the C-wise premises, the odour was again detected when walking on the easternmost portion of the C-wise premises (final product storage) and near the offices/carpark, which are the areas closest to the Mushroom Exchange Premises.

- This odour from the Premises was distinctly different from the piggery odour which could be detected when walking up the road between the start of the piggery shed and the newly constructed Pond 0.

Leachate management

- The pump system was not operational at the time of the visit. It was noted by DWER officers that the pump was also not operational at a site inspection conducted earlier in the year (8 March 2016) and had not been operational for three months prior. The pump was however noted to be operational during an inspection carried out on the 9 December 2016.
- A significant volume of straw material was observed in Pond 1.
- Leachate pooled over a large area of the Hardstand (estimated to be a minimum of 1200m^2 surface area at 2 to 3cm deep).
- Soil immediately adjacent to the Hardstand and Pond 3 was observed to be damp, and leachate appeared to be leaking from the Hardstand area.

Hardstand

DWER officers also noted extensive cracking has occurred in the Hardstand, with a significant volume of the leachate/run-off pooling within the cracks.

Key findings

The Delegated Officer has reviewed the information gathered from site inspections and has found:

1. *There is extensive cracking in the Hardstand throughout the Premises.*
2. *There is a possibility that leachate is leaking through bunding and Hardstand adjacent to Pond 3.*

4.7.6 Annual reports

The annual reporting period for the Licence is the financial year, with Annual Audit Compliance Reports (AACRs) and Annual Environmental Reports (AERs) due for submission to DWER on or before 1 August each year.

2013-2014 Reports

The annual report contained the information required by the Licence. The AACR reported non-compliance with condition G1 of the Previous Licence to maintain a 35 meter internal buffer due to the location of the static composting run on the C-Wise premises boundary.

The AACR also reported that the June 2014 groundwater samples were missed and instead taken in July 2014.

2014-2015 Reports

The annual report contained the information required by the Licence. The AACR reported non-compliance with condition G1 of the Previous Licence to maintain a 35 metre internal buffer due to the location of the static composting run on the C-Wise premises boundary.

The review required the Licence Holder to submit evidence that the WA State Manager has authority to sign the report, and confirm the unit used for standing water level. This information was provided by the Licence Holder.

It was noted in this review that there were elevated levels of nutrients in the groundwater but it was not possible to determine if the Premises were the source.

2015-2016 Reports

The annual report contained the information required by the Licence. The AACR reported non-compliance with condition G1 of the Previous Licence to maintain a 35 metre internal buffer due to the location of the static composting run on the C-Wise premises boundary.

2016-2017 Reports

The annual report contained the information required by the Licence. The report states that monitoring bores MB1 and MB5 were slow yielding and had cloudy samples. These were replaced by two new bores MB1S and MB5S.

The AACR reported non-compliance with condition G1 of the Previous Licence to maintain a 35 metre internal buffer due to the location of the static composting run on the C-Wise premises boundary.

4.7.7 Compliance history check

DWER records show that Licence Holder has received two Letters of Warning;

- April 2011 for failing to submit annual reports and conduct groundwater monitoring for a number of years; and
- September 2013 due to failure to submit an AACR for the 2011-2012 period.

DWER records do not show any other enforcement action being undertaken against the Licence Holder.

4.8 Monitoring data and investigations

4.8.1 Groundwater monitoring

DWER undertook a review of the groundwater monitoring data provided by the three premises at Nambeelup Farm over the 2010 to 2017 period. Details of this review are included in Appendix 4.

Key findings

The Delegated Officer has reviewed the groundwater monitoring programs and has found that:

1. *A shared approach and consistent methodology for all premises will facilitate better understanding of contamination events and the effectiveness of controls.*
2. *Synchronising monitoring bore sampling across all three sites is necessary to allow more comprehensive and meaningful data interpretation.*
3. *Mercury, zinc and arsenic should be included in the monitoring suite of analytes to ensure that the potential risk to human health and the environment from this type of contamination can be assessed.*
4. *The selected suite of analytes with the addition of selected metals is considered appropriate for the characterisation and detection of*

groundwater contamination caused by nutrient rich leachates derived from organic materials.

The Delegated Officer has reviewed the spatial configuration of the existing monitoring bore network and has found:

5. *The existing monitoring network, when used as an integrated network across premises' boundaries, is sufficient to identify whether containment infrastructure such as ponds and hardstands are effectively controlling leachate emissions.*
6. *The monitoring network is not able to identify contamination sources at a small spatial scale such as a single pond. Additional investigations in the form of seepage rate measurements are required for this purpose.*
7. *The monitoring network includes bores located up and down hydraulic gradient at varying distances from the potential operational contamination sources allowing the determination of a suitable background level against which bores influenced by site sources can be compared.*
8. *The current network does not allow detailed tracking of contamination and plume delineation, and is insufficient to inform on the risk of impacts on sensitive receptors.*

The Delegated Officer has reviewed groundwater monitoring data illustrated in Appendix 4 and concluded that:

9. *Groundwater monitoring results infer that groundwater flow in the area of interest is in a south-westerly direction.*
10. *The levels of nutrients in multiple bores indicate that containment infrastructure integrity may be compromised at all three premises resulting in seepage to groundwater.*
11. *A groundwater contamination plume is likely to extend from the operational area in a south-westerly direction indicating an open pathway to impact sensitive environmental receptors located downgradient from the premises.*

The Delegated Officer has reviewed groundwater monitoring data from Mushroom Exchange bores illustrated in Appendix 4 and concluded that:

12. *The submitted data has some gaps highlighting the importance to ensure that data quality and consistency is maintained in future submissions.*
13. *High nutrient levels above background have been detected in multiple bores surrounding the Mushroom Exchange infrastructure indicating the likely presence of a nearby contamination source. It is therefore necessary to confirm through testing that containment infrastructure on site is effective.*

4.8.2 Odour

Due to a marked increase in complaints received by the Department in the Mandurah area (Appendix 5, Fig. 1), the Department undertook the Mandurah Odour Investigation to ascertain

which odour sources were the major contributors to odour impacts in the Mandurah area and, if possible, to determine the odour impact extent of those sources. Details of the complaints and the investigation are included in Appendix 5, with the final odour investigation included in Appendix 6.

Key findings

The Delegated Officer has reviewed the odour complaint information and odour investigation and has found:

1. *There is a potential pathway for odours to travel over 8km from the Premises.*
2. *Odour emissions observed in the Mandurah area are mainly attributable to the Nambeelup Farm premises.*

A Technical Expert Report was prepared by the Department's Air Quality Services function in November 2016. The report includes a review of the documentation shown in Table 8, which was provided to the Department by the Licence Holder.

The report is included in Appendix 7.

Table 8: Odour investigation reports

Document	Author	Date of document
Hardcopy report: *Draft Investigation of Odour Emissions from Nambeelup Precinct Operations.*	David Pitt, Environmental Alliances Pty Ltd (ENVALL)	July 2016
Waste water quality Laboratory Report (ARL job number 16-03831 Revision 01) contained as an attachment in a hardcopy request for advice from DER Acting Executive Director Compliance and Enforcement.	Analytical Reference Laboratory (ARL)	20 June 2016

Key findings

The Delegated Officer has reviewed the information regarding the Premises in the Department's Technical Expert Report and has found:

1. *Water quality from Pond 1 is poor and the reuse of this water on various processes on the Premises is likely to result in significant levels of odour emissions.*
2. *The results indicate that the pH of water in the pond is slightly acidic (6.8) which could result in the release of hydrogen sulphide (H_2S) which is odourous*
3. *The pond water has an Oxidation Reduction Potential (ORP) value of -286 mV, which is considered to be large and is also indicative of increased risks of production of sulfides, fatty acids and potentially methane*
4. *The re-use of pond water in large quantities over a wide surface area results in an odour source with a large surface area thus increasing odour emissions.*

5. Consultation

DWER met with the Shire of Murray and the City of Mandurah during the Review. No formal comments were received from these stakeholders.

The Review was advertised on the DWER website for a period of 25 calendar days from 24 October 2017. No comments were received from the public.

6. Location and siting

6.1 Siting context

Nambeelup Farm is in the locality of Nambeelup in the Shire of Murray and is approximately 60km south of Perth, and approximately 10km northeast of Mandurah town centre. The premises location is shown in Figure 2.

Figure 2: Regional location of Nambeelup Farm

The relative location of the three Nambeelup Farm premises is shown in Figure 3. The immediate surrounding land is predominantly undeveloped land and rural properties, with a number of commercial kennels located to the south. Murray field airport, a small private airport run by the Royal Aero Club of Western Australia, is located directly south of the Premises.

Figure 3: Delineation of Nambeelup Farm premises (CM-Farms premises is Lot 89 and 109)

6.2 Residential and sensitive premises

The approximate distances to residential receptors from the operational area of the Premises are shown in Table 9 and in Figure 4. Distances were measured using the Intramaps Mapping System on the Shire of Murray's website.

Table 9: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Murrayfield Airport	500m south of the Premises boundary
Rural residential premises 1	Approximately 1,400m south-west of the Premises
Rural residential premises 2	Approximately 1,680m south-east of the Premises
Nearest Residential development (Stake Hill)	Approximately 3,900m north-west of the Premises
Southern portion of Stake Hill residential area	Approximately 4,000m west of the Premises
Barragup Residential Area	Approximately 4,400m south-west of the Premises
Mandurah townsite	Approximately 10,000m south-west of the Premises

Figure 4: Distance to residential receptors from the Premises

6.3 Specified ecosystems

The distances to specified ecosystems are shown in Table 10 and on Figure 5 and Figure 6.

Table 10: Specified ecosystems

Specified ecosystems	Distance from the Premises
Nature reserve	Crown land vested in the Conservation Commission of Western Australian for the conservation of flora and fauna is located approximately 700m to the south west of the Premises
Threatened Ecological Communities and Priority Ecological Communities	A threatened ecological community is located approximately 5km to the south west of the Premises
Rare flora	The Premises is located within an area approximately 20km by 9km known to contain declared rare flora.
Other relevant ecosystem values	**Distance from the Premises**
Environmental Protection Peel Inlet – Harvey Estuary Policy 1992	The Premises is within the EPP area.
Rights in Water and Irrigation Act 1914 • Surface Water (Serpentine River System) • Groundwater (Murray)	The Premises is within the Policy area.

6.4 Groundwater and water resources

The distances to groundwater and water sources are shown in Table 11 and Figure 5 to Figure 9.

Table 11: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental Value
Groundwater	Groundwater is generally less than 2m from the ground surface across the Premises area (see Figure 7). Data provided by Marillier, 2012 indicate that the regional direction of groundwater flow may be in a west to north-westerly direction towards the Serpentine River (see Figure 8). There may be local variations in flow direction near Nambeelup Farm due to the presence of water table management drains, seepage from ponds, and local groundwater abstraction. This is evident in small scale groundwater monitoring and contours at the Nambeelup Farm area documented by Geo and Hydro (2010)[1] that indicate groundwater flow in a south-westerly direction.	There are several abstraction bores within the vicinity and down hydraulic gradient from the Premises and are used for livestock watering and irrigation (see Figure 9).
RAMSAR wetland	Peel-Yalgorup System (Peel Estuary-Harvey Inlet) located over 11km west-southwest of the Premises.	Wetland of international significance.
Geomorphic Wetlands	There are five conservation category wetlands within 1km of the Premises operational areas: • One approximately 1km south west of the Premises; • Two approximately 800m and 600m south-east of the Premises; and • Two approximately 400m and 800m north of the Premises.	Conservation category Wetlands (see Figure 5).

[1] Geo and Hydro Environmental Management Pty Ltd 2010: Watertable contours across Custom Compost Lot 230 Nambellup Rd Nambellup, Figure 5. Submitted by Custom Compost

Groundwater and water sources	Distance from Premises	Environmental Value
Waterbodies	The Nambeelup Brook is located approximately 2km east of the Premises. The Serpentine River is located approximately 2.5km west of the Premises. Goegrup Lake is approximately 5km south west of the Premises and is fed by both the Serpentine River and Nambeelup Brook.	All three waterbodies are Conservation category wetlands (western end of Nambeelup Brook only) and ultimately drain to the Peel Harvey Estuary.

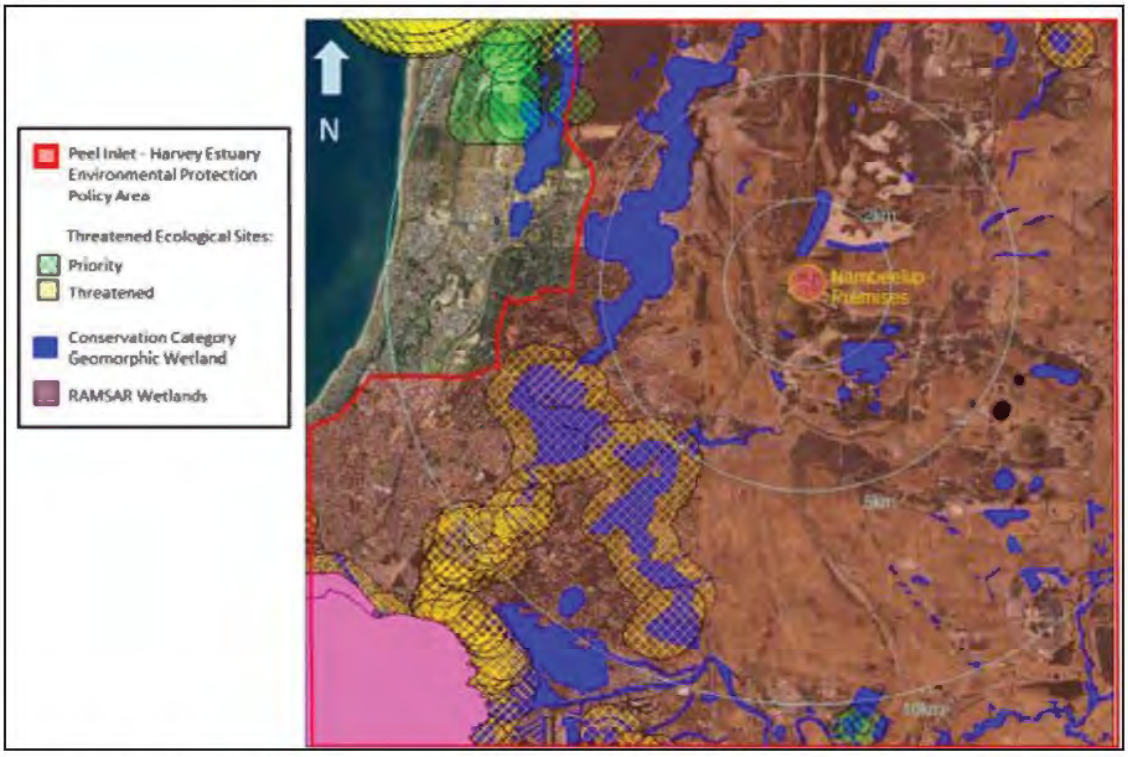


Figure 5: Specified ecosystem and water resource locations within regional area

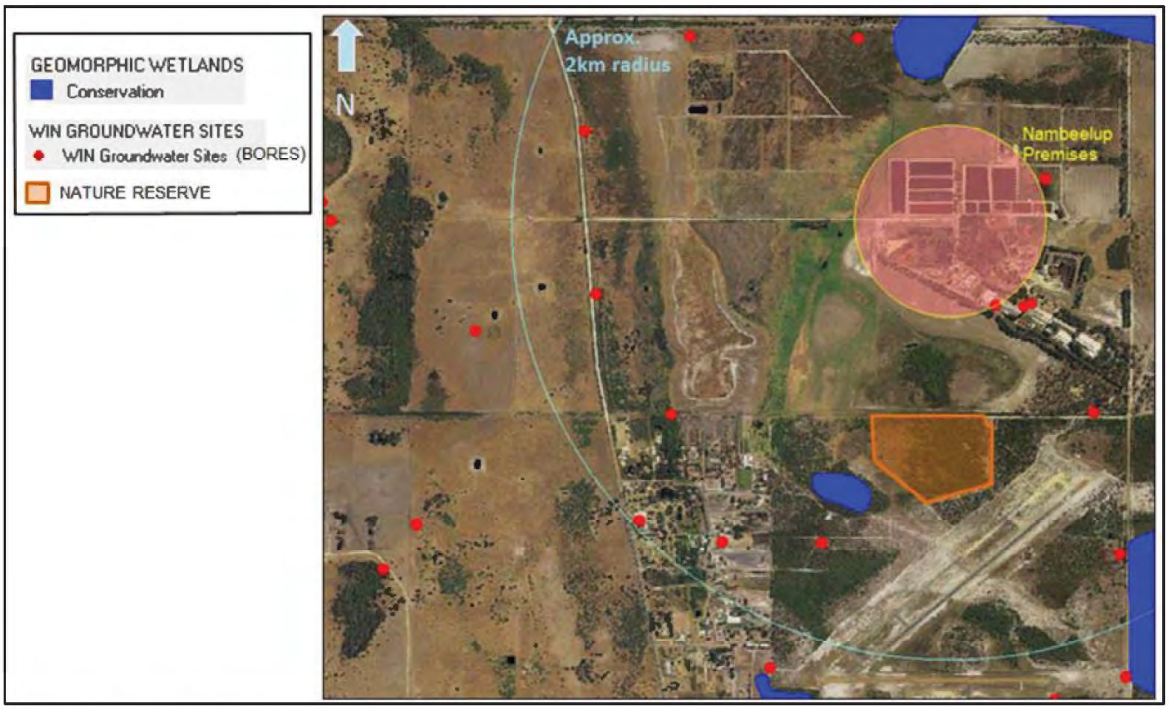


Figure 6: Specified ecosystem and water resource locations within local area

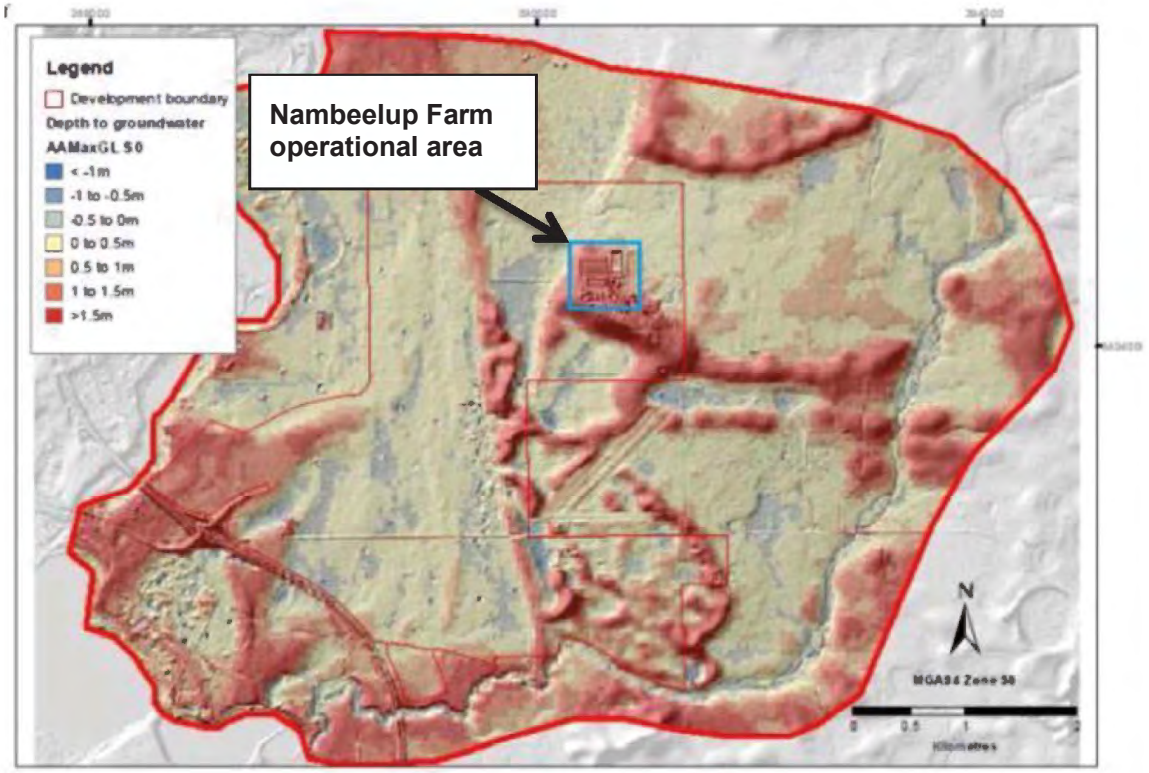


Figure 7: Depth to groundwater (Marillier, B 2012)

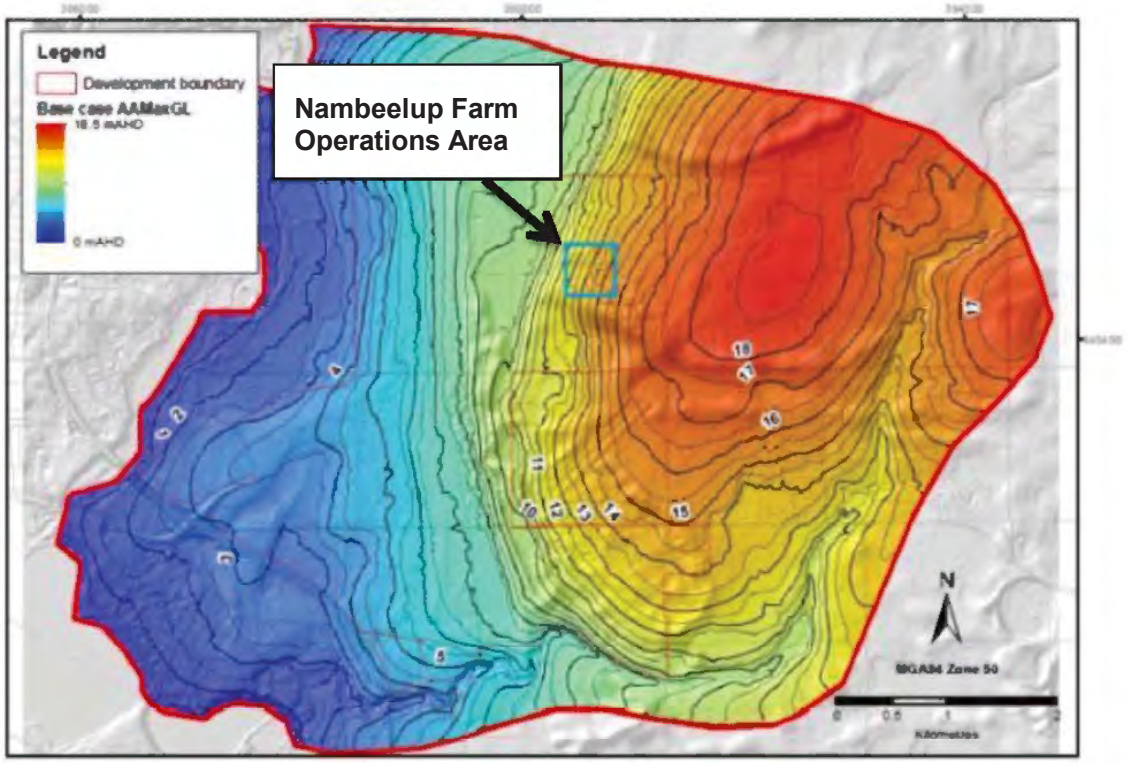


Figure 8: Annual Average maximum groundwater level (Marillier, 2012)

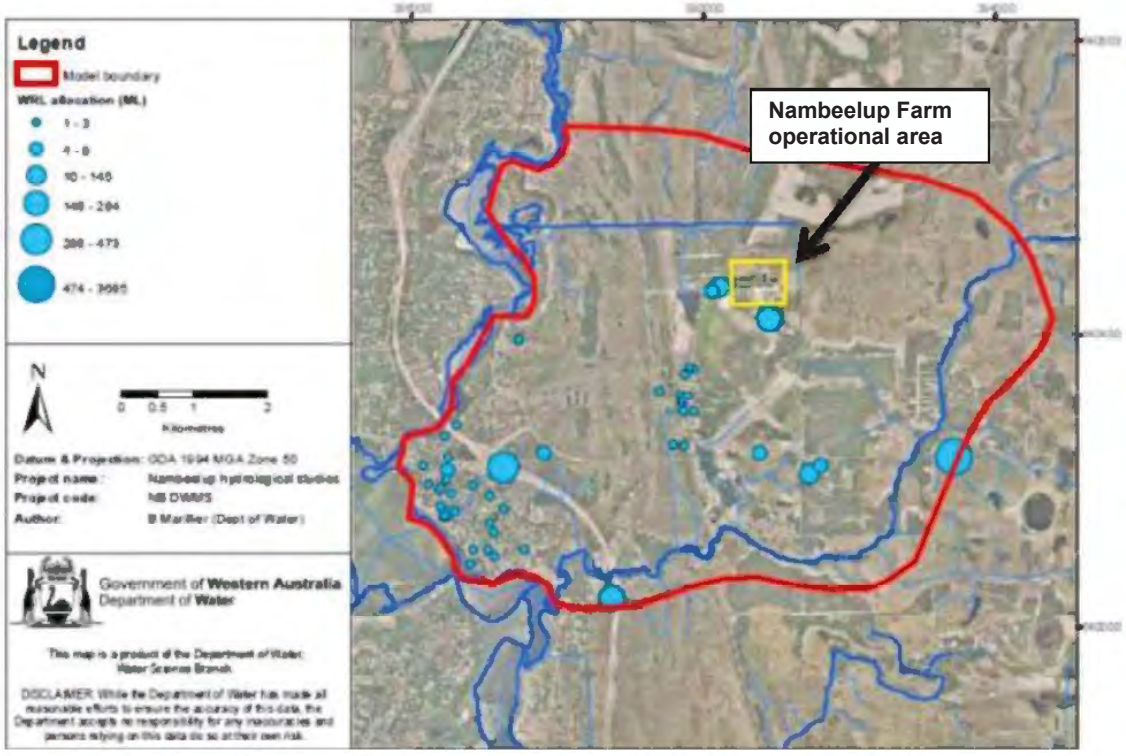


Figure 9: Water extraction bores

6.5 Soil type

The Premises is underlain by sandy sediments that comprise the Bassendean Sand and Gnangara Sand units of the superficial formation which has a combined thickness of approximately 10m in the area. These sediments are in turn underlain by the sandy sediments that comprise the Rockingham Sand unit. The superficial formations and the Rockingham Sand unit together form an extensive unconfined aquifer that that has a combined saturated thickness of 40m to 50m in the area (Hall *et al*., 2010; Marillier, 2012).

6.6 Meteorology

6.6.1 Wind direction and strength

The following wind roses (Figure 10) provide the annual wind direction and strength (km/h) for 9am and 3pm between the years 1988 and 2001 in Mandurah (BoM 2016). The region has a dominant wind direction consisting of easterly winds during the morning and south-westerly winds in the afternoon.

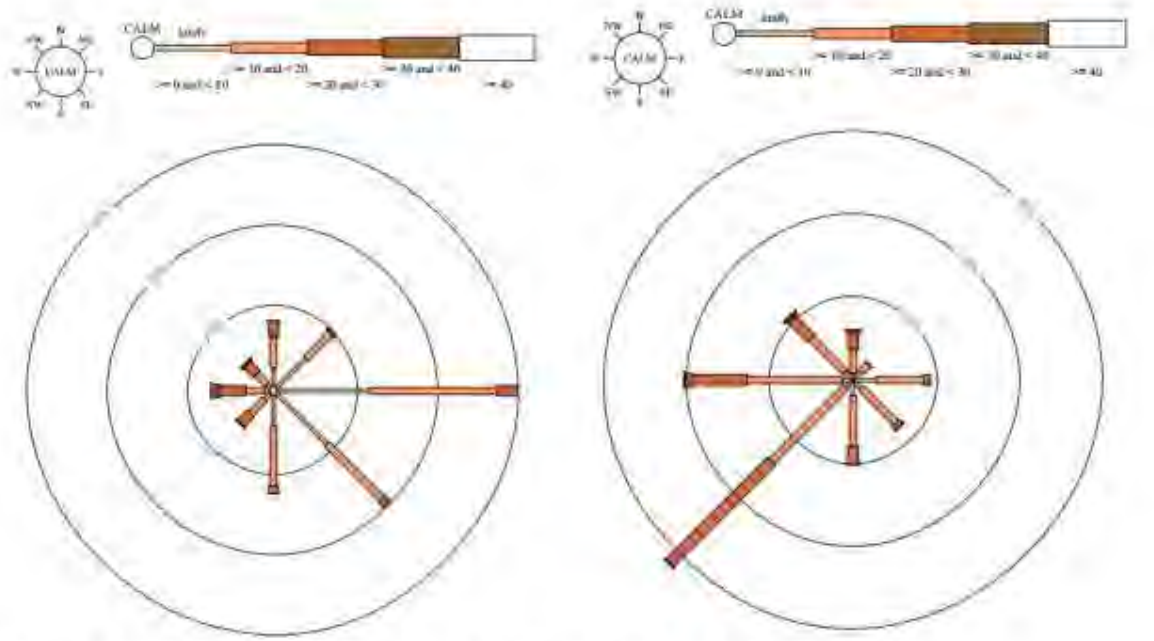


Figure 10: Wind roses for Mandurah at 9am and 3pm (BoM 1988-2001)

6.6.2 Rainfall and temperature

The Nambeelup locality experiences mild wet winters and hot dry summers. Figure 11 shows the mean rainfall and maximum temperatures for Mandurah (closest available weather station) for the period 2001-2016. Mandurah receives a mean annual rainfall of approximately 670mm.

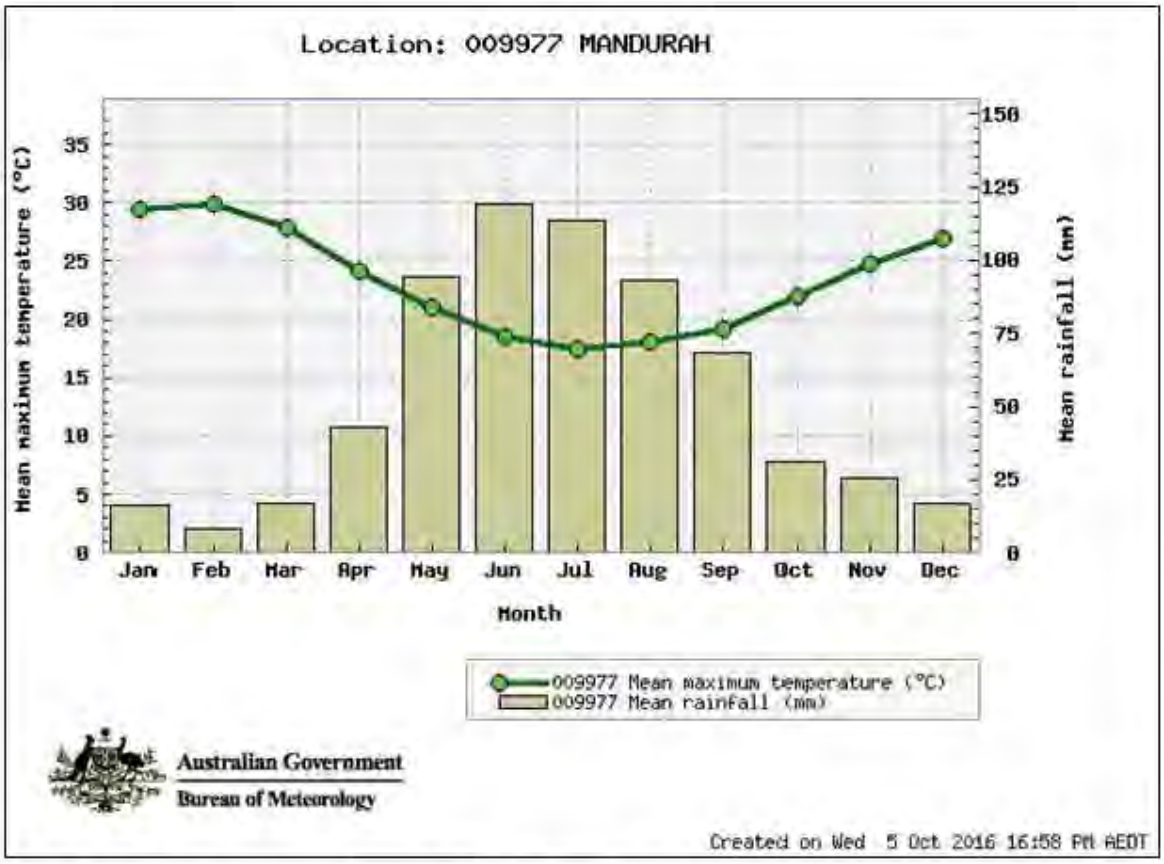


Figure 11: Mean temperature and rainfall at Mandurah (BoM 2001-2016)

7. Risk assessment

7.1 Confirmation of potential impacts

Identification of key potential emissions, pathways, receptors and confirmation of potential impacts are set out in Table 12 below. Table 12 also identifies which potential emissions will be progressed to a full risk assessment. Some potential emissions/impacts may not receive a full risk assessment where a potential receptor or pathway cannot be identified.

Table 12: Identification of key emissions

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
Source (see Section 6 for infrastructure references)	**Feedstock acceptance, handling and storage**	Unloading/movement of solid feedstocks Storage of feedstocks (straw bale storage on bare ground)	Leachate: Seepage through Hardstand Run-off from Hardstand	Peel-Yalgorup RAMSAR Wetland Peel Inlet and Harvey Estuary EPP area	Overland flow Seepage through soil Transport through groundwater	Increased phosphorus load on Peel Inlet and Harvey Estuary catchment leading to contamination of surface waters. Contamination of surface waters at the point of groundwater expression Impact the biological diversity of wetland flora and fauna including thrombolite and water bird species	Yes	See to section 7.4
				Groundwater (abstraction bores)		Contamination of groundwater supply for nearby users	Yes	See section 7.4
				Geomorphic Wetlands – conservation category wetlands		Contamination of surface waters at the point of groundwater expression Contribute to eutrophication and	Yes	See section 7.4

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
				Nambeelup Brook		algal blooms which can impact ecosystem function.	No	Nambeelup Brook is located approximately 2.5km up gradient from the Premises. Seepage is not considered likely to travel to this receptor
				Serpentine River			Yes	See section 7.4
				On site premises and adjoining land		Contamination of soil	Yes	See section 7.4
				Nature reserve		Impact on biological diversity of flora and fauna within conservation area	Yes	See section 7.4
				Threatened Ecological Communities and Priority Ecological Communities.		Impact on the biological diversity of sensitive ecological communities	Yes	See section 7.4
			Odour	Residential receptors located between 1.4km – 8.5km away Patrons of air field located 500m south	Air (windborne)	Impacts to amenity and wellbeing	Yes	See section 7.5
			Dust including bioaerosols			Amenity impacts from visible dust plumes and deposition on property Nuisance impacts Public health effects from inhaled particulates/bioaerosols	No	Sufficient separation distance. Nearest residential receptors are 1.4km from the Premises. There is no history of dust complaints from the Premises. General provisions of the EP Act apply

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
			Compost Fire (particulates and noxious gases)			Public health effects from inhaled particulates	No	Sufficient separation distance. Nearest residential receptors are 1.4km from the Premises General provisions of the EP Act apply
	Mixing of feedstock and pond water	pre-treatment of feedstock (spraying bales with pond water) pre-treatment of feedstock (breaking bales and adding chicken manure) Excess pond water drain to ponds	Leachate Seepage through Hardstand Run-off from Hardstand	Peel-Yalgorup RAMSAR Wetland/Peel Inlet and Harvey Estuary EPP area	Overland flow and seepage through soil	Increased phosphorus load on Peel Inlet and Harvey Estuary catchment leading to contamination of surface waters Contamination of surface waters at the point of groundwater expression Impact the biological diversity of wetland flora and fauna including thrombolite and water bird species	Yes	See section 7.4
				Groundwater (abstraction bores)		Contamination of groundwater supply for nearby users	Yes	See section 7.4
				Geomorphic Wetlands – conservation category wetlands		Contamination of surface waters at the point of groundwater expression Contribute to eutrophication and algal blooms which can impact ecosystem function	Yes	See section 7.4
				Nambeelup Brook			No	Nambeelup Brook is located approximately 2.5km up gradient from the Premises. Overland flow and seepage is not considered likely to travel to this receptor

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
				Serpentine River			Yes	See section 7.4
				On site premises and adjoining land		Contamination of soil	Yes	See section 7.4
				Nature reserve		Impact on biological diversity of flora and fauna within conservation area	Yes	See section 7.4
				Threatened Ecological Communities and Priority Ecological Communities.		Impact on the biological diversity of sensitive ecological communities	Yes	See section 7.4
			Odour	Residential receptors located between 1.4km – 8.5km away Patrons of air field located 500m south	Air (windborne)	Impacts to amenity and wellbeing	Yes	See section 7.5
	Composting Process	Formation of windrows Turning of windrows Application of bore water via hose Excess liquid drains to ponds	Leachate: Seepage through Hardstand Run-off from Hardstand	Peel-Yalgorup RAMSAR Wetland/Peel Inlet and Harvey Estuary EPP area	Overland flow and seepage through soil	Increased phosphorus load on Peel Inlet and Harvey Estuary catchment leading to contamination of surface waters Contamination of surface waters at the point of groundwater expression Impact the biological diversity of wetland flora and fauna including thrombolite and water bird species	Yes	See section 7.4

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
				Groundwater (abstraction bores)		Contamination of groundwater supply for nearby users	Yes	See section 7.4
				Geomorphic Wetlands – conservation category wetlands		Contamination of surface waters at the point of groundwater expression Contribute to eutrophication and algal blooms which can impact ecosystem function	Yes	See section 7.4
				Nambeelup Brook			No	Nambeelup Brook is located approximately 2.5km up gradient from the Premises. Overland flow and seepage is not considered likely to travel to this receptor
				Serpentine River			Yes	See section 7.4
				On site premises and adjoining land		Contamination of soil	Yes	See section 7.4
				Nature reserve		Impact on biological diversity of flora and fauna within conservation area	Yes	See section 7.4
				Threatened Ecological Communities and Priority Ecological Communities.		Impact on the biological diversity of sensitive ecological communities	Yes	See section 7.4
			Odour	Residential receptors located between 1.4km –	Air (windborne)	Impacts to amenity and wellbeing	Yes	See section 7.5

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
			Dust including bioaerosols	8.5km away Patrons of air field located 500m south		Amenity impacts from visible dust plumes and deposition on property Nuisance impacts Public health effects from inhaled particulates/bioaerosols	No	Sufficient separation distance. Nearest residential receptors are 1.4km from the Premises. There is no history of dust complaints from the Premises. General provisions of the EP Act apply
			Compost Fire (particulates and noxious gases)			Public health effects from inhaled particulates	No	Sufficient separation distance. Nearest residential receptors are 1.4km from the Premises. General provisions of the EP Act apply
	Composted material ready for dispatch	Compost removed from Premises	Pathogens	None	None	Public health effects from inhaled or ingested pathogens	No	There are no potential receptors or pathway as the compost is not sold to small retail customers. Planning approval does not allow retail sales. Compost is removed from the Premises for further pasteurisation at another facility.

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
	Leachate collection and storage system	Collection of leachate via channels, spillway and pump Storage of leachate in ponds	Leachate Seepage through Hardstand and ponds Overtopping of ponds Liner rupture	Peel-Yalgorup RAMSAR Wetland/Peel Inlet and Harvey Estuary EPP area	Overland flow Seepage through soil Transport through groundwater	Increased phosphorus load on Peel Inlet and Harvey Estuary catchment leading to contamination of surface waters Contamination of surface waters at the point of groundwater expression Impact the biological diversity of wetland flora and fauna including thrombolite and water bird species	Yes	See section 7.4
				Groundwater (abstraction bores)		Contamination of groundwater supply for nearby users	Yes	See section 7.4
				Geomorphic Wetlands – conservation category wetlands		Contamination of surface waters at the point of groundwater expression Contribute to eutrophication and algal blooms which can impact ecosystem function	Yes	See section 7.4
				Nambeelup Brook			No	Nambeelup Brook is located approximately 2.5km up gradient from the Premises. Overland flow and seepage is not considered likely to travel to this receptor
				Serpentine River			Yes	See section 7.4
				On site premises and adjoining land		Contamination of soil	Yes	See section 7.4

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
				Nature reserve		Impact on biological diversity of flora and fauna within conservation area	Yes	See section 7.4
				Threatened Ecological Communities and Priority Ecological Communities.		Impact on the biological diversity of sensitive ecological communities	Yes	See section 7.4
			Odour	Residential receptors located between 1.4km – 8.5km away Patrons of air field located 500m south	Air (windborne)	Impacts to amenity and wellbeing	Yes	See section 7.5
	Operation of vehicles and other machinery	Operation of vehicles, compost turner, front end loader and pump	Noise	Residential receptors located between 1.4km – 8.5km away Patrons of air field located 500m south	Air (windborne)	Amenity impacts causing nuisance	No	Sufficient separation distance. Nearest residential receptors are 1.4km from the Premises. Noise Regulations apply

7.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 13 below.

Table 13: Risk rating matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost Certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with Table 14 below.

Table 14: Risk criteria table

Likelihood		Consequence		
The following criteria has been used to determine the likelihood of the risk / opportunity occurring.		The following criteria has been used to determine the consequences of a risk occurring:		
			Environment	Public Health* and Amenity (such as air and water quality, noise, and odour)
Almost Certain	The risk event is expected to occur in most circumstances	Severe	• **on-site impacts**: catastrophic • **off-site impacts local scale**: high level or above • **off-site impacts wider scale:** mid level or above • Mid to long term or permanent impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are significantly exceeded	• Loss of life • **Adverse health effects:** high level or ongoing medical treatment • Specific Consequence Criteria (for public health) are significantly exceeded • **Local scale impacts:** permanent loss of amenity
Likely	The risk event will probably occur in most circumstances	Major	• **on-site impacts**: high level • **off-site impacts local scale**: mid level • **off-site impacts wider scale**: low level • Short term impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are exceeded	• **Adverse health effects:** mid level or frequent medical treatment • Specific Consequence Criteria (for public health) are exceeded • **Local scale impacts**: high level impact to amenity
Possible	The risk event could occur at some time	Moderate	• **on-site impacts**: mid level • **off-site impacts local scale**: low level • **off-site impacts wider scale**: minimal • Specific Consequence Criteria (for environment) are at risk of not being met	• **Adverse health effects:** low level or occasional medical treatment • Specific Consequence Criteria (for public health) are at risk of not being met • **Local scale impacts:** mid level impact to amenity
Unlikely	The risk event will probably not occur in most circumstances	Minor	• **on-site impacts**: low level • **off-site impacts local scale**: minimal • **off-site impacts wider scale**: not detectable • Specific Consequence Criteria (for environment) likely to be met	• Specific Consequence Criteria (for public health) are likely to be met • **Local scale impacts:** low level impact to amenity
Rare	The risk event may only occur in exceptional circumstances	Slight	• **on-site impact**: minimal • Specific Consequence Criteria (for environment) met	• **Local scale**: minimal to amenity • Specific Consequence Criteria (for public health) met

^ Determination of areas of high conservation value or special significance should be informed by the Guidance Statement: Environmental Siting.

* In applying public health criteria, DWER may have regard to the Department of Health's, Health Risk Assessment (Scoping) Guidelines

"on-site" means within the prescribed Premises boundary.

7.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 15 below:

Table 15: Risk Treatment

Risk Rating	Acceptability	Treatment
Extreme	Unacceptable.	Risk event will not be tolerated. DWER may refuse application.
High	Acceptable subject to multiple regulatory controls.	Risk event will be tolerated and may be subject to multiple regulatory controls. This may include both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls.	Risk event is tolerable and is likely to be subject to some regulatory controls. A preference for outcome-based conditions where practical and appropriate will be applied.
Low	Acceptable, generally not controlled.	Risk event is acceptable and will generally not be subject to regulatory controls.

7.4 Risk of leachate impacts

7.4.1 General hazard characterisation and impact

There are no point source emissions of leachate to surface water or groundwater associated with the operation of the Premises. However, unintended leachate emissions high in nutrients may arise.

Emissions of leachate may result from seepage or overland flow to groundwater or adjoining land. The soil at the Premises is fine to coarse sand which is considered likely to allow leachate seepage to move through the soil profile. The depth to groundwater is approximately two meters which increases the likelihood of leachate seepage reaching groundwater. This may result in the contamination of the soils and groundwater within and adjacent to the Nambeelup Farm premises, which may impact nearby users. DWER's GIS mapping system indicates that groundwater in the area may have a TDS concentration of 500 to 3000 mg/L, and is considered to be fresh to brackish. Therefore the groundwater is considered a receptor of beneficial use as it may be considered potable, suitable for irrigation or livestock. This is consistent with the presence of groundwater extraction bores in the area as identified in Section 0.

Rising groundwater, the result of mounding, has the potential to intercept the root zone of native vegetation. This may lead to an oversaturation of soils and/or accumulation of salts that can impact the growth of native vegetation.

If the flow of contaminated groundwater reached the nature reserve located approximately 700m south west of the Premises, this could result in impacts to the health and diversity of

flora and fauna within the reserve.

The pathway for emissions to surface water may be via overland flow or within groundwater flow. Contaminated groundwater may be expressed within the Geomorphic Wetlands and the Serpentine River, which are both down-gradient of the Premises. Emissions may contribute to the phosphorus load within the Peel Inlet and Harvey Estuary, which is fed by the Serpentine River. Threatened ecological communities are also located within the vicinity of the conservation category wetlands and are likely to be impacted by any contamination of the groundwater and surface water in the area.

The expression of contaminated groundwater in surface water bodies may result in eutrophication and the excessive growth of algae. Algae growth may impact the survival of existing organisms through light and oxygen restriction and cause the degradation of the surface water value and beneficial use. Contamination in the groundwater and/or the wetlands may impact the biological diversity of threatened ecological communities.

7.4.2 Sources

Emissions of leachate may occur from the following sources summarised in Table 16.

Table 16: Potential sources of leachate emissions

Source	Potential event
Feedstock Storage	• Contaminated surface runoff • Leaching through Hardstand
Pre-treatment	
Composting	
Leachate collection and storage system	• Contaminated surface runoff • Leaching through Hardstand • Overtopping • Leaching through pond liner due to liner damage/faults or ponds intersecting groundwater resulting in increased seepage.

7.4.3 Criteria for assessment

The following guidelines are considered appropriate assessment criteria to assess the potential impact on the beneficial use of groundwater.

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality ANZECC & ARMCANZ (2000) for livestock drinking water quality.

The following guidelines are considered appropriate assessment criteria to assess the potential impact on groundwater dependent and freshwater ecosystems and surface water quality.

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality ANZECC & ARMCANZ (2000) for slightly–moderately disturbed ecosystems (95% protection level trigger values).

7.4.4 Licence Holder controls

The leachate drains to ponds which are lined with a HDPE liner and there are provisions for pond overflow.

Table 17: Licence Holder leachate controls

Source	Control(s)	Operation details	Reference to Issued Licence Premises Layout Map
Feedstock Storage	Bunded Hardstand area Urea/nitrogen based fertilisers stored undercover	Feedstock storage, pre-treatment and composting are undertaken on the Hardstand. Note: Hardstand material was tested in October 2014 and found to meet a hydraulic conductivity of 2.3 x 10^{-11}. However, during a site visit in October 2016 Departmental officers identified extensive cracking in the Hardstand which is likely to have compromised the integrity of the Hardstand.	Bunkers
Pre-treatment			Hardstand
Composting			Hardstand
Leachate collection system	Three ponds	1mm HDPE lined Overflow from Pond 1 and Pond 2 flow to Pond 3.	Pond 1, Pond 2, Pond 3

7.4.5 Key findings

The Delegated Officer has reviewed the information regarding the groundwater impacts from the Premises and has found:

1. *The storage and handling of compost and leachates has the potential to impact groundwater and surface water quality if not appropriately contained.*
2. *The soil type at the Premises is readily permeable and groundwater is likely to be located within two meters below ground level.*
3. *There are several potential receptors present. Groundwater is considered a pathway and receptor.*
4. *DWER officers have observed cracking in the Hardstand which may compromise the integrity of the Hardstand.*
5. *Groundwater monitoring at the Premises to date indicates a significant elevation of nitrogen and phosphorus above background levels.*
6. *Groundwater monitoring regime could be further improved to more accurately determine any impacts.*
7. *Groundwater impacts are cumulative with all three premises at Nambeelup Farm likely to be contributing.*

7.4.6 Consequence

The guidelines for livestock drinking water quality indicate that concentrations of total dissolved solids between 2000-3000mg/L may result in a reluctance of poultry to drink, and levels above 3000mg/L may result in a decline in animal condition (poultry is the most sensitive of the livestock considered) (ANZECC & ARMCANZ 2000). The recent monitoring results (2016-2017 averaged data) showed that a number of bores exceeded 2000mg/L

(CW01, CW02, CW05(A), CM08S and CM11S). The highest results were from bores CM11S and CW05(A), which are located on the western perimeter of the operational areas, and were above 3000mg/L.

The guidelines for slightly to moderately disturbed ecosystems provides a 95% protection trigger level value of 0.9mg/L for ammonia (ANZECC & ARMCANZ 2000). The recent monitoring results (2016-2017 averaged data) show that the majority of the bores within the Nambeelup Farm Premises exceed that trigger level to some degree. However, a number of bores (CM11S, CW05(A), CW02 and ME01) show levels of ammonia in excess of 30 times the trigger level. The results for bores CM11 and CW05(A) were 127 and 144 times higher than the trigger level respectively.

Bore CM10S is inferred to be downgradient of the operational areas and is the closest bore to the conservation category wetlands and the nature reserve. The results for this bore show an ammonia level of 6mg/L, however it is located approximately 400m from these receptors.

Based on the key receptors (potential beneficial use of groundwater within and adjacent to the Nambeelup Farm premises, the nearby nature reserve and wetland, and the EPP area with its nutrient load management requirements), the Delegated Officer has determined that leachate from individual sources could cause low-level off-site impacts to the groundwater quality and the nearby nature reserve and wetland, and nutrient inputs into the EPP area with a risk that specific consequence criteria are not being met. Therefore, the Delegated Officer considers the consequence to be **Moderate**.

7.4.7 Likelihood of consequence

Feedstock storage

Based upon the Licence Holder's control measures, observations from site visits, the predominately dry nature of feedstocks, and despite the damaged Hardstand the Delegated Officer has determined that the likelihood of moderate leachate impacts from the storage of feedstocks will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **Unlikely.**

Pre-treatment of feedstock (spraying and bale breaking)

Based upon the Licence Holder's control measures, observations from site visits of large volumes of leachate pooling on the Hardstand, cracking in the Hardstand and groundwater monitoring results, the Delegated Officer has determined that the likelihood of moderate leachate impacts from the bale wetting and bale breaking stage will probably occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of leachate impacts from the spraying and bale breaking stage to be **Likely.**

Compost piles and windrows

Based upon the Licence Holder's control measures, observations from site visits of large volumes of leachate pooling on the Hardstand, cracking in the Hardstand and groundwater monitoring results, the Delegated Officer has determined that the likelihood of moderate leachate impacts from the compost piles and windrows will probably occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of leachate impacts from the composting piles and windrows to be **Likely.**

Leachate collection and storage system

Based upon the Licence Holder's control measures, observations from site visits of large volumes of leachate pooling on the Hardstand, cracking in the Hardstand and groundwater monitoring results, the Delegated Officer has determined that the likelihood of moderate leachate impacts from the leachate collection system will probably occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of leachate impacts from the leachate collection system to be **Likely.**

7.4.8 Overall rating

Feedstock storage

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of leachate impacts from feedstock storage is **Medium.**

Pre-treatment of feedstock (spraying and bale breaking)

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of leachate impacts from pre-treatment of feedstock is **High.**

Windrows

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of leachate impacts from compost piles and windrows is **High.**

Leachate collection and storage system

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of leachate impacts from the leachate collection system is **High.**

Collective sources

Considering the multiple potential sources of leachate within the Premises and within the other Nambeelup Farm Premises, the Delegated Officer has determined that the multiple sources contribute to an increased overall consequence from the emissions, as they may result in a greater cumulative volume of leachate emitted and therefore increase the severity of the impact on receptors. The Delegated Officer has determined that leachate emissions from the Nambeelup Farm premises collectively could cause mid-level off-site impacts and could therefore have a **Major** consequence.

The Delegated Officer considers that the likelihood of a major impact resulting from the Nambeelup Farm premises collectively is **Possible**.

The Delegated Officer has determined that the overall rating for the collective sources is **High**.

7.5 Risk of odour impacts

7.5.1 General hazard characterisation and impact

Individual responses to odour emissions may vary depending on age, health status, sensitivity, and odour exposure patterns. Perceived odour intensity may increase or decrease on exposure. Community response to an odour can include annoyance, potentially leading to stress, and loss of amenity. Exposure to repeated odour events can create a nuisance effect.

The sources of odour within the Premises are discussed in the section below.

The location of the Premises adjacent to the C-Wise and CM Farms premises results in cumulative odour impacts from the Nambeelup Farm premises. The cumulative effect is considered to increase the consequence and likelihood of odour emissions from the Premises.

Exposure times and frequency of odour emissions depend on day to day activities and weather conditions.

The Mandurah Odour Investigation identified that odour from the Nambeelup Farm area could be recognised up to 8.5km from the premises, within the suburbs around Mandurah.

Sources

Feedstock storage

The Licence Holder stores chicken manure, gypsum and straw bales on the Premises prior to use in the composting process. Chicken manure is the most odourous of these feedstocks and between 600 to 1200m^3 of manure are stored in open-air bunkers for extended periods of time.

Pre-treatment of feedstock (spraying and bale breaking)

During the pre-treatment of the feedstock, straw bales are sprayed with leachate using sprinklers. The leachate then drains towards the storage ponds via a direct channel and/or flowing over the Hardstand area towards the pump and spillway. The bale breaking occurs once per week and involves the breaking open of anaerobic straw bales and adding chicken manure. During this activity leachate similarly flows and pools over the Hardstand area towards the pump and spillway.

Windrows

The compost is formed into open-air windrows. During the creation of the compost piles and windrows bore water is added to maintain the desired moisture content. During this activity leachate also flows over the Hardstand area towards the pump and spillway. The compost piles are turned every second or third day to promote aeration. Anaerobic zones may form within the windrows between turns. Gypsum is added to the compost which has the potential to release sulphur emissions.

Leachate collection and storage system

Leachate from the above processes flows and pools over the Hardstand area towards the pump and spillway. This creates a large surface area of leachate over the Hardstand area and therefore creates elevated potential for odour emissions. The leachate is directed to Pond 1 for storage before being reused in the bale wetting stage. In the event that Pond 1 overflows or is too full, the leachate is directed to Pond 2. There is an agitator within Pond 1 which is intended to provide some aeration of the leachate.

7.5.2 Criteria for assessment

There are no set threshold or concentration criteria for odour assessment. The general provisions of the EP Act make it an offence to cause or allow unreasonable emissions which includes emissions of odour that unreasonably interfere with the health, welfare, convenience, comfort or amenity of any person.

7.5.3 Licence Holder controls

The Licence Holder provided a draft odour management plan to the Department on the 10 October 2013. During a site visit on the 13 October 2016, it was confirmed that the Licence Holder is yet to finalise an odour management plan. The following controls are based on information gathered by DWER officer's from the site visit and information provided by the Licence Holder in support of the February 2016 licence renewal.

Table 18: Licence Holder infrastructure controls for odour emissions

Source	Control(s)	Operation details	Reference to Issued Licence Map (Attachment 1)
Controls for odour			
Feedstock storage	Wetting down of storage areas to prevent dispersion of dry manure	Wetting down of storage areas when handling feedstock	Site Map
Pre-treatment of feedstock (bale wetting and breaking)	Timing of bale wetting	Wetting occurs after 9am on Thursdays and Fridays	Site Map
	Wetting of bales during breaking stage to prevent dispersion of dry manure	Wetting of bales during bale break stage.	Site Map
Compost piles and windrows	Management of compost to prevent anaerobic conditions.	Turning windrows every second or third day (third day where the second day is during the weekend)	Site Map
		Windrow size of 2m x 2m to prevent anaerobic cores	Site Map
		Control of moisture content	Site Map
Leachate collection and storage system	Active pond is fitted with an agitator	24 hour operation	Site Map

7.5.4 Key findings

The Delegated Officer has reviewed the information regarding the odour impacts from the Premises and has found:

1. *The three Nambeelup Farm premises are likely to have a cumulative odour impact.*
2. *Odour emissions from the Nambeelup Farm area have had a demonstrated impact on receptor amenity.*
3. *The appropriate management of leachates and leachate ponds is imperative for managing odour emissions from the Premises.*

7.5.5 Consequence

Based upon the sensitivity of residential receptors and the nature and characteristics of the odour, the large residential population located within the distance which odour from the Premises has previously travelled (as determined in the Mandurah Odour Investigation), the Delegated Officer has determined that odour emissions from individual sources may cause mid level impacts to amenity. Therefore, the Delegated Officer considers the consequence to be **Moderate.**

7.5.6 Likelihood of consequence

Feedstock storage

Based upon the Licence Holder's control measures, DWER investigations, site visits and technical advice, the Delegated Officer has determined that the likelihood of moderate odour impacts from the storage of feedstocks will not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **Unlikely.**

Pre-treatment of feedstock (spraying and bale breaking)

Based upon the Licence Holder's control measures, DWER investigations, site visits and technical advice, the Delegated Officer has determined that the likelihood of moderate odour impacts from the bale wetting and bale breaking stage will probably occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of odour impacts from the spraying and bale breaking stage to be **Likely.**

Windrows

Based upon the Licence Holder's control measures, DWER investigations, site visits and technical advice, the Delegated Officer has determined that the likelihood of moderate odour impacts could occur at some time. Therefore, the Delegated Officer considers the likelihood to be **Possible.**

Leachate collection and storage system

Based upon the Licence Holder's control measures, DWER investigations, site visits and technical advice, the Delegated Officer has determined that the likelihood of moderate odour impacts will probably occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **Likely.**

7.5.7 Overall rating

Feedstock storage

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of odour on sensitive receptors during operation is **Medium.**

Pre-treatment of feedstock (spraying and bale breaking)

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of odour on sensitive receptors during operation is **High.**

Windrows

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of odour on sensitive receptors during operation is **Medium.**

Leachate collection and storage system

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of odour on sensitive receptors during operation is **High.**

Collective sources

Considering the multiple potential sources of odour within the Premises and within the other Nambeelup Farm Premises, the Delegated Officer has determined that the multiple sources contribute to an increased overall consequence from the emissions, as they may result in greater cumulative odour emissions and therefore increase the severity of the impact on amenity. The Delegated Officer has determined that odour emissions from the Nambeelup

Farm premises collectively could cause high level impacts to amenity and could therefore have a **Major** consequence.

The Delegated Officer considers that the likelihood of a major impact resulting from the Nambeelup Farm premises collectively is **Likely**.

The Delegated Officer has determined that the overall rating for the collective sources is **High.**

7.6 Summary of risk assessment and acceptability

A summary of the risk assessment and the acceptability of the risks with treatments are set out in Table 19 below. Controls are described further in Section 8.

Table 19: Risk assessment summary

	Emission		Pathway and Receptor	Licence Holder controls	Impact	Risk Rating	Acceptability with treatment (conditions on instrument)
	Type	**Source**					
1A	Leachate	Feedstock storage	Seepage through soil to groundwater on-site. Overland flow and migration through groundwater to adjacent land, wetlands, nature reserve and Serpentine River (EPP).	Bunded Hardstand area. HDPE lined ponds.	Contamination of groundwater supply for nearby users. Impact to flora and fauna at nearby nature reserve Contamination of surface waters and impacts to ecosystem function.	Major Unlikely **Medium Risk**	Acceptable, generally subject to regulatory controls.
1B		Pre-treatment				Major Likely **High Risk**	Acceptable subject to multiple regulatory controls.
1C		Composting				Major Likely **High Risk**	Acceptable subject to multiple regulatory controls.
1D		Leachate collection and storage system				Major Likely **High Risk**	Acceptable subject to multiple regulatory controls.
2A	Odour	Feedstock storage	Air (windborne)	Storage within bunkers, wetting down of manures	Amenity impacts on residential receptors and users of airfield.	Major Unlikely **Medium Risk**	Acceptable, generally subject to regulatory controls.
2B		Pre-treatment		Spraying commences later in the mornings.		Major Likely	Acceptable subject to multiple regulatory controls.

	Emission		Pathway and Receptor	Licence Holder controls	Impact	Risk Rating	Acceptability with treatment (conditions on instrument)
	Type	Source					
						High Risk	
2C		Composting		Small size windrows to prevent anaerobic cores. Regular turning of materials.		Major Possible **High Risk**	Acceptable subject to multiple regulatory controls.
2D		Leachate collection and storage system		Agitator in Pond 1		Major Likely **High Risk**	Acceptable subject to multiple regulatory controls.

8. Determined Regulatory Controls

8.1 Summary of controls

A summary of the risks with corresponding controls are set out in Table 19. The risks are set out in the assessment in Section 7 and the controls are detailed in this Section 8. Controls will form the basis of conditions in the Licence set out in Attachment 1.

Table 19: Summary of regulatory controls to be applied

			Controls						
			8.2 Production limit	8.3 Waste acceptance controls	8.4 Infrastructure and equipment	8.5 Operational controls	8.6 Groundwater monitoring	8.7 Pond water quality monitoring and actions	8.8 Specified actions
Risk Items (see risk analysis in section 7)	1A Leachate from feedstock storage				•	•	•		
	1B Leachate from pre-treatment				•	•	•		
	1C Leachate from composting				•	•	•		
	1D Leachate from leachate collection and storage system		•		•	•	•		•
	2A Odour from feedstock storage			•	•	•			
	2B Odour from pre-treatment		•		•	•		•	
	2C Odour from composting		•		•	•			
	2D odour from leachate collection and storage system				•			•	

8.2 Production limit

The Licence Holder will be limited to producing a maximum of 37,000 tonnes of compost per Annual Period.

Grounds: *There is no production or design capacity specified within the Existing Licence, and the current level of production is up to 37,000 tonnes of compost produced per year. The Licence Holder has not proposed any increase in production.*

8.3 Waste acceptance controls

The Licence Holder will be limited to accepting the following waste which have been risk assessed as part of this licence review:

- chicken manure

This restriction does not preclude the acceptance of non-waste feedstocks, such as fertilisers for example.

Grounds: *The waste types which may be accepted at the Premises are limited to those which have been assessed.*

8.4 Specific infrastructure and equipment controls

8.4.1 Leachate impact controls

The following infrastructure and equipment should be maintained and operated onsite for leachate management:

- bunded and graded Hardstand;
- drainage infrastructure: channel and spillway;
- lined leachate ponds; and
- groundwater monitoring bores.

A requirement that the Hardstand meets a hydraulic conductivity of less than 1.0 x 10^{-9} m/s will be included.

The Hardstand will be required to be capable of accommodating the weight and movement of vehicles and equipment used on the Hardstand, without compromising the integrity of the Hardstand or altering the drainage. The Hardstand must have a drainage gradient to ensure the free drainage of all leachate to the leachate ponds. The drainage infrastructure consisting of drainage channel and spillway will be required to meet a hydraulic conductivity of less than 1.0 x 10^{-9} m/s.

The Licence Holder will be required to repair the Hardstand within six months of the issue of the Revised Licence. A report by a suitably qualified expert will be required, verifying that the specifications for the Hardstand have been met.

Note: *These controls generally replicate the Licence Holder's controls and were considered by the Delegated Officer in determining leachate emission impact risk.*

Grounds: *The maintenance of the existing infrastructure and construction of any new infrastructure to the specified standard is necessary for the mitigation of leachate impacts to groundwater. The specification of a Hydraulic Conductivity of less than 1.0 x 10^{-9} m/s for the Hardstand and drainage infrastructure will ensure that seepage of leachate and consequently groundwater contamination from these locations is adequately controlled. The Delegated Officer notes that groundwater monitoring results indicate that there is likely seepage from the existing leachate collection and storage infrastructure. A requirement for the Licence Holder to undertake testing to determine the integrity of the pond liners is included as a specified action*

within Section 8.8.

A key finding of this assessment is that the existing Hardstand is extensively cracked (see Appendix 3, Photos 11-14, 33-40) indicating it was not constructed to withstand operational activities and is likely to be allowing leachate to seep through the surface. The requirement for the Hardstand to be capable of accommodating the weight and movement of vehicles is necessary to maintain the Hardstand's integrity.

The Delegated Officer has therefore determined that the existing Hardstand must be repaired and that an expert report is required to verify that the required hydraulic conductivity and structural integrity is met.

Appropriate grading of the Hardstand and drainage infrastructure prevents pooling and overflow thus reducing the risk of seepage and controlling odour. Pooling and inadequate drainage is an issue identified at site visits (Appendix 3, Photos 16, 27-29, 45 and 46).

The Delegated Officer has determined that the Licence Holder's proposed method of repair consisting of the application of a cementitious polymer as filler for cracks is acceptable if it can be verified that the result will meet the outlined criteria relating to hydraulic conductivity and structural integrity. The Licence Holder may be required to undertake additional repairs should cracking re-occur.

8.4.2 Odour control

The following infrastructure and equipment should be maintained and operated onsite for odour management:

- aerator that achieves aeration of the entire pond surface, designed to prevent the generation of mist and operates continuously;
- concrete bunkers;
- infrastructure for the removal of solids from the leachate flow into the ponds;
- bale dunking system; and
- bale line covers.

The Licence Holder will also be required to construct new and upgrade existing infrastructure.

Bale line covers are to be installed to contain sprays of odourous recirculated leachate and chicken manure particles, reducing their dispersion through the air. Bale line covering will include coverage of the gap between the bale breaker and the chicken manure hopper, the output conveyor and provide enclosure over the top of the chicken manure hopper.

A bale dunking system designed to infuse straw bales with leachate from the ponds is to be installed, eliminating the need for spray application for initial wetting of the bales. The bale dunking system is required to include:

- a drip tray to temporarily hold dunked bales and direct runoff back into the dunking bath;
- containment of overflow from the bath to prevent overflow from spilling onto the Hardstand; and
- a pipeline directing any overflow back to Leachate Pond 1.

An appropriate screen is to be installed to capture solid materials preventing it from entering the ponds and Pond 1 is to be equipped with an aerator to improve the pond water quality. This infrastructure is required to be installed prior to leachate being directed into the ponds following the pond clean-up discussed below in Section 8.8.1.

Concrete bunkers are currently in place to hold chicken manure and gypsum.

Grounds: *The Delegated Officer has determined that based on the outcomes of the risk assessment detailed in this report, additional regulatory controls through licence conditions are required to mitigate the high odour impact risk from the pond water quality and bale wetting and bale breaking activities.*

The Delegated Officer considers that aeration of Leachate Pond 1 is necessary to achieve an improvement in the pond water quality, and therefore a reduction in the odour risk associated with the pond water. It has been determined through consultation with the Licence Holder that due to the complexities surrounding the generation of odour, the use of water quality parameters to control and manage odour has limitations. As an alternative, the pond aeration will be required to achieve aeration across the entire pond surface, to maintain an aerobic layer at the pond surface. Continuous oxygenation of the ponds through aeration, acts to ensure aerobic conditions are maintained within the pond surface and can decompose odourous compounds (generated within deeper water or sludges) before they emit to the atmosphere. This requirement applies only to Leachate Pond 1 because this is the first pond in the train of ponds, and the other two ponds are generally empty.

The Delegated Officer considers that modifying the process of bale wetting by introducing bale dunking as the means of initial wetting as opposed to spray wetting will reduce the potential for odour generation. It is considered that the dispersion of droplets of odourous liquids through air as occurs during spray wetting will likely cause greater odour emissions that travel further than the process of bale dunking. Odour generation will be more confined to the dunking bath and the liquid infused bale as it emerges from the bath thus reducing the potential for odourous droplets to be dispersed as far.

The drip tray and containment of overflow from the dunking bath is intended to reduce the volume of leachate running across the hardstand, reducing the surface area from which odour may be generated.

In addition the enclosure of the bale line is required to achieve a further reduction in odour emissions at the process stage where bale breaking occurs, which is one of the major odour sources on site.

A key finding of the assessment is that the leachate receiving pond (Pond 1) is also a major source of odour at the Premises, and this is considered to be attributable to its high organic load and consequently anaerobic state. On-Premises observations indicate that there is significant influx of solid materials including fine debris into the pond (see Appendix 3, Photos 25, 26, 51). The Delegated Officer considers that the requirement to install additional solids capture infrastructure is required to prevent solid material entering the ponds and will assist in maintaining an aerobic state in the ponds resulting in reduced odour emissions from this source. A maximum screen opening size of 5mm will be specified within the Licence, which allows for a screen with a slightly larger opening size than has been proposed by the Licensee (1.4mm). The specification of the maximum screen opening size provides enforceable wording for the performance and compliance of the solids capture infrastructure.

8.5 Operational Controls

8.5.1 Leachate impact controls

The Licence Holder will be required to meet the following operational controls for leachate management:

- Immediately clean spills from outside the Hardstand area.
- The storage of chicken manure, gypsum and urea/other nitrogen based fertilisers and the processes of pre-treatment, composting and the storage of composted material ready for dispatch must be undertaken on the Hardstand area.

- Maintenance of minimum of 300mm freeboard in Pond 3.

Grounds: *The Delegated Officer has determined that based on the outcomes of the risk assessment detailed in this report, additional regulatory controls through licence conditions are required to mitigate the high leachate impact risk.*

The Delegated Officer considers that the requirement to immediately clean spills form outside the Hardstand area will ensure that the likelihood of seepage to groundwater is minimised by removing any potential source from spills.

The requirement for storage, pre-treatment and composting on the Hardstand area is considered to mitigate the risk of leachate seepage and impacts to groundwater.

The Delegated Officer considers that the requirement to maintain a freeboard of 300mm within Pond 3 at all times is sufficient to mitigate potential overflow.

8.5.2 Odour impact controls

The Licence Holder will be required to meet the following operational controls for odour management:

- Chicken manure must be stored in a bunker, and the manure stockpile must not exceed the height of the bunker walls.
- Leachate must not pool on the hardstand.
- From six months from the issue date of the Revised Licence, spray wetting of bales for the initial wetting (this excludes the application of leachate within the bale line) must be replaced with bale dunking.
- Prior to ceasing spray wetting of bales, only large droplet sprinklers must be used.
- Immediately after dunking, dunked bales must be held above the bath or placed onto a drip tray (which directs runoff back into the bath) for no less than two minutes prior to placement on the Hardstand. This will minimise the runoff from the dunked bales on the Hardstand area.
- All mixed feedstocks and windrows must be turned at least every three days to maintain aerobic conditions.

Grounds: *The Delegated Officer has determined that based on the outcomes of the risk assessment detailed in this report, additional regulatory controls through licence conditions are required to mitigate the high odour impact risk.*

Storage of the chicken manure within a bunker and maintaining the material below the height of the bunker wall will assist in mitigating the odour impacts from its storage as it minimises wind dispersion of the manure and potential odours.

A key finding of the assessment is that the pooling of leachates over a large surface area contributes to odour emissions from the Premises. The Delegated Officer considers that the requirement to ensure leachate does not pool on open Hardstand areas will minimise the surface area of leachates and therefore limit the source of odour emissions. Actions such as keeping drainage free from blockages and obstructions will prevent pooling. It is also considered important that leachate runoff across the Hardstand from bales that have been submerged in the dunking bath is minimised by allowing the dunked bales to drain into the bath prior to being transferred to the bale laydown area.

The Delegated Officer has considered that once improvements in pond water quality have been achieved, odour emissions from pond water will be reduced but notes that odour emissions from a pond surface are lower than odour emissions from the same liquid dispersed as droplets into air. The process of bale spraying will be replaced with bale dunking as

discussed in Section 8.4.2.

The Delegated Officer has determined that the use of large droplet sprinklers, as opposed to sprinklers with a finer spray, will reduce the dispersion of odour during the application of leachate to straw bales during pre-treatment, prior to the transition from spray wetting to dunking. It is also noted that there is expected to be an improvement in pond water quality prior to the transition to bale dunking based on pond monitoring and actions discussed in Section 8.7.

The Delegated Officer considers that appropriate maintenance of the composting process is necessary to adequately control the risk of odour from the Premises. The requirement to turn all mixed feedstocks and the windrows to promote an aerobic state is considered to be effective in minimising odour emissions from these materials.

8.6 Groundwater monitoring and reporting

8.6.1 Groundwater monitoring requirements

The Licence Holder is required to carry out ongoing quarterly groundwater monitoring at all bores on the Premises for the following parameters:

- Standing water level
- pH
- Total dissolved solids (TDS)
- Mercury
- Zinc
- Arsenic
- Nitrate-nitrogen
- Nitrite-nitrogen
- Ammonium-nitrogen
- Total nitrogen
- Total phosphorus

The Licence Holder is required to conduct a once-off groundwater monitoring event for the following metals:

- Cadmium
- Chromium
- Copper
- Iron
- Manganese
- Nickel
- Lead

The Licence Holder will be required to undertake all groundwater monitoring following the methods specified in AS 5667.1 and AS 5667.11 and have the results tested by a NATA accredited laboratory for the analytes specified.

Note: *The ongoing monitoring is based on the existing monitoring requirements but has been*

expanded to include mercury, zinc and arsenic as new analytes.

CM Farms will be required to install an additional groundwater monitoring bore on the southern boundary of the CM Farms premises to provide further data closer to the sensitive receptors south of the Premises. The monitoring data from all three Nambeelup Farm premises will in future be interpreted collectively; therefore this requirement on the CM Farms Licence is also relevant to addressing the leachate risk from this Premises. Further investigation or regulatory control may be required in future depending on the groundwater quality results obtained from the additional bore.

***Grounds**: Due to high levels of groundwater contamination documented from the groundwater bores at the Premises (Appendix 4), quarterly monitoring is required to allow for a more thorough interpretation of monitoring results. DWER will be able to use the monitoring results to assess whether appropriate progress has been made or whether additional controls need to be implemented. The parameters required to be sampled on an ongoing basis have been expanded to include mercury, zinc and arsenic and are consistent with monitoring carried out at the other Nambeelup Farm premises and relevant to the materials received, used, and stored at the three premises.*

Mercury, zinc and arsenic have been included in the quarterly monitoring suite of analytes to ensure that the potential risk to human health and the environment from this type of contamination can be assessed on an ongoing basis. The once-off monitoring for other metals is required to detect the presence and levels of these metals, though ongoing monitoring for these metals is not currently considered necessary. If the results show there has been an impact, the Delegated Officer may review the current groundwater monitoring parameters.

The selected suite of analytes with the addition of selected metals is considered appropriate for the characterisation and detection of groundwater contamination caused by nutrient rich leachates derived from organic materials.

The requirement to have the samples taken using a specified method and analysed in a specified laboratory is considered appropriate in ensuring the quality of the data submitted.

8.6.2 Groundwater monitoring reporting

The Licence Holder will also be required to provide a quarterly report of groundwater monitoring results (excluding the last quarter of the year which will be captured within the annual report), which includes a summary of results above the background levels (as determined in Appendix 4) for the previous quarter and the raw monitoring data in Excel format.

The Licence Holder will also be required to report all groundwater monitoring results on an annual basis. This report will be required to contain raw data in excel format, comparison of data against groundwater background levels (as determined in Appendix 4) and ANZECC stock water guidelines, and details of sampling quality assurance and quality control.

***Grounds:** The Delegated Officer considers that this reporting is appropriate to monitor groundwater impacts at the Premises, and the specification of the reporting requirements is sufficient to enable DWER to analyse the data. The data will be used to determine the adequacy of infrastructure controls and assess for groundwater impacts resulting from infrastructure defects, failure, or malfunction (e.g. pond seepage as a result of liner failure). DWER may review the appropriateness and adequacy of the licence controls based on the review of the monitoring data.*

The quarterly reporting frequency provides a mechanism for DWER to be informed of issues and respond to an exceedance of background levels within a shorter timeframe than if the exceedance was only reported annually.

8.7 Pond monitoring and actions

8.7.1 Pond monitoring requirements

The Licence Holder is required to undertake ongoing monitoring of pond water at the Premises for the following parameters:

- Oxidation Reduction Potential (ORP)
- Dissolved oxygen (DO)
- pH
- Temperature
- Biochemical oxygen demand (BOD_5)
- Volume of sludge

The Licence Holder will be required to de-sludge a pond when sludge is at more than 30% capacity. Capacity is calculated as pond water volume, not including freeboard.

The Licence Holder will be required to undertake a once-off monitoring event for the following parameters:

- Total nitrogen
- Total phosphorus

***Note**: Following the issue of the Revised Licence, a program of inspections for the Nambeelup Farms premises will be undertaken to assess compliance with the Revised Licence and the effectiveness of the licence conditions. The management of the ponds will be a particular focus.*

***Grounds**: Pond water quality sampling was requested by the Department in June 2016 for all ponds at Nambeelup Farm for the purpose of evaluating the potential for the production of odourous compounds. Pond water quality analysis results are further discussed in Appendix 7 highlighting the need to improve the water quality for odour reduction.*

Ongoing monitoring is therefore considered necessary to assess whether the ponds are working effectively and to evaluate the potential for the production of odourous compounds. A monitoring regime of all operational ponds at the Premises has been specified in the licence, with the parameters based on those analysed in June 2016 at all the Nambeelup Farm premises.

A once-off nutrient monitoring event is required to provide information that can be used with pond integrity testing results to determine the quantities of contaminants being emitted from the Premises.

Desludging of the ponds will ensure that the operational capacity of the ponds is maintained. The buildup of sludge in the aerobic ponds can also promote anaerobic conditions that increase the risk of odourous compounds being generated.

The Delegated Officer has determined that once-off monitoring for total nitrogen and total phosphorus is required to provide the concentrations necessary for an estimation of the emission rate of nitrogen and phosphorus through the pond liners (the requirement for the Licence Holder to provide this estimation is addressed within Section 8.8.2).

8.7.2 Pond monitoring reporting

The Licence Holder will be required to provide within an annual report, the raw pond monitoring data, time series graphical plots and details of the sampling quality assurance and quality control.

Details of any sludge removal from the ponds will be required within the annual report.

Grounds**:** *The Delegated Officer considers that the water quality monitoring is required to ensure that ponds are adequately managed so that odour generation is minimised. DWER may use the reported monitoring results to assess whether ponds have been appropriately managed or whether additional controls are required. DWER may also request pond monitoring data outside the annual reporting timeframe as part of compliance inspections or complaint investigations.*

8.8 Specified actions

8.8.1 Pond clean-up

The Licence Holder will be required to undertake a clean-up of Ponds 1, 2 and 3 by emptying the ponds of leachate, sludge, floating solid matter. The contents of the ponds must be removed from the Nambeelup farm premises on the day of removal from the ponds. This must be undertaken by 15 October 2018.

The Licence Holder will be required, at least 5 days prior to the clean-up being undertaken, to provide written notification to the Department of the date on which this clean-up will occur.

Grounds: *The Delegated Officer considers that the removal of sludge and solid matter from the ponds will assist in reducing the organic load within the ponds. This is expected to reduce the risk of anaerobic conditions and the potential for odour generation within the ponds. The Delegated Officer also considers that the removal of the recycled leachate, and the* ***subsequent replacement with 'new' leachate which results from the use of bore water initially,*** *would allow for an immediate decrease in the odour risk presented by the recycled leachate and allow the new infrastructure (aerator and solids capture) to better maintain the water quality in future.*

As the ponds have not been effectively aerated previously, this sludge removal event is considered to present a greater odour risk than future sludge removal events, as the ponds are expected to be maintained in an aerobic state in future.

The notification to the Department of the date on which the clean-up will occur is considered necessary, as this event could potentially generate additional odour emissions during the day that ***it's being undertaken.***

8.8.2 Pond liner integrity testing

The Licence Holder will be required to carry out liner integrity testing on all ponds within the Premises. This testing should be carried out by 15 February 2019.

The results of the liner integrity testing shall be reported to the Department within one month of the completion of the testing for each pond. An estimation of the total volume of seepage (from that pond per year) and total mass of nitrogen and phosphorus emitted via seepage (from that pond per year) will also be required to be reported at this time. The designed hydraulic conductivity of the liner (in an undamaged or repaired state), hydraulic head pressure and pond monitoring results for total nitrogen and total phosphorus shall inform these estimations.

If damage to the pond liner is detected, an upgrade plan must also be provided at this time.

Grounds*: Nambeelup Farm is classified as contaminated under the CS Act. Groundwater monitoring carried out across Nambeelup Farm suggests that sources of contamination are present. The monitoring is not able to confirm the exact location of sources within the Nambeelup Farm premises; however the ponds are potential sources.*

Given the potential for the ponds to be sources of contamination, a requirement for the Licence Holder to test liner integrity has been included in the Licence. The Delegated Officer

considers that the electrical testing (ASTM D6747, D7007, D7703, D7002 or D7703) for liner integrity is the most appropriate testing method. A method of measuring seepage from the ponds through an overnight water balance test was considered, however given the relatively small size and frequent emptying of the ponds at the Premises, the requirement to undertaken electrical liner integrity testing is preferable to the overnight water balance test.

In the current operational setting pond liners are potentially exposed to considerable wear and tear. Examples are UV damage that occurs over time, particularly when liners are not covered and liner damage caused by upward pressure due to shallow groundwater.

The Delegated Officer has determined that it is necessary to estimate the seepage rate and the rate of nitrogen and phosphorus emissions from the ponds to allow further consideration of the potential risk to receptors and to verify that the mass of phosphorus emissions are not inconsistent with the environmental quality objectives of the Peel Inlet-Harvey Estuary EPP. DWER will consider the estimations submitted. If the seepage rates from the ponds are considered to be too high, additional regulatory controls may be needed.

8.8.3 Depth to groundwater investigation

The Licence Holder is required to conduct an investigation into the depth to groundwater from the base of the ponds to the maximum groundwater level.

Grounds: *The risk to groundwater increases with reduced separation distance. If the separation distance is not sufficient, seepage from ponds may be a significant source of groundwater contamination. Knowledge of separation distance is also important for assessing whether there may be upward pressure on liners that could lead to damage particularly for ponds that are not continuously filled.*

The groundwater report will be used to determine the appropriateness of the pond systems and verify the specified control measures are in place. DWER may review the appropriateness and adequacy of the Licence controls based on the details of the report together with the results of the liner testing. Additional controls may be required to mitigate the risk from any ponds that do not have a sufficient separation distance.

9. Appropriateness of Licence conditions

The conditions in the Issued Licence in Attachment 1 have been determined in accordance with DWER's *Guidance Statement on Setting Conditions*.

Condition Ref	Grounds
Emissions	This condition is valid, risk-based and consistent with the EP Act.
Compost production limit	This condition is valid and risk-based (see Section 8).
Waste acceptance controls	These conditions are valid, risk-based and contain appropriate controls (see Section 8).
Infrastructure and equipment controls	These conditions are valid, risk-based and contain appropriate controls (see Section 8).
Operational Controls	These conditions are valid, risk-based and contain appropriate controls (see Section 8).
Groundwater Monitoring	These conditions are valid, risk-based and contain appropriate controls (see Section 8).
Pond Monitoring and actions	These conditions are valid, risk-based and contain appropriate controls (see Section 8).
Specified Actions	These conditions are valid, risk-based and contain appropriate controls (see Section 8).

Record-keeping	These conditions are valid and are necessary administration requirements to ensure compliance.
Ongoing reporting	These conditions are valid and are necessary reporting requirements to ensure compliance and assessment of environmental performance.

DWER notes that it may review the appropriateness and adequacy of controls at any time, and that following a review, DWER may initiate amendments to the Licence.

10. Licence duration

Giving consideration to the current lease period for the Premises, and the annual licence fee period, the Issued Licence has an expiry date (27 April 2020) which provides an eighteen month extension on the expiry date of the existing Licence.

Due to a previous 6 month extension to the Licence, an eighteen month extension rather than a 12 month extension is preferable to realign the licence expiry date with the annual licence fee period.

The Licence period will extend beyond the current lease period, however this is considered to be a low risk as the lease is expected to be extended beyond the Licence expiry date. Should the lease not be extended and on-going management of the site is considered necessary the Department will consider issuing a Closure Notice on the Premises. The Issued Licence duration may be extended in future should the lease for the Premises also be extended.

11. Licence Holder consultation

The Licence Holder was provided with the draft decision report and draft Licence on 29 March 2017 for an initial consultation period. The Licence Holder was provided with the revised draft decision report and draft Licence on 13 February 2018 for a second consultation period.

The Licence Holder provided comments which are summarised along with DWER's response in Appendix 2.

12. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this decision report (summarised in Appendix1). This assessment was also informed by a site inspection by DWER officers on 13 October 2016.

Based on this assessment, it has been determined that the Revised Licence will be granted subject to conditions commensurate with the determined controls and necessary administration and reporting requirements.

Ruth Dowd
Senior Manager Waste Industries
Delegated Officer
under section 20 of the *Environmental Protection Act 1986*

Appendix 1: Key Documents

In-text references			
	Document Title	**In-text ref**	**Availability**
1	ANZECC & ARMCANZ, 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.	ANZECC & ARMCANZ 2000	www.agriculture.gov.au/SiteCollectionDocuments/water/nwqms-guidelines-4-vol1.pdf
2	Australian Pork Limited, 2010. *National Environmental Guidelines for Piggeries, Second Edition (Revised).*	Austrailan Pork Limited, 2010	www.australianpork.com.au
3	Bureau of Meteorology - Climate data online. Accessed 5 October 2016	BOM 2016	bom.gov.au
4	Department of Environment Regulation, Western Australia, 2014. *Assessment and management of contaminated sites, Contaminated sites guidelines.*	DER 2014	www.der.wa.gov.au/your-environment/contaminated-sites/61-contaminated-sites-guidelines
5	Department of Water, Western Australia, 2009. *Ponds for stabilising organic matter.* Water Quality Protection Note, WQPN 39.	DoW, 2009	water.wa.gov.au
6	Department of Environmental Quality, State of Idaho, 2014. *Statistical Guidance for Determining Background Ground Water Quality and Degradation*.	DoEQ, 2014	www.deq.idaho.gov/media/1226/guidance-statistical-degradation.pdf
7	Hall, J., Kretschmer, P., Quinton, B. and Marillier, B., 2010. *Murray Hydrological Studies: Surface water, groundwater and environmental water. Conceptual model report.* Department of Water, Water Science Technical Series, Report WST 16.	Hall *et al.*, 2010	www.water.wa.gov.au
8	Ham, J.M. and Baum, K.A., 2009. *Measuring seepage from waste lagoons and earthen basins with an overnight water balance test*. Transactions of the American Society of Agricultural and Biological Engineers, 52(3), 835-844	Ham and Baum, 2009	DWER records
9	Marillier, B., 2012. *Nambeelup Groundwater Modelling Report*. Department of Water, Water Science Technical Report No WST 47.	Marillier, 2012	water.wa.gov.au and DWER records (A1169872)

10	United States Environmental Protection Agency (US EPA), 2011. *Principles of design and operations of wastewater treatment pond systems for plant operators, engineers, and managers* (457 pages) Accessed 3 March 2017.	US EPA, 2011	https://www.epa.gov/sites/production/files/2014-09/documents/lagoon-pond-treatment-2011.pdf
11	YSI International, 2008. *ORP Management in Wastewater as an Indicator of Process Efficiency,* Application Note.	YSI Environmental 2008	https://www.ysi.com/File%20Library/Documents/Application%20Notes/A567-ORP-Management-in-Wastewater-as-an-Indicator-of-Process-Efficiency.pdf
12	Zang, R.H., Dugba, P.N. and Bundy, D.S. 1997 *Laboratory study of surface aeration of anaerobic lagoons for odor control of swine manure*. Transactions of the American Society of Agricultural and Agricultural Engineers 40(1): 185-190	Zang *et al.*, 1997	-

Other documents

	Document Title	Availability
1	Licence L7210/1997/10	accessed at http://www.dwer.wa.gov.au
2	Mushroom Exchange Pty Ltd Nambeelup Compost Facility Odour Management Plan (Draft) – October 2013	DWER records (A683292)
3	Letter from Brian Backhouse to Hayden Nebel regarding DER Inspection 08 March 2016, Dated 13 April 2016	DWER records (A1083092)
4	Nambeelup Compost Facility – Mushroom Exchange – Annual Environmental Report 2015-2016	DWER records (A1140291)
5	Nambeelup Compost Facility – Mushroom Exchange – Annual Environmental Report 2016-2017	DWER records (A1536972)
6	Mushroom Exchange Inspection Report July 2014	DWER records (A800762)
7	Mushroom Exchange Inspection Close out Letter – 12 September 2013	DWER records (A674749)
8	Mushroom Exchange Inspection Report April 2013	DWER records (A673372)
9	MushroomExchange Pty Ltd ASIC lookup	DWER records (A1174048)
10	Mushroom Exchange planning approval for rural industry	DWER records (A1174057)
11	Contaminated Sites Act 2003 – Basic Summary of Records Search Response – Lot 89 on Plan 741	DWER records (A1169774)
12	Sublease 230 Gull Road Nambeelup WA – George Weston Foods Limited, Derby Industries Pty Ltd,	DWER records (A1176727)

	MushroomExchange Pty Ltd.	
13	Extension of Sublease – 230 Gull Road, Nambeelup WA - George Weston Foods Limited, Derby Industries Pty Ltd, Mushroomexchange Pty Ltd.	DWER records (A1176874)
14	Licence Application – Chiquita Mushrooms Pty Ltd, Dated 30 January 2004	DWER records (A269445)
15	Letter: New Commercial Arrangement between Custom Composts and Chiquita Mushrooms, Andrew Gulliver, Dated 19 September 2002	DWER records (268517)
16	Letter: *Review of Existing Premises and Proposed Licence Amendments*, Mushroom Exchange Pty Ltd, 28 April 2017	DWER records (A1420102)
17	Letter: *Review of Existing Premises and Proposed Licence Amendments*, Mushroom Exchange Pty Ltd/Costa, dated 16 June 2017	DWER records (A1452529)
18	Email: *Re: Site visit Mushroom Exchange follow up*, Backhouse, B. 27 July 2017	DWER records (A1490248)
19	Email: Costa – *Mushroom Exchange – Controls,* Backhouse, B. 26 October 2017	DWER records (A1566799)
20	Letter: *Re: Notice under Section 59(B) of the Environmental Protection Act 1986 regarding licence review and amendment of Licence L7210/1997/10*, Mushroom Exchange Pty Ltd/Costa, dated 30 March 2018.	DWER records (A1645750)
21	Letter: *Re: Notice under Section 59(B) of the Environmental Protection Act 1986 regarding licence review and amendment of Licence L7210/1997/10 – Request for further information*, Mushroom Exchange Pty Ltd/Costa, dated 16 May 2018.	DWER records (A1675342)
22	DER (10 June 2016) File Note: Nambeelup Site Visit (CM Farms piggery, C-Wise, Costa mushroom compost) following odour complaints, 27 May 2016.	DWER records (A1189748)
23	DER *Guidance Statement on Regulatory principles,* July 2015	Accessed at http://www.dwer.wa.gov.au
24	DER *Guidance Statement on Setting conditions,* September 2015	
25	DER *Guidance Statement on Licence duration,* November 2014	
26	International Organisation for Standardization (ISO) 2014. *International Standard ISO 17289 Water quality – Determination of dissolved oxygen – Optical sensor method*	Accessed at www.iso.org/standard/59515.html

Appendix 2: Summary of Licence Holder's Comments on Draft Risk Assessment and Conditions

Table 1: Licence Holder's comments in response to the draft Decision Report and Licence provided to the Licence Holder on 29 March 2017 and 13 February 2018.

Aspect	Summary of Licence Holder comment	DWER response
Draft Licence – Condition 12: Feedstock Controls The Licence Holder must only accept the following feedstock materials at the Premises: a) Hay bales b) Chicken manure c) Gypsum	**Comments received on 28 April 2017:** The limiting of feedstocks should include water including recycled water, and have the option for minor additives if conditions dictate. Why is this condition necessary? **Comments received on 29 March 2018:** The limitation of the types of feedstocks allowed does not give Costa the ability to adjust its composting formulation if required. There is no flexibility in the licence condition. We may wish to use other additives such as Urea, Canola seed etc from time to time to adjust our formulation to ensure that our compost has the desired levels of nutrients to meet the exacting demands of the mushroom mycelium. There are many variants of mushroom compost around the world and many additives used to achieve a desired outcome – a restriction on the types of feedstock is unnecessarily onerous. This control achieves no environmental objective, is restrictive on quality control and should be removed. **Comments received on 16 May 2018:** Re-iteration of the above comments received on 29 March 2018. The types of additional feedstocks required may include but not limited to the following: **Legumes –** such as Soya Beans, Cotton Seed, Canola etc.	Water and recycled water do not need to be specified as a feedstock that is being accepted at the Premises, as water is sourced from the bore within the Nambeelup Farm premises and the recycled water is sourced only from the ponds within the Premises. The term **"hay bales"** has been changed to **"straw bales" for consistency throughout** the documents. The condition which restricted the types of feedstocks which could be accepted at the Premises has been amended to restrict only the types of waste which can be accepted. This wording therefore does not preclude the acceptance of non-waste feedstocks, such as fertilisers for example.

Aspect	Summary of Licence Holder comment	DWER response
	These products would be sourced in "meal" form (cracked and semi processed) and stored in bulk on our site – the approximate usage would be around 10-15 tonnes per week (500-800 tonnes per annum) based on current production volumes and intelligence gathered from other composters. We do not believe that this feedstock would cause any detrimental impact on the site. **Urea or other nitrogen based fertilisers –** this product would be sourced in bag form and stored under cover. The usage would be approx. 200-250kg per week (10-15 tonnes per annum). We do not believe that this volume of Urea stored correctly, will create any further risk impact to our site. **Straw substitution –** Maize stalks/sorghum stalks – this product would be sourced in a bulk/baled form. Volumes to be consumed would be based on substitution rates with wheat straw. We do not believe that these products would create any further risk to the site.	
Draft Licence – Condition 12: Feedstock Controls Clarification requested regarding whether chicken manure has been treated prior to acceptance (in relation to the *Biosecurity and Agriculture Management (Stable Fly) Management Plan 2016*)	**Comments received on 16 May 2018:** Costa purchases its chicken manure from C-Wise – it is our understanding that this chicken manure does not receive any form of 'treatment' prior to receipt at C-Wise. It is stockpiled at C-Wise and then delivered to our storage area as needed.	Noted and the decision report has been updated to reflect that C-Wise has applied to DPIRD for approval for the acceptance of untreated chicken manure.

Aspect	Summary of Licence Holder comment	DWER response
Draft Licence – Condition 13 Table 2 (6): Specified Infrastructure and Equipment Controls Pond aerator. Fit for the purpose of maintaining a Dissolved Oxygen level of 1mg/L within active leachate pond(s)	**Comments received on 28 April 2017:** Regarding DER's objective to reduce the potential odour source from the active liquid holding ponds by better aeration; Costa has encountered and remedied similar issues by aeration at its other facilities and commits to implementing those as Nambeelup. Costa is prepared, if requested, to provide to DER the details of such successful operations at its other locations which Costa submits would lead to a less prescriptive approach to the relevant proposed conditions. **Further comments received on 16 June 2017:** Costa proposes to install two high speed turbines into the first two ponds. Details: • 4kw Aquafen High Speed Turbine – will reduce odour by changing the active pond(s) from anaerobic state to aerobic state through the introduction of 1.3-.8kg)2/kWh. This turbine will run continuously • The addition of this turbine coupled with filtration of the leachate prior to entry to the pond will reduce the organic loads in the leachate pond water further reducing the possibility of odours. **Comments received 29 March 2018:** Costa is concerned that the measure identified by DWER is going to be unachievable – the pond is currently performing at 0.3-0.4mg/L and based on discussions with co-lessees it is understood that 1mg/L will not be achievable with the type of ponds that we all collectively run on this site. Costa proposes that we use Redox as a measure of dam health as currently measured C-Wise. Costa has no experience with this measure but would propose that we will begin conducting a testing regime that identifies our dam	The method of aeration proposed using a specific high speed turbine is acceptable if it achieves aeration of the entire pond surface and it is designed to prevent the generation of mist. The details of the aerator design have not been specified within the Licence. The Delegated Officer has considered the use of Oxidation Reduction Potential instead of Dissolved Oxygen as an indicator of potential odour generation from the ponds. As an alternative to the DO action criterion of 1mg/L, an ORP action criterion of -25mV was considered as a level which may prevent the generation of hydrogen sulfide. However, following further consideration the Delegated Officer has determined that due to the complexity of the potential reactions within the pond, neither parameter is entirely appropriate as a single indicator of the risk of odour emissions from the ponds. Therefore, this action criterion may not be an effective control. As an alternative, the aeration of Leachate Pond 1 will be required to achieve the aeration of the entire surface of the pond, so that an aerobic layer is maintained at

Aspect	Summary of Licence Holder comment	DWER response
	health and also develop protocols to help control and maintain at what is determined to be appropriate levels with guidance and advice from C-Wise and other wastewater quality experts as deemed appropriate. C-Wise's comments on this topic are provided (as appears within the WA Composts Pty Ltd Decision Report).	the surface. The aeration will be required continuously (when there is a sufficient depth of leachate within the pond to allow the operation of the aerator). The requirement that the aerator must be fit for the purpose of maintaining a Dissolved Oxygen level of greater than 1mg/L has been removed from the Licence. The Dissolved Oxygen action criterion has been removed from the pond monitoring condition.
Draft Licence - Condition 13 Table 2(7): Specified Infrastructure and Equipment Controls A shed is to be constructed to encompass all bale wetting and bale breaking activities at the premises. The shed is to contain all leachate generated during these processes and direct leachates to a pond via an enclosed pipe. The shed is to contain an	**Comments received on 28 April 2017:** Although Costa does not necessarily accept that the odours generated from the wetting of stray bales using sprinklers is a particular problem off-site, it accepts that reduction of this source as identified by DER will help to reduce the overall odour profile from the combined site. The solution proposed by DER to conduct the sprinkler application of recycled water to the straw bales in a new purpose built enclosure. Costa believes that this proposal has unmanageable occupational health constraints, is not followed anywhere else in the world that we are aware of and will not necessarily achieve the desired objectives and proposes to use another solution currently employed at other Costa sites. Costa does not have confidence in the efficacy of a scrubbing system for such an intermittent large volume flow of gases (two days a week), particularly in the known local circumstances of unreliable power supply.	**Response to comments received prior to 29 March 2018:** The decision reports and licence conditions have been amended to include the proposed controls of bale dunking and bale line cover in place of the previously mandated enclosed shed. Consideration has been given to the odour risk associated with the volume of leachate runoff which may be generated by the dunked bales. A requirement has been included within the draft Licence that dunked bales must be held above the dunking bath for two minutes to minimise the leachate runoff when placed on the hardstand.

Aspect	Summary of Licence Holder comment	DWER response
odour extraction and odour treatment system.	Costa proposed to implement a bale-dipping mechanism which will totally eliminate the sprinkler application or recycled water. We will therefore accept the alternative to the DER Draft Condition 13 (Table 2, item 7) requiring construction and operation of the purpose built enclosure for the wetting of hay bales by replacing it with one constraining the application of odorous water to bales by sprinkler (also delete condition 20 – requirement not to apply recycled water outside the enclosure). Costa will commit to the bale wetting by dunking, and will provide any details of experience elsewhere if requested by DER. **Further comments received on 16 June 2017:** Costa believes the use of a bale dunking mechanism will significantly reduce the potential for odour through no need for spray**ing leachate thus creating an "aerosol effect" with the** leachate. This coupled with the above control of having an aerobic water source will further reduce the potentially odorous nature of this activity. Costa is using this approach at another of its facilities with a high degree of success. Costa will build the bale dunker (basically a 40´ container with two lifting / lowering mechanisms inside it) that is semi-automated to have the straw bales offset either going into the leachate or coming out at any one time. The bale dunker will be set up in a similar place to the existing spray system (to the south of the bale break line) as the bales will still need to go through the bale break line at the end of the pre-wet phase. The bales will be stacked up to three high upon completion of the dunking process reducing the overall footprint consumed by this activity.	**See comments below relating to Condition 15 below regarding further feedback on the bale dunking requirements.**

Aspect	Summary of Licence Holder comment	DWER response
	This system is much more efficient in that the time the bale is held under the leachate within the container allows complete absorption of water into the bale as opposed to the current spray system where you need the time to get the water to evenly be absorbed into the bales. Due to no sprays as well there will be no over spray effect either ensuring the water is being directed to where it is needed at all times. This will reduce the amount of runoff form the bales as the water has been absorbed by the straw. The pond water will be pumped to the dunking container and controlled via level switch. Any excess water not absorbed within the bale will run off back to the leachate pond pre collection area, be filtered and fed back into the aerobic pond and recycled. The hardstand area does not pool water and any excess water is always running back to the leachate collection area. At this stage it is envisaged that the bale dunking exercise will take approximately one day to complete and at this stage it is intended to conduct this on a Friday. The Bale breaking activity will continue as it has previously, however Costa proposes to enclose parts of the bale line to reduce the potential for any odours to emanate from the activity. The bale break activity is expected to still take approximately one day to complete – this is currently a Tuesday. In particular we are proposing to enclose: • The area immediately after the set of flails between the flails and the manure application hopper. This area has leachate water being applied to the straw post the flails. This enclosure will be removable for cleaning purposes but during normal operation would be a closed system.	

Aspect	Summary of Licence Holder comment	DWER response
	• The top of the manure application hopper will be enclosed to significantly reduce any dry chicken manure plumes from being released into the atmosphere when the loader driver dumps a new load of manure into the receiving hopper. • The full length of the output conveyor will be enclosed to reduce the likelihood of any odours being reduced form the subsequent addition of more water. **Additional information provided by the Licence Holder on 10 July 2017:** The intention as discussed is to cover as much of the line as is practicable to minimise and potential sprays of either water or dust easily being dispersed into the wider environment. Essentially will involve the enclosure of the gap between the bale breaker and the chicken manure hopper (water spray minimisation) / an appropriate enclosure over the top of the chicken manure hopper (dust minimisation) followed with an enclosure of the output conveyor (water spray minimisation).	
Draft Licence - Condition 14: Specified Infrastructure and Equipment Controls The Licence Holder must provide written confirmation to the CEO that the Hardstand has been temporarily repaired through sealing of all visible cracks with a water resistant material within (2 weeks from date of issue); and has been reconstructed or	**Comments received on 28 April 2017:** Regarding the DER objective to reduce the potential of leachate leaking from the operating sealed area, DER is correct that there are parts of the operating sealed area which have significant cracks. The overall sealed area however is larger than required for actual operations. Costa proposes to survey the sealed area to identify those significant areas without cracks and to operate liquid-producing activities there. Should any part of that newly defined operating area have cracks, costa will seal them with appropriate sealant. Costa believes it will require more time than that proposed by DER to determine the most appropriate solution to this issue. It would appear on the surface that some significant engineering or review of the current process will be necessary to determine the best approach. Based on our current understanding the six month time frame to remedy this will not suffice. We will be	DWER acknowledges recent improvements in some groundwater quality data, however the hardstand still presents an ongoing risk as a potential source of groundwater contamination. Following the initial comments received, the requirement within the draft Revised Licence to temporarily repair and later reconstruct or re-surface has been replaced with the requirement to repair the hardstand. To allow for trials to be conducted, a six month timeframe for implementation has been specified.

Aspect	Summary of Licence Holder comment	DWER response
resurfaced no later than (6 months from the issue date).	happy to engage with DER on proposed solutions and work out the best overall solution to this as soon as an agreed process is determined. **Comments received on 16 June 2017:** While we understand that the hardstand is cracked the groundwater monitoring that has been conducted suggests that the actual levels of contamination around our site have been decreasing in recent times, which does not reasonably align with the requirement to resurface the area because of its cracks. This would further suggest that the underlying liner installed beneath the concrete is still intact and this it is adequately providing the protection desired by DER. If a risk based approach is applied then if at any time in the future a change in the downward trend was to occur within any one year testing period, then further discussions and potential remediation measures may need to be installed to ensure no long term damage to the environment occurs. **Further information provided on 10 July 2017:** Costa has proposed to repair the hardstand using a specific product (cementitious polymer) that can seal the cracks and achieve the required structural integrity as a working surface for equipment. Before the hardstand can be repaired, trials with the product will need to be conducted on small sections of the hardstand to determine its effectiveness. **Comments received on 29 March 2018:** Costa has been conducting a number of trials with a third party organisation to fill the cracks that are evident on the hardstand. The product being trialled is a cement-based product with a polymer added that provides a degree of flexion and compressibility. The trials conducted thus far have had limited	The Delegated Officer considers that in the context of ongoing operations, it is necessary that the hardstand repair method can achieve the hydraulic conductivity specified within the draft Revised Licence.

Aspect	Summary of Licence Holder comment	DWER response
	success and we are working with the third party provider to find a suitable product that will meet our needs. Costa is committed to finding a suitable product that will fill the cracks on the hardstand and provide appropriate levels of permeability. However, we are not confident that the measure being required in the licence is either going to be realistic or achievable. In **addition we seriously doubt that there would be any "suitably qualified expert" that will certify the repairs as expected.** As indicated previously the option of entirely replacing the hardstand is not palatable. Costa requests that we can have a degree of flexibility around this challenging area, while we try to source a suitable product that will satisfy the expectations of DWER. Re-iteration of comments received on 16 June 2017 regarding groundwater monitoring results and the liner beneath the hardstand.	
Draft Licence - Condition 4: Infrastructure Controls Screen and trap – Licensee to advise screen opening size for screen or details of equivalent solids capture infrastructure being installed	**Comments received 29 March 2018:** Costa does not understand the requirement to specify the screen size of the filter here. How is this relevant to the farm performance? Costa requests that this condition be removed from the Licence. **Comments received 16 May 2018:** The current screen on site has perforations in the screen of approx. 1.4mm.	DWER has expanded on the justification for the specification of a maximum screen opening size within Section 8. A maximum screen opening size of 5mm by 5mm has been specified within the Specified Infrastructure and Equipment Controls section of the Licence.
Draft Licence - Condition 18:	**Comments received on 28 April 2017:** The requirement to have all three ponds retain a 500mm freeboard shows a lack of understanding of the Costa water	The requirement to maintain a freeboard for Pond 2 and Pond 3 has been removed to account for the specific overflow design

Aspect	Summary of Licence Holder comment	DWER response
Operational Controls The Licence Holder must maintain a freeboard of at least 500mm within all ponds at all times.	management process and how the three ponds onsite are used. To summarise, Pond 1 is the main pond and used on a weekly basis to provide the recycled water to the pre-wetting of bales and when bale break occurs. The second and third ponds are typically empty and are used in the event there is significant rainfall. Pond 1 is the primary capture point for all leachate and any rainfall and this then overflows into Pond 2 and when this is full it will overflow into Pond 3. **Further comments received on 16 June 2017:** Mushroom exchange use three controlled ponds. Pond One (approximately 450m³) is the active working pond and used every week to contain leachate and supply water to the pre-wet and bale break process. Pond Two (approximately 450m³) is an overflow pond and back up to Pond One – typically this pond is empty but at times can be approximately half full with leachate that would normally be consumed during the week. Pond Three (approximately 1000m³) is the overflow contingency pond that only ever has water in it after a significant rainfall event – any water captured in this pond gets reused during the coming weeks as a top up for Pond One reducing our need to take water from the CM Farm bore.	system of the ponds. The required freeboard for Pond 1 within the draft Revised Licence has been changed to 300mm as this is consistent with the current freeboard level required at the CM Farms and C-Wise Premises and is considered by the Delegated Officer to be sufficient.
Draft Licence – Condition 21: Operational Controls The Licence Holder must immediately place wetted feedstocks into windrows following the bale break stage.	**Comments received on 28 April 2017:** Costa does not wish to go directly into windrows as this will lead to a significant deterioration of the compost structure making it unsuitable for the Phase Two and Phase Three composting conducted as its Casuarina site. Can DER explain the reason for this prescriptive condition? **Comments received 29 March 2018:** The placement of straw immediately into windrows will have a significant detrimental effect on the quality of the substrate used in the next phase of the composting process. The	The justification for this requirement is included in Section 8 of the Decision Report. The windrow arrangement is expected to improve the passive diffusion of oxygen into the composting material by having a higher surface area to volume ratio than the pile, reducing the potential for the material to become anaerobic. DWER has re-considered this requirement based on the potential impact to the

Aspect	Summary of Licence Holder comment	DWER response
	reasons for the existence of a big lump after the bale break process as two fold: - The temperature achieved within the lump vs the windrows has an impact on the breakdown of the straw achieved within the first few days. - The length of the straw is reduced by each turn with the rick (the rick is used to turn windrows), which increases the bulk density of the compost throughout the process. This may impact on the pasteurisation process at the Casuarina site which uses the mushroom compost produced at the Premises.	compost produced for growing mushrooms at another facility. This requirement has been removed from the Licence, however the Condition which requires the turning of composting windrows has been amended to include the turning of all mixed feedstocks following the bale breaking stage.
Draft Licence – Condition 15: Operational Controls The Licence Holder must hold dunked straw bales above the dunking bath for no less than two minutes immediately following dunking and prior to placement of the bales on the Hardstand.	**Comments received on 29 March 2018:** Holding the bales for a minimum of two minutes will be an extremely inefficient process – Costa does not believe that holding the bales for this length of time will have any benefit in the long run. Costa would prefer to remove the bale from the dunking machine immediately which is as per its design. At the completion of the dunking process, the area can be washed down with fresh water to ensure that any leachate on the hardstand is minimised and reduces the likelihood of pooled leachate. Costa therefore requests that this condition be removed from the proposed licence.	As the intent of the requirement was to reduce odour emissions by reducing the volume of leachate running over the hardstand during the dunking process. The washing down of the hardstand after the dunking is not expected to achieve this outcome. DWER acknowledges that holding the bales over the dunking bath will be less efficient than placement directly onto the hardstand after dunking. To try to accommodate a more efficient process, Condition 4 and Condition 15 have been amended to allow for the placement of dunked bales onto a drip tray from which the leachate runoff flows back into the dunking bath.

Aspect	Summary of Licence Holder comment	DWER response
Draft Licence – Conditions 23, 24 and 25: Operational Controls The Licence Holder must monitor the Carbon to Nitrogen Ratio of each windrow weekly until a ratio of 25:1 is met for that windrow. The Licence Holder must take action if the ratio is not met, and the CEO must be notified within 5 days. The Licence Holder must report the results of monitoring annually.	**Comments received on 28 April 2017:** The draft conditions about controlling C:N ratio and all of the monitoring and reporting that go with it should be deleted. The draft conditions are prescriptive make-work with no contribution to outcomes above business as usual. The whole business of professional manufacture of quality mushroom substrate for mushroom growing revolves around managing C:N ratio. The effective production requires careful control of C and N inputs (and gypsum and water) and oxygen, and management of the biological process. Mushroom substrate production requires a C:N ratio that starts at around 25:1 and then progressively declines throughput the process of composting to be around 20:1 when it leaves the site. **Comments received on 29 March 2018:** Costa currently conducts C:N ratio analysis on all of it's crops – these are conducted at Bale break and at the completion of Phase 1 – 14 days later. The sampling regime is currently conducted on a composite basis for each crop. The need to conduct this exercise weekly and on each individual windrow is excessive and we have enough historical data to show that our C:N ratio is consistent in how it moves throughout the composting process. Costa requests that this condition is removed from the proposed licence.	DWER has re-considered the requirement to undertake C:N ratio process monitoring. This requirement has been removed from the Licence, on the basis that the Licensee has been and will continue to monitor their composting process and that the records of this monitoring may be requested by DWER if required.
Draft Licence – Condition 27: Groundwater monitoring and actions Groundwater monitoring requirements which included an increased monitoring frequency if	**Comments received on 28 April 2017:** Costa notes there is a background of high values for groundwater contaminants which precedes Costa at the site. Costa should not unnecessarily contribute to pollution as such, but does not accept that it can be held responsible for either high groundwater numbers or even seasonal or tidal variation in numbers. We would like to understand how the trigger values for reporting an action have been derived to ensure that what has been proposed is an achievable target.	The appropriateness of the trigger values (action criteria for nitrogen and phosphorus) has been reviewed. The trigger values have been removed, and instead background levels have been calculated for comparison with monitoring results.

Aspect	Summary of Licence Holder comment	DWER response
action criteria levels for phosphorus and nitrogen are exceeded.		The monitoring frequency will be quarterly, with a requirement to report the monitoring results quarterly for review.
Draft Licence – Condition 34: Specified Actions The Licence Holder must test the seepage rate and the integrity of the ponds – both an overnight water balance test and electrical testing of liner integrity is required for all ponds.	**Comments received on 28 April 2017:** DER identifies potential seepage or leakage of liquid through the HDPE of the holding ponds as requiring testing. Costa commits to overnight testing of liquid levels annually. Only in circumstances of a demonstrated seepage or leakage will Costa consider a more sophisticated electrical leak location test. Leak location is pointless in the absence of a demonstrated loss of water, and electrical leak location is a well-known electrical risk in such a high water-table environment. **Comments received on 29 March 2018:** Costa has been in discussions with the other lessees on the site and it has been determined that Electrical Testing can be conducted safely on our dams – Costa would propose that either method of testing can be used to determine pond liner integrity as it makes sense that we all attempt to utilise a similar testing regime and also pool resources to utilise a very limited contractor resource. Specifically, it is proposed that: 1. Where conditions allow, an electrical leak detection test will be used to satisfy the Pond seepage rate testing requirement, and where conditions do not allow, a hydrostatic leak test will be used. This will be either a procedure following the method of Ham and Baum (2009), or the equivalent ASTM/Australian Standard method. 2. The completion date be extended to 12 months because the test work for the entire set of dams across the site cannot be completed within 2 months.	**Response to comments received prior to 29 March 2018:** DWER has reconsidered the requirement for both types of testing to be undertaken for each pond. The requirement to undertake electrical liner integrity testing has been removed from the draft Revised Licence. A requirement to undertake this electrical liner integrity testing may be required in future if the results of the overnight water balance test suggest that there may be damage to the liner that should be repaired. **Response to comment received on 29 March:** DWER has considered the Licensee's preference to have the option to undertake either form of testing. Given the relatively small size and frequent emptying of the ponds at the Premises, the requirement to undertaken electrical liner integrity testing is preferable to the overnight water balance test. The requirement to undertake the electrical liner integrity testing has been included within the

Aspect	Summary of Licence Holder comment	DWER response
		Licence. The requirement to undertake the overnight water balance test has been removed from the Licence. A 6 month period will be specified for the completion of the testing.
Draft Licence - Condition 38: Specified Actions The Licence Holder must provide to the CEO a depth to groundwater report by (within 3 months of issue) showing the separation to maximum groundwater level from the base of the ponds. **Draft Decision Report – Section 8.3.1: Leachate impact controls** The Delegated Officer considers that a minimum of 2m separation distance between the base of the ponds and the average maximum groundwater level is appropriate for groundwater protection.	**Comments received on 28 April 2017:** This historically contaminated site is previously drained land with high water table. It is unlikely that the DER-proposed 2m separation of holding ponds from water tables is achieved now, or even can be achieved at this site. Furthermore, whilst there is scientific demonstration of the benefits of a separation zone to allow unsaturated flow to minimise biological contaminants from point sources, there is no benefit obvious to Cost of separation in this particular circumstance. Conditions relating to measuring (and even implementing) such separation should be deleted. **Comments received on 16 June 2017:** Costa has not completed a hydrogeological assessment of the pond area at Nambeelup however the redrilling of two of our groundwater monitoring bores have provided the following information: • Profile – Bassendean Landform – Pale Grey Medium Sand. Rounded Grain. (0.15m: Munsell 10YR 6/1) • A1: Slight Organic Content: 0-10cm • A2: Uniform pale grey sand • Continues same to 5.5 m- some fines of biotite & Olivine; approximately 2.5% fines or marine lime grains. Further to the recent rebore of two of the groundwater monitoring bores Costa has collected and provided to the DER the water table height as we have collected our quarterly	DWER acknowledges that a separation distance of 2m from the base of the ponds to the groundwater level may not be achievable for the existing ponds, however having an understanding of whether there is any separation distance will provide further information that is relevant to the assessment of seepage risk from the ponds. In regards to the level of the water table in mb TOC (meters below top of casing), reference to the depth of groundwater below top of casing does not allow DWER to determine the distance from the base on the ponds to the groundwater level. The mention of a minimum separation distance of 2m within the Decision Report has been removed. The requirement for the depth to groundwater report remains within the draft Revised Licence.

Aspect	Summary of Licence Holder comment	DWER response
	groundwater monitoring results. These show that the active water table around our site is approximately 3-6 mb TOC. Two Ponds were originally installed in late 1997 when the composting facility was first established at Nambeelup. At the time they were built they were lined with a 1mm thick HDPE liner. In 2009 a change was made to divide one of the ponds in half creating what is now Pond One and Pond Two, leaving Pond Three as originally built. At this time the overflow arrangement as described above and a change to the process management was created, as in the past the two ponds used to fill equally together. Costa has not tested the Leachate pond for Phosphorus in the past but recent analysis of the leachate water suggest that the Total Nitrogen levels average 1500mg/L.	
Draft Licence - Condition 29: Record Keeping The Licence Holder must record details of complaints received and any action taken by the Licence Holder in response to the complaint.	**Comments received on 29 March 2018:** Costa has no issues with recording and reporting any complaints made against our site, however we seek clarity from DWER as to how this can be realistically done. DWER's current practice for dealing with a complaint they receive is to send it to Costa, C-Wise and CM Farms. This occurs without any verification that odour is actually emanating from the combined sites and that it is in fact the source of the complaint. If DWER already has this information what is the point of the three lessees having to reproduce information that DWER already has and which in fact may not be linked to our site. In this situation the onus of proof is reversed and we are expected to prove that the odour did not come from our site - this is both unfair and a denial of due process.	The condition wording has been amended to make it clear that the Licensee must only record the complaints which are received directly to the Licensee, which does not include the complaints summary information which is sent to the Licensee from DWER. The Licensee should consider whether the Premises has contributed to the complaints that were received by DWER, however the condition wording does not state that the Licensee is expected to prove that the odour did not come from the Premises.
Draft Licence – Conditions 31 and 32: Ongoing reporting	**Comments received on 29 March 2018:** There appears to be a duplication of reporting from a quarterly to an annual period – can we please request that DWER review these clauses and try to avoid unnecessary duplication.	The annual and three quarterly reports require that information regarding the groundwater and pond monitoring data is provided, as the Delegated Officer has

Aspect	Summary of Licence Holder comment	DWER response
		determined that receipt of the monitoring data at quarterly intervals is preferable to the receipt of the data only annually. However, Condition 31 requires only three quarterly reports, so avoid the overlap of a fourth quarterly report and the annual report. No change has been made to these conditions.
Decision Report – odour assessment and investigations	**Comments received on 28 April 2017:** There are vagaries with the given description of the odours. Costa accepts that there was a heightened period of odour complaints, but is disappointed in the nature of the odour study applied through DER. There is no numerical definition in the study of the expected air quality and no assessment of the Costa contribution to that. Major potential sources like seaweed on beaches seem to have been ignored. Lakes and waterbodies are dismissed as odour sources through a brief inspection although it is well established that they have peaks of odours with algal growth cycles. We would be happy to discuss, but this may not assist where Costa has accepted most of the objectives of the amended licence. Costa accepts that the identified onsite odours are strong at their facility, but is not convinced that the identified odours are of the type and magnitude that would persist over offsite distances. Nonetheless we will take action to minimise those.	The following information was provided to the Licence Holder on 11 July 2017 via letter in regards to the methodology within the Mandurah Odour Investigation: *With regard to the odour assessment methodology, the Department field odour surveys follow a method derived from the German standard VDI 3940 Part 2 (2006). Using this method, field measurements are reported as "odour recognised" or "not recognised" and the "odour character" (should the odour be recognised). Odour units refer to the measurement of odour concentration, which is not an odour dimension measured when performing odour field surveys. Also, the strength (or intensity) of an odour is reported following a scale that is presented in the German standard VDI 3940 Part 3 (2010). The measurement of odour intensity was not within the scope of the Mandurah Odour Investigation.*

Aspect	Summary of Licence Holder comment	DWER response
		DWER acknowledges that there are other odours sources within the Mandurah area and that further investigation would assist in differentiating the odours from the Nambeelup Farms premises and other sources. There may be potential for further investigations to be undertaken following the implementation of the controls within the Revised Licence, if odour within the area continues to impact on amenity.
Complaints – N/A to conditions	**Comments received on 28 April 2017:** Have there been relevant odour complaints over the past 6 months? It would seem helpful if DER associates those complaints with Costa activities that DER reports those to Costa on (say) a monthly basis. Otherwise there is no feedback between activities and complaints to assist management.	Noted. DWER has now implemented a process of notifying the Nambeelup Farm Licence Holders of relevant complaints on a regular basis.
Prescriptive nature of conditions – N/A to specific conditions	**Comments received on 28 April 2017:** Costa has been surprised by the very prescriptive approach taken by DER in relation to this licence amendment, considering the work that had been conducted by the Composting Working Group over the last eighteen months of where we have been a part of an the outcomes based approach that was being promoted and endorsed by DER representatives during these workshops.	Noted. DWER has considered outcome based conditions where possible, however enforceable outcome based conditions which control potential emission sources have been difficult to achieve, particularly in regards to odour emissions. Where there is a level of uncertainty, DWER has included licence conditions that will generate the information required to create more certainty, or has relied on more prescriptive regulatory controls.

Appendix 3: Photographs from Site Visit 13 October 2016

Photo 1 – Chicken manure stockpile and storage area.

Photo 2 – Fuel tank – fully bunded.

Photo 3 – Hardstand area bunded edge.

Photo 4 – empty bay used to dry out straw collected from the leachate pond.

Photo 5 – Chicken manure stockpile.

Photo 6 – Gypsum stockpile.

Photo 7 – Storage bunker with residual manure.

Photo 8 – Bales being wet with leachate.

	
Photo 9 – Run-off in bale spraying area.	Photo 10 – Bales being sprayed with leachate.

	
Photo 11 – Cracks in bunker walls and Hardstand floor..	Photo 12 – Cracks in bunker walls and Hardstand floor.

	
Photo 13 – Static composting tunnel (Not part of Premises).	Photo 14 – Cracks in Hardstand.

Photo 15 – Bale spraying, airborne leachate.

Photo 16 – Pooling of leachates on Hardstand.

Photo 17 – Cracks in Hardstand.

Photo 18 – Cracks in Hardstand.

Photo 19 – Wetting of bales and bale breaker machine.

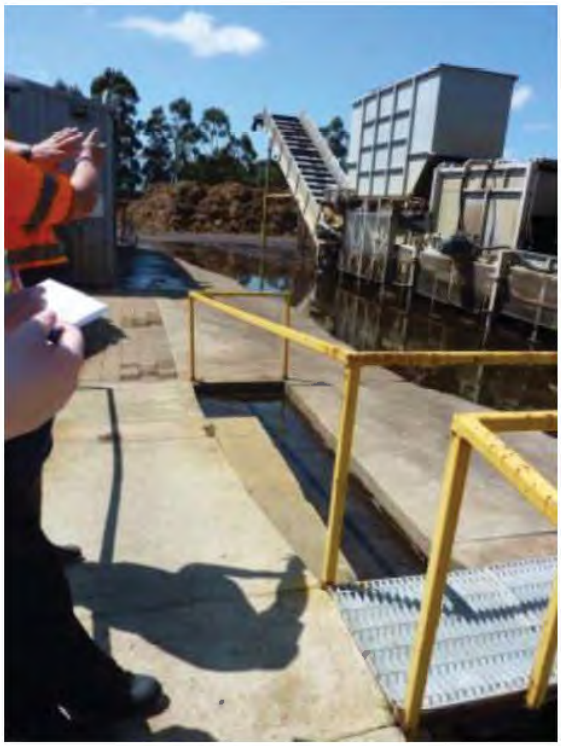


Photo 20 – Flow of leachates past machinery and through leachate channel.

Photo 21 – Flow of leachates past machinery and through leachate channel.

Photo 22 – Leachate channel flow to pond 1.

Photo 23 – Leachate channel flow to pond 1.

Photo 24 – Pond 1.

Photo 25 – Pond 1.

Photo 26 – Pond 1.

Photo 27 – Leachate pooling near spillway/pump.

Photo 28 – Leachate pooling near spillway/pump, showing pump outfall.

Photo 29 – Leachate pooling near spillway/pump.

Photo 30 – Spillway showing broken pump.

Photo 31 – Spillway.

Photo 32 – Hardstand area showing leftover compost pile from this week's shipment.

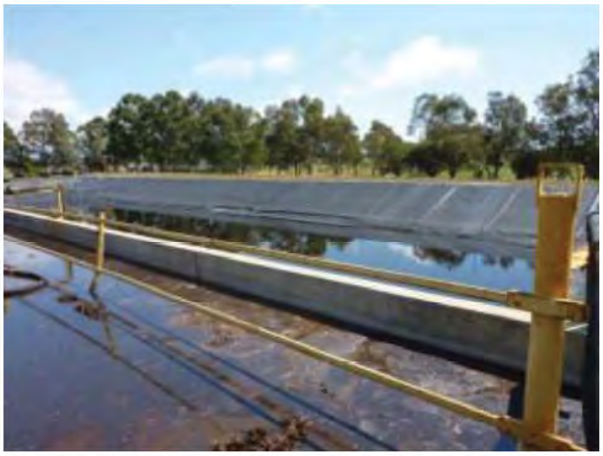
33 – Cracks in Hardstand and leachate pooling.

34 – Cracks in Hardstand and leachate pooling.

35 – Cracks in Hardstand and leachate pooling. Pond 3 in distance.

36 – Cracks in Hardstand.

	
37 – Cracks in Hardstand.	38 – Cracks in Hardstand.
	
39 – Cracks in Hardstand and leachate pooling.	40- Cracks in Hardstand and leachate pooling.

	
41- bale wetting and bale storage in distance.	42 – Pond 3 (overflow).
	
43 – Ricks/Windrows.	44 – Turning of current compost pile.
	
45 – leachate pooling on Hardstand.	46 – Pooling of leachate on Hardstand.

	
47 – Pooling of leachate towards spillway.	48 – Straw collecting at spillway and in pump which is currently broken.
	
49 – Edge of bunded Hardstand and pond 3. Ground is noticeably damp along edge of Hardstand.	50 – Pond 2, not currently in use. Small volume of sludge in bottom of pond.
	
51 – Outlet from leachate drainage channel into pond 1.	

Appendix 4: Groundwater monitoring

1. Monitoring programs

Groundwater monitoring has been undertaken at each of the three premises (C-Wise, CM Farms and Mushroom Exchange) according to their licence conditions. Available data spans the timeframe from 2010 to 2017. Sampling intervals have been variable with CM Farms and C-Wise monitoring biannually and Mushroom Exchange in quarterly intervals. Interpreting groundwater data in the context of the entire site encompassing all three bore networks is made more difficult by unsynchronised sampling events.

Key findings

The Delegated Officer has reviewed the groundwater monitoring programs and has found that:

1. *A shared approach and consistent methodology for all premises will facilitate better understanding of contamination events and the effectiveness of controls.*
2. *Synchronising monitoring bore sampling across all three sites is necessary to allow more comprehensive and meaningful data interpretation.*

2. Monitoring analytes

The monitored analytes are largely consistent for all three operations reflecting that nutrients are the main contaminants likely to enter the groundwater from storage ponds and processing areas. Monitoring analytes include:

- Total nitrogen (C-Wise, CM Farms) / total inorganic nitrogen (Mushroom Exchange)
- Ammonia nitrogen
- Nitrate nitrogen
- Nitrite nitrogen
- Total phosphorus
- pH
- Total dissolved solids

Nutrient rich seepage can change the chemical environment within the soil leading to the mobilisation of metals and metalloids from the soil into the groundwater. Measuring this secondary contamination needs to be considered as part of the standard monitoring analyte suite, particularly with regards to potentially toxic elements such as mercury, zinc and arsenic that can have impacts on human health.

While CM Farms and Mushroom Exchange potential discharges conform with the selected suit of analytes except for metals, C-Wise is receiving a range of controlled liquid wastes such as waste oil and industrial wash water that can contain a variety of other contaminants not captured by the

current monitoring regime. There is a risk that controlled liquid wastes such as industrial wash waters have introduced Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS), which are known to be persistent, bioaccumulative and toxic. It is therefore required that testing for these substances is included in the next groundwater monitoring event to determine whether PFAS is present in the groundwater.

Key findings

The Delegated Officer has determined that:

1. *Mercury, zinc and arsenic should be included in the monitoring suite of analytes to ensure that the potential risk to human health and the environment from this type of contamination can be assessed.*
2. *The selected suite of analytes with the addition of selected metals is considered appropriate for the characterisation and detection of groundwater contamination caused by nutrient rich leachates derived from organic materials.*
3. *The current monitoring regime is not sufficient to detect contamination from the range of controlled liquid wastes currently received by C-Wise.*
4. *Testing for PFAS should be included in the next groundwater monitoring.*

3. Monitoring bore network spatial configuration

The location of groundwater bores in relation to operational infrastructure such as ponds and hardstands is shown in Figure 1. It is expected that contamination levels detected in groundwater bores are highest where the bore is closest to the source of the contamination and that attenuation occurs with greater distance from the source.

Small scale groundwater contours at the Nambeelup Farm area have been documented by Geo and Hydro (2010)[1].

The contours indicate that the dominant groundwater flow in this area is in a westerly to south-westerly direction. Bores located down hydraulic gradient from contamination sources are therefore expected to show higher levels of contaminants than those located up hydraulic gradient.

C-Wise

C-Wise bores (CW01-04A) 'frame' the operational pond area by being located near corners of a rectangle drawn around the ponds. An additional bore (CW05A) is placed at the north-western corner of the hardstand area of the composting operation. Bores are located close to potential sources of contamination so that monitoring can seek to detect any seepage and therefore provide information on the likely effectiveness of pond lining and leachate management systems.

Based on the proximity to the C-Wise storage ponds and the dominant groundwater flow, bores CW01 and CW05A would be expected to show higher levels of contaminants if leakage from the ponds occurred. Although located up hydraulic gradient, the close proximity of bore CW02 to C-Wise and CM Farm ponds makes it possible that impacts from either ponds' leakages will be

[1] Geo and Hydro Environmental Management Pty Ltd 2010: Watertable contours across Custom Compost Lot 230 Nambeelup Rd Nambeelup, Figure 5. Submitted by Custom Compost

detected in this bore. Bore CW05A also has the potential to be impacted by potential seepage from multiple sources including the storage ponds of C-Wise, CM Farms and leachate seepage from the C-Wise hardstand area.

Bore CW01 located between the C-Wise and CM Farm ponds should detect seepage from both pond clusters. Bores CW03A and CW04A are located up hydraulic gradient and thus would be less impacted by seepage plumes. CW03A is further away from the ponds than CW04A and is therefore expected to have the lowest contaminant levels.

The C-Wise bore network, consisting of five bores, should be capable of detecting any contamination originating from the main operational areas of ponds and hardstand. However, some of the bores may be influenced by contamination from other premises which makes the clear attribution of sources more difficult. In addition, there are no C-Wise bores south of the ponds and hardstand despite the likelihood that a contamination plume would travel downgradient in a south-westerly direction.

Mushroom Exchange

Mushroom Exchange maintains five monitoring bores located close to their operational infrastructure. Bores ME02 and ME03 are north of the ponds, bores ME04 and ME05/S east of the Hardstand, and bore ME01/S west of the ponds. Due to their proximity to the infrastructure the bores should be capable of detecting any contamination caused by seepage from the ponds and Hardstand. Bores ME01/S and ME02 may also be influenced by potential contamination plumes from C-Wise ponds located north of the bores. There is no Mushroom Exchange bore south-west of the infrastructure which is the likely direction in which a contamination plume originating from the Mushroom Exchange ponds or Hardstand would travel.

Figure 1: Groundwater monitoring bore network for CM Farms, C-Wise and Mushroom Exchange.

CM Farms

CM Farms maintains a network of ten monitoring bores of which three are located close to infrastructure and the remaining seven at varying distances west, north-west and south-west from the ponds and hardstand.

Bore CM11S is situated west of Pond 5 where it is likely to capture groundwater contamination originating from the adjacent pond cluster. There are no further CM bores near this pond cluster but C-Wise bores CW01and CW02 east of the pond cluster, as well as CW05A southwest of the ponds, should also detect any contamination originating from the ponds.

In February 2016, three new monitoring bores were installed at the new Pond 0. Two shallow bores CMWS01 on the western side and CMWS02 on the eastern side of the pond. A deep bore (CMDW03) has also been installed on the western side of the pond. The bores should be able to detect any contamination originating from Pond 0 but will potentially also be influenced by any contamination plumes from sources located at the C-Wise and Mushroom Exchange premises. Monitoring data from the new bores at Pond 0 are not included in this analysis due to only limited data points being available at the time of assessment.

Bores CM09S and CM10S are located approximately 500m west and 800m south-west of CM Farms ponds respectively. Being hydraulically downgradient from CM Farms, C-Wise and Mushroom Exchange sources, they should be able to detect any contamination plumes from all up gradient operations. The ability to identify distinct sources, however, becomes more difficult the further the bores are away from source locations.

The remaining six bores are located at distances from 700m to 1500m from operational sources. Bores at these distances will reflect background conditions if they are located up-gradient and to varying degrees will capture contamination from operational sources depending on their distance and direction from the source.

Key findings

The Delegated Officer has reviewed the spatial configuration of the existing monitoring bore network and has found:

1. *The existing monitoring network, when used as an integrated network across premises' boundaries, is considered sufficient to identify whether containment infrastructure such as ponds and hardstands are effectively controlling leachate emissions.*
2. *The monitoring network is not able to identify contamination sources at a small spatial scale such as a single pond. Additional investigations in the form of pond seepage rate measurements are required for this purpose.*
3. *The monitoring network includes bores located up and down hydraulic gradient at varying distances from potential operational contamination sources allowing the determination of a suitable background level against which impact bores influenced by site sources can be compared.*
4. *The current monitoring network does not allow detailed tracking of contamination and plume delineation, and is insufficient to inform on the risk of impacts on sensitive receptors.*

4. Monitoring data analysis: Contaminant concentrations, sources and groundwater flow

The available monitoring data has been analysed by:

- Comparing contaminant levels found near operational infrastructure with background levels.
- Reviewing contaminant concentrations in the context of groundwater flow and the location of contaminant sources and receptors.
- Reviewing and interpreting data trends identifying correlations and fluctuations.

Groundwater monitoring data maps have been created showing levels of contaminants in bores across the monitoring network for total phosphorus (TP), total nitrogen/total inorganic nitrogen (TN/T(I)N), and total dissolved solids (TDS). Data was summarised by calculating concentration averages for each analyte from each bore. For Figure 2 concentration averages were obtained from data between 2010 and 2017 and for Figure 3 concentrations were averaged over the period from 2016 to late 2017 only. The shorter timeframe provides a picture of the current situation while the longer timeframe considers contamination history.

A background groundwater quality level for selected analyte concentrations was derived using data from bore CM06S. The bore is located up hydraulic gradient, to the north-west of the three Nambeelup premises. It is therefore not likely to be influenced by contamination sources from the premises. An Upper Tolerance Limit (UTL) is calculated for each background contaminant concentration according to a defined statistical approach (DoEQ, 2014). The set confidence level is 95%. Contaminant concentrations from other bores can then be compared against the calculated UTLs to understand whether monitoring results from the other bores differ from background levels. The UTLs are shown in Table 1 as Background levels.

To aid data visualisation and interpretation data are displayed in a spatial context in Figure 2 and Figure 3. Data was simplified by distributing values over five categories based on a background level multiplier as outlined in Table 1.

Table 1: Groundwater contamination categories

Analytes	Units	Guideline	Background levels (UTL CM06S)	<2x	<3x	<4x	<5x	>5x
TN	mg/L	2#	8.11	16.22	24.3	32.4	40.6	>40.6
TP	mg/L	0.2#	2.17	4.34	6.51	8.68	10.9	>10.9
TDS	mg/L		764	1528	2292	3056	3820	>3820

Department of Environment Regulation Contaminated sites guidelines (DER2014)

A summary of monitoring results between 2010 and 2017 is provided in Figure 2 showing that the highest contaminant levels occured in operational areas near the ponds and attenuate with distance to the source. Nutrient levels in some bores exceeded the selected reference background level by more than five times indicating the presence of contaminant sources. Given the proximity to ponds and hardstands, this containment infrastructure may be compromised resulting in significant seepage. The fact that bores at different premises next to different pond clusters are affected also points to multiple contamination sources.

The results infer the groundwater flow direction as south-westerly. Consistently, there are higher concentrations down hydraulic than up hydraulic gradient.

The contamination levels detected in bores CM09S and CM10S indicate that a groundwater contamination plume may extend from the operational area in a south-westerly direction towards sensitive environmental receptors located downgradient from the premises. To

delineate the full extent of such a contamination plume would require more detailed groundwater investigations.

A comparison of Figure 2 and Figure 3 shows a similar pattern between averaged results over the long term (2010-2017) or over the short term (2016 – 2017), specifically that contamination concentrations are higher down hydraulic gradient than up hydraulic gradient. Decreases in contaminant concentrations are observed in some bores in most recent times particularly up hydraulic gradient from Mushroom Exchange pond clusters and C-Wise pond clusters (Figure 3). Down hydraulic gradient improvements in concentrations are more difficult to identify as a consistent observation across all contaminants. There are both lower and higher concentrations for some contaminants in bores down hydraulic gradient from ponds and hardstands when comparing historic averages with recent averages.

Key findings

The Delegated Officer has reviewed groundwater monitoring data illustrated in Figure 2 and Figure 3 and concluded that:

1. *Groundwater monitoring results infer that groundwater flow in the area of interest is in a south-westerly direction.*
2. *The levels of nutrients in multiple bores indicate that containment infrastructure integrity may be compromised at all three premises resulting in seepage to groundwater.*
3. *A groundwater contamination plume is likely to extend from the operational area in a south-westerly direction towards sensitive environmental receptors located downgradient from the premises.*

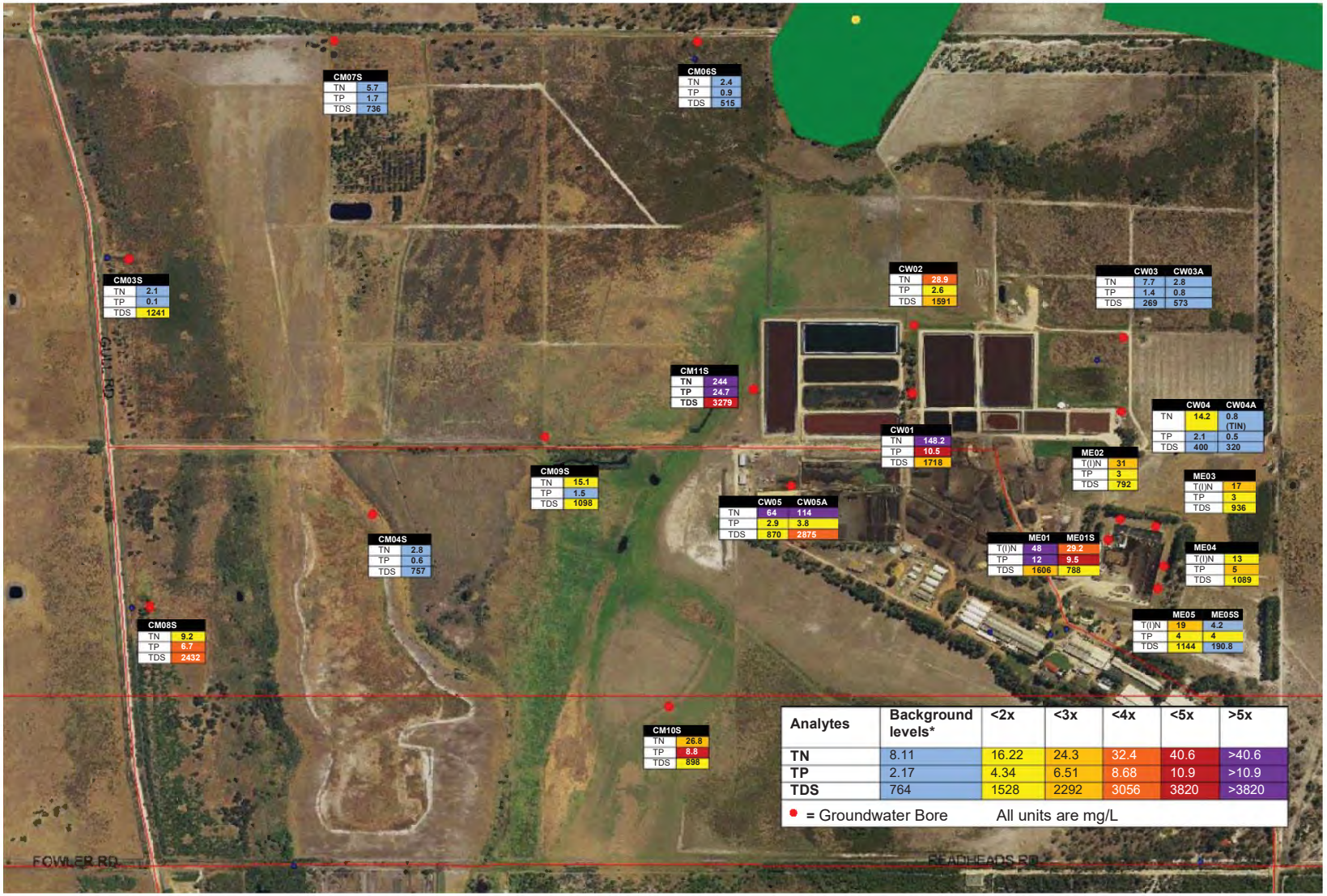


Figure 2: Groundwater monitoring results. Values for each analyte represents an average for data from 2010 to 2017. Selected analytes: Total Nitrogen (TN) or alternatively Total Inorganic Nitrogen (TIN), Total Phosphorus (TP) and Total Dissolved Solids (TDS).

*** Background levels were calculated using a statistical analysis from the data from CM06S for further details see Section 4**

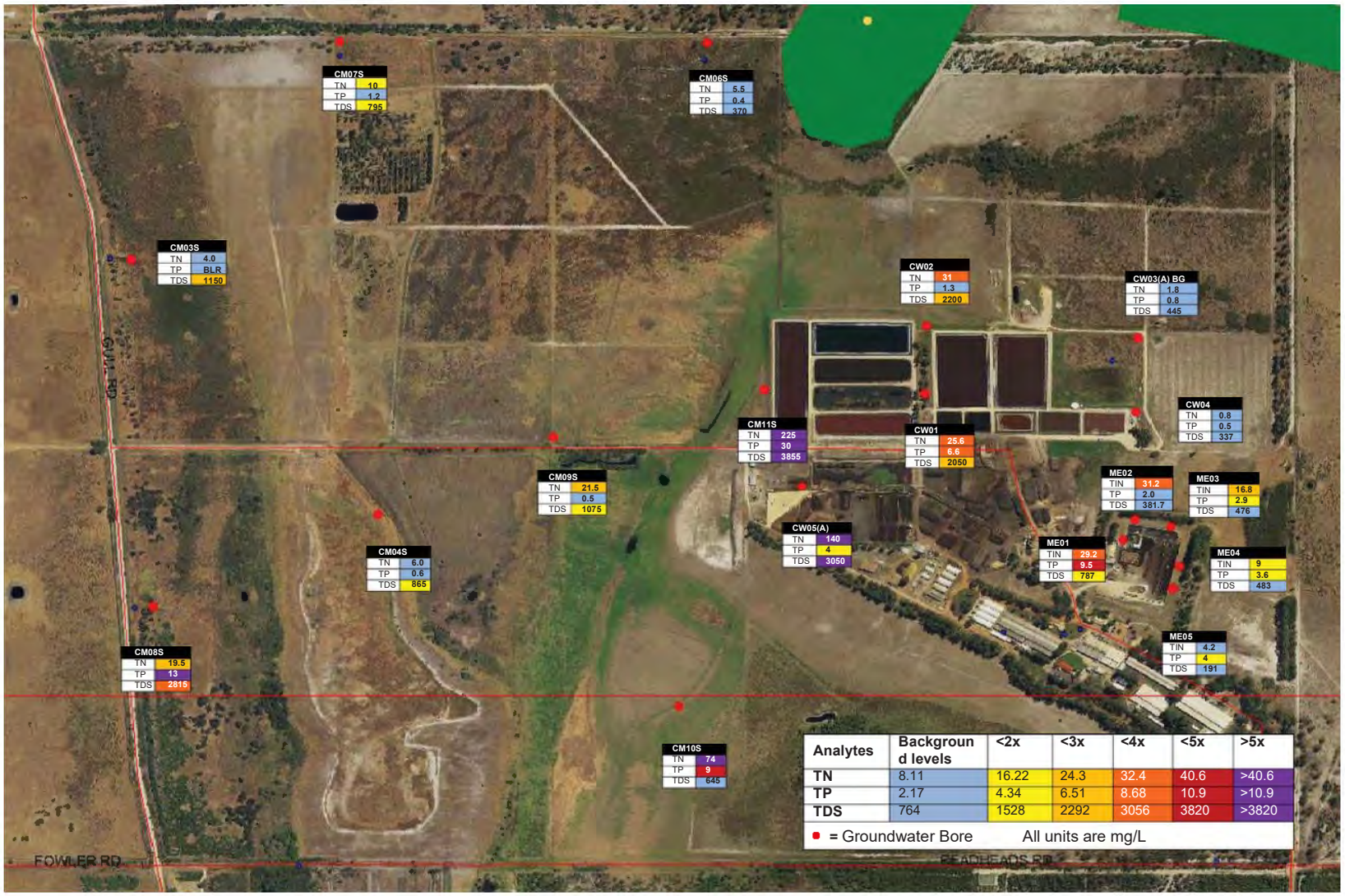


Figure 3: Groundwater monitoring results Values for each analyte represents an average for data from data for 2016 - 2017 in mg/L. Selected analytes: Total Nitrogen (TN) or alternatively Total Inorganic Nitrogen (TIN), Total Phosphorus (TP) and Total Dissolved Solids (TDS).

Data averaged from sampling events: CM: May and October 2016, CW: CW01 June and October 2016 CW02, CW03A and CW05A June and October 2016 CW04A January 2017· ME: July, October 2016 and January, April 2017.

*** Background levels were calculated using a statistical analysis from the data from CM06S for further details see Section 4**

5. Detailed analysis of contaminant concentrations

For a more detailed analysis data trends as graphed in Figure 4 are reviewed and discussed in the following paragraphs. The data is based on the information received from the licence holders submitted in Annual Environmental Reports (AERs). The bores have been renamed to accommodate the display of all bores on a single map. While the numbering has been retained, a two letter pre-fix has been added to denote ownership according to licence holder (CW = C-Wise, CM = CM Farms, ME= Mushroom Exchange). The three C-Wise bores CW03A, CW04A and CW05A were installed between 2010 and 2017 and have replaced bores CW03, CW04 and CW05. The replacement bores are located in approximately the same locations as the bores that were replaced.

To facilitate data visualisation and comparison the data are presented as line graphs in Figure 4. The data, however, is discontinuous consisting of separate distinct data points.

C-Wise

Monitoring data from C-Wise is graphed in Figure 4.

Total inorganic nitrogen (T(I)N) is an important analyte that can indicate the presence of nutrient rich leachate. When comparing the concentrations of T(I)N across the C-Wise bore network (Figure 4a), it is evident that bore CW03A and previously bore CW03 as well as CW04A and previously CW04 are consistently showing lower levels of T(I)N. Bore results from CW03 and CW03A are consistent with background levels. This is also true for CW04A and CW04, except for data before January 2014. These levels are up hydraulic gradient from potential contamination sources such as ponds and hardstands. Results from bore CW01 located west of the C-Wise ponds shows concentrations significantly elevated (more than 5 times) above background levels. Equally, bore CW02 is impacted by above background concentrations, except for sampling dates between July 2013 and January 2014. Notably from February 2015 to most recent sampling in October 2016 there is an increasing trend in concentration. Data availability for bore CW05/5A is limited but particularly the most recent data points from February 2015 to June 2016 show significantly elevated concentrations (more than 5 times) above background levels. The results indicate that there is likely to be active sources near bores CW01, CW02 and CW05A contributing to T(I)N levels elevated above background.

The concentrations of T(I)N are closely related to the concentrations of nitrate, nitrite and ammonia.

When comparing nitrate and nitrite levels with T(I)N concentrations, the nitrate results for bores CW01 and CW04/4A account for much of TN while TN in bores CW02 and CW05A is dominated by ammonia. The ammonia levels for recent data points are high with 120mg/L of ammonia recorded in the latest sample from June 2016.

Together with T(I)N, TP describes the nutrient component of wastewaters and leachates. Elevated TP levels can have detrimental impacts on native plants and promote algal blooms in water bodies. The Peel Inlet Harvey Estuary Environmental Protection Policy (EPP 1992, s. 6, 7) specifically addresses the need to reduce nutrient inputs including phosphorus from its policy area which includes the Nambeelup premises.

TP levels in bore CW01 have consistently been significantly (between 4 and 5 times) above background levels (Figure 4e) and a recent result from bore CW05A from June 2016 also indicates an elevated level. However, data return for bore CW05A has large gaps and is therefore hard to interpret with regards to any trends. The concentrations in the remaining bores CW02, CW03/3A and CW04/4A appear to have remained consistent with background levels at least since July 2013. The results indicate that there are potentially active contaminant sources near bores CW01 and CW05A contributing to TP levels elevated above background.

The pH levels separate mainly bore CW04 and CW03 (pH between 4 and 5) against bores CW01 and CW05A (pH between 6 and 7) (Figure 4g). This separation is consistent with findings derived from the other analytes including TDS that infer greater impact of nutrient leachates on bore CW01 and CW05A.

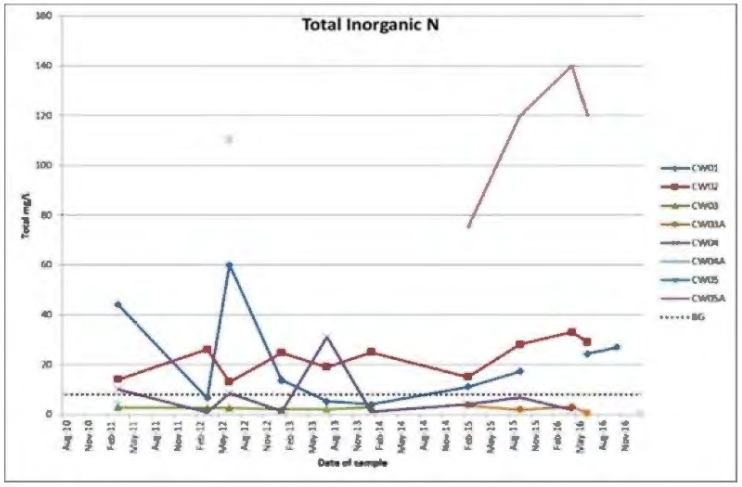
Elevated levels of TDS were recorded in bores CW01, CW02 and CW05A (Figure 4f).

Key findings

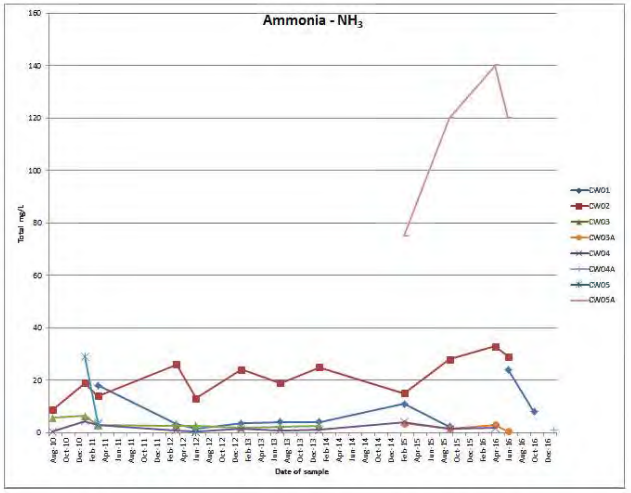
The Delegated Officer has reviewed groundwater monitoring data from C-Wise bores illustrated in Figure 4 and concluded that:

- *The submitted data has significant gaps requiring improvements in data quality and consistency in future submissions.*
- *High ammonia levels have been detected in bore CW05A indicating the likely presence of a nearby contamination source.*
- *Given the observed fluctuations and levels of contaminants recorded in some bores, the current biannual sampling regime is not considered sufficient to adequately document environmental performance and determine contamination sources.*
- *High nutrient levels in multiple bores indicate that there is likely to be a contaminant source or sources nearby, which need to be identified. It is therefore necessary to confirm through testing that containment infrastructure on site is effective.*

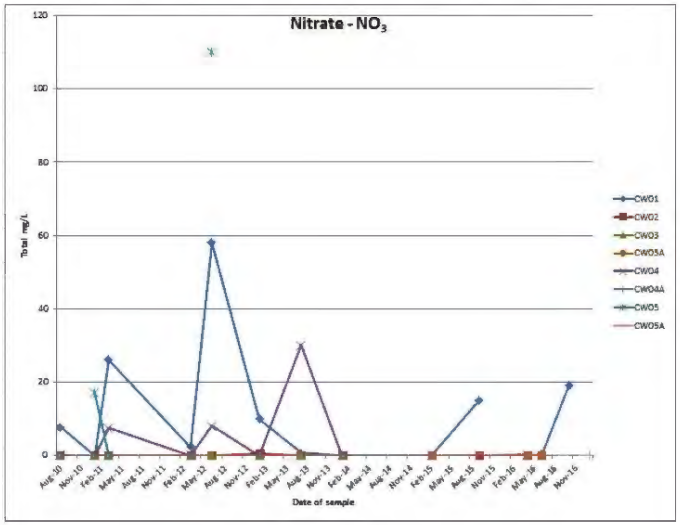
a) Total Inorganic Nitrogen in relation to BG



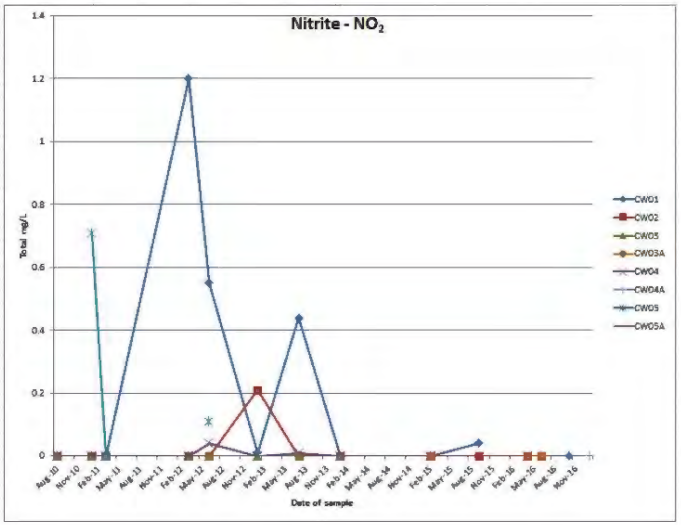
b) Ammonia concentrations



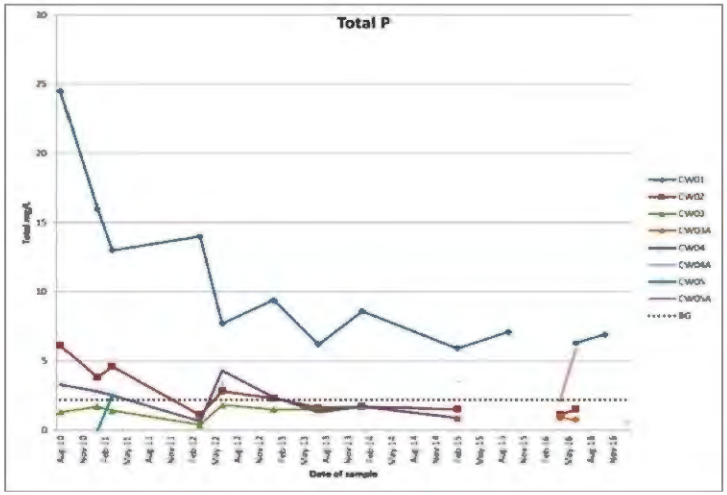
c) Nitrate concentrations



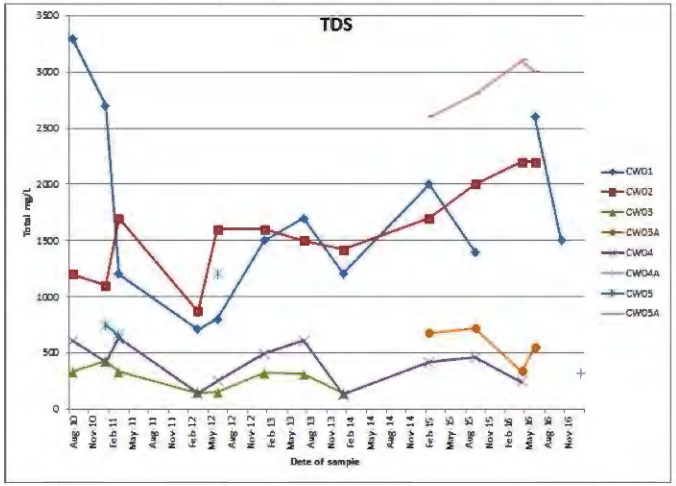
d) Nitrite concentrations



e) Total Phosphorus in relation to BG



f) Total Dissolved Solids concentrations



g) PH

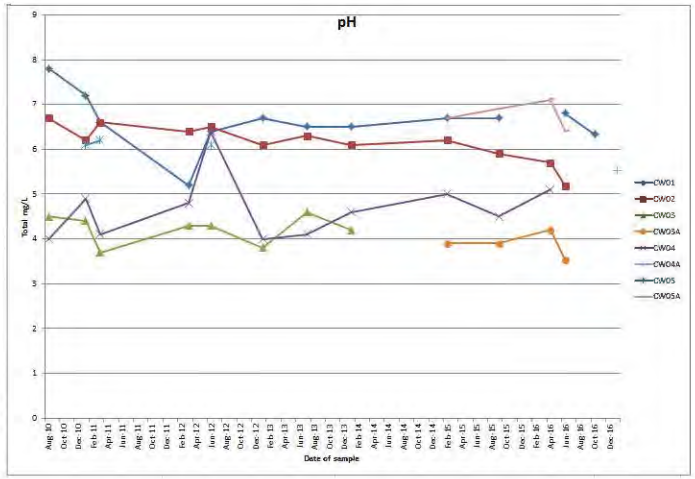


Figure 4: Groundwater monitoring data submitted by C-Wise, 2010 to 2017.

CM Farms

Monitoring data from CM Farms has been graphed by analyte in Figure 5. High levels of TN (more than 5 times background levels) have been recorded from bore CM11S (Figure 5a) which is located west of Pond 5. High levels also occurred in bore CM10S in June 2016 but the level dropped significantly in October 2016. It is unclear what could cause such a fluctuation. Recent results also show bore CM09S and CM08S above background levels. These results indicate that there are potential contaminant sources up hydraulic gradient from the bores that may be impacting on TN concentrations. Given the proximity of bore 11S to CM Farms ponds, these could be an active contamination source. They could also affect bore CM10S which is located 800m south-southwest from CM11S and down hydraulic gradient from the ponds. In addition the results from bore CM09S could be impacted by the same contaminant source due to its location approximately 500m southwest of bore CM11S.

Ammonia and Nitrate levels are graphed in Figure 5b-c. Nitrite has not been graphed as it remained below detection level for the entire monitoring period. Concentrations of Ammonia and Nitrate show elevated levels and fluctuating patterns in bore CM11S indicating potential impacts from a nearby contamination source.

Bore CM11S also recorded high levels (more than 5 times background levels) of TP and similar to TN the graph shows substantial fluctuations. There is some graph alignment between TN and TP between May and October 2015 indicating they are likely to be caused by the same contamination source. It is likely that this source is one or multiple CM Farm ponds located close to CM11S. The fact that there are large nutrient spikes indicate that there may have been some events such as operational activities that contributed to increased nutrient seepage. It is unclear, however, what these events were.

Data spikes are also observed in bores CM11S, CM09S and CM08S for TDS (Figure 5f) and it is unclear what these are caused by.

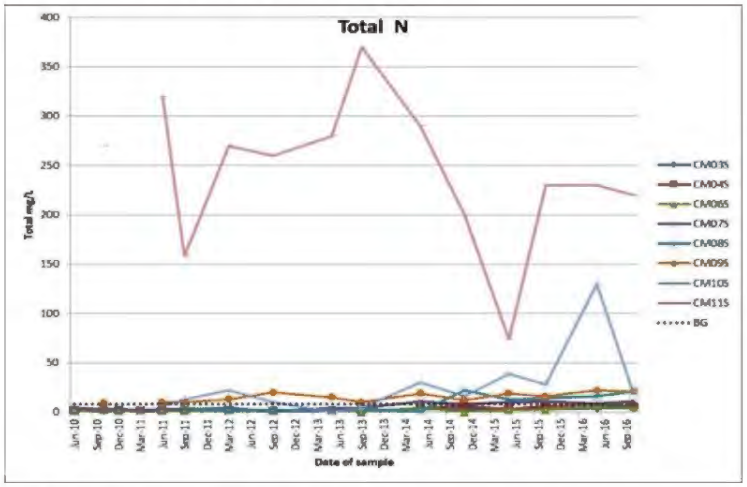
It is possible that data spikes reflect some level of seasonality and rainfall pattern but such a pattern is not clearly discernible. The cause is more likely to be data integrity issues relating to sampling methodologies.

Key findings

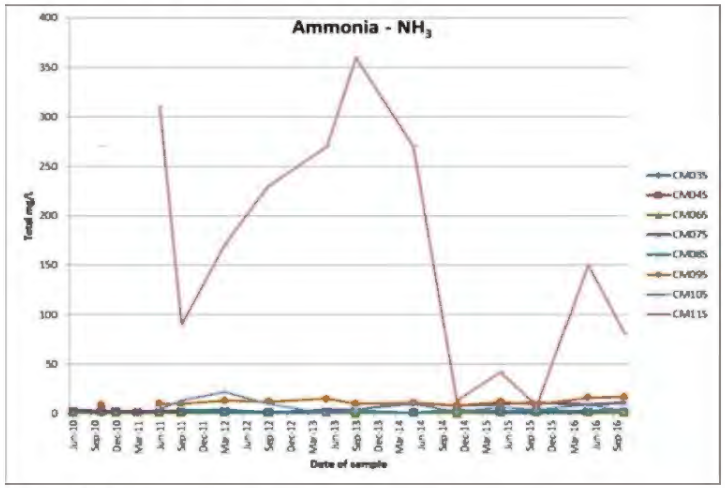
The Delegated Officer has reviewed groundwater monitoring data from CM Farm bores illustrated in Figure 5 and concluded that:

- *High nutrient levels have been detected in bore CM11S indicating the likely presence of a nearby contamination source.*
- *From the location of the impacted bore, it is inferred that one or multiple CM Farm ponds could be the contamination source.*
- *Given the observed fluctuations and high levels of contaminants recorded, the current biannual sampling regime is not sufficient to adequately document environmental performance and determine contamination sources.*
- *High nutrient levels in bore CM11S and bores CM10S and CM09S indicate that a groundwater contamination plume originating at the operational area may have mobilised and moved in a south-westerly direction towards sensitive receptors.*

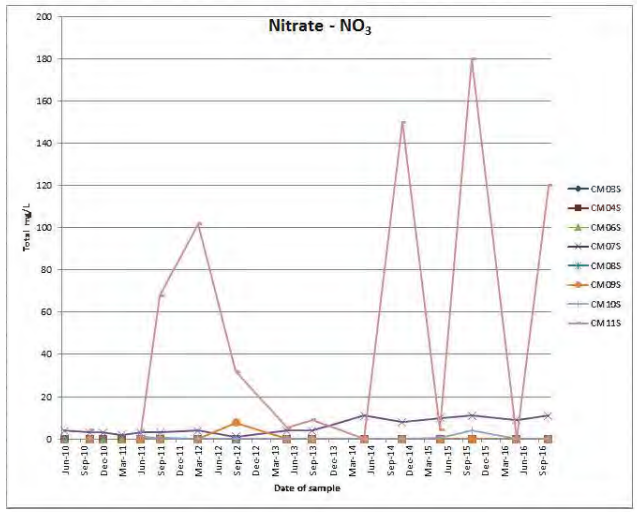
a) Total Nitrogen in relation to BG



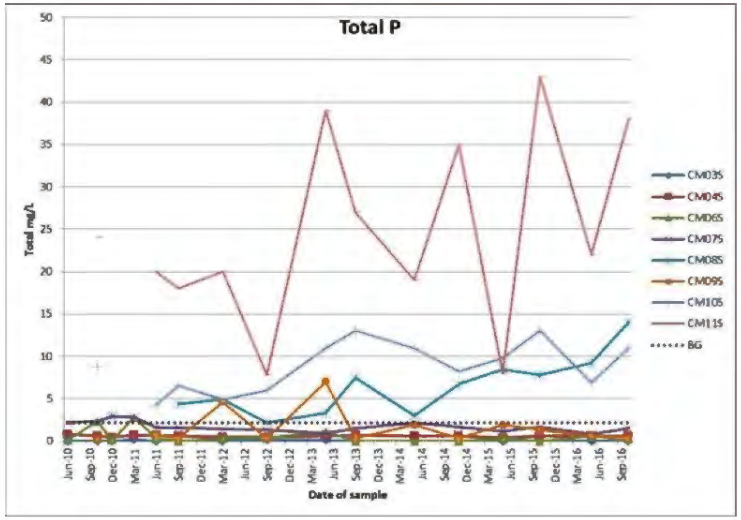
b) Ammonia concentrations



c) Nitrate concentrations



d) Total Phosphorus in relation to BG



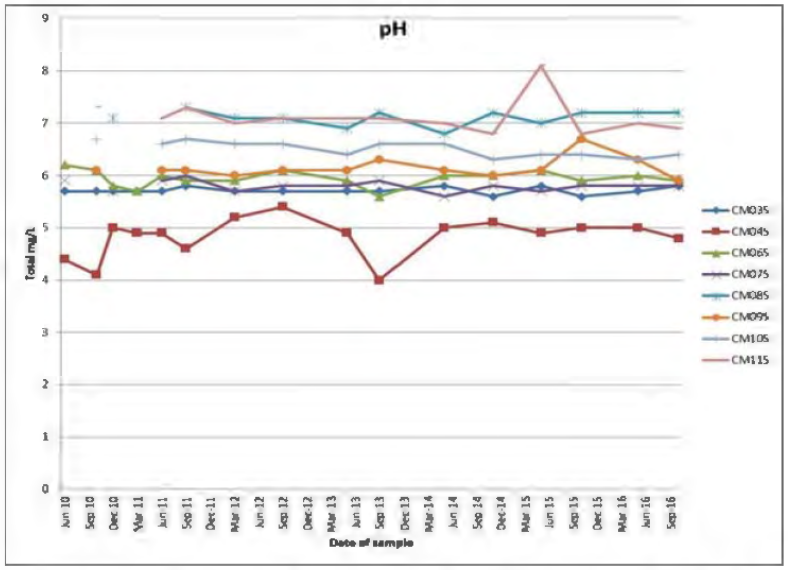
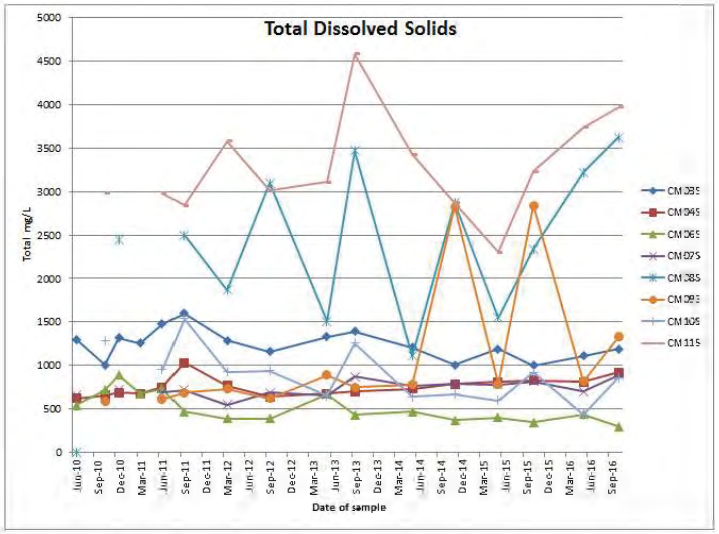
e) pH	f) Total Dissolved Solids concentrations
	

Figure 5: Groundwater monitoring data submitted by CM Farms, 2010 to 2016

Mushroom Exchange

Monitoring data from Mushroom Exchange has been graphed by analyte in Figure 6. In contrast to data from C-Wise and CM Farms, the data from Mushroom Exchange has been collected in quarterly intervals which provides greater detail and data resolution. However, the quarterly sampling intervals are not consistent and there are some data gaps.

Nitrogen based nutrient concentrations are shown in Figure 6a-d. T(I)N levels graphed in Figure 6a show high concentrations and large fluctuations over the historical time series. Such data fluctuations are difficult to interpret in light of describing any trends. Generally T(I)N concentrations in bores ME01 and ME02 are higher and above the background level compared to bores ME03 and ME04. This is consistent with a downgradient location of bores ME01 and ME02 in relation to possible sources from the Mushroom Exchange pond cluster. ME01 and then ME02 appear to be the most impacted bores on the premises. Recent data points from October 2016 and January and April 2017 show a trend of declining concentrations of T(I)N in bores ME01S and ME02.

Concentrations of ammonia, nitrate and nitrite show patterns and fluctuations that are not easily explained. There may be some alignment with T(I)N data however. The data for ammonia in bore ME01 (Figure 6b), for instance, mirrors the data for T(I)N in the same bore (Figure 6a). Data points for nitrate (Figure 6c), however, are more closely aligned with T(I)N concentration in bores ME03, ME04 and ME05 (Figure 6a).

A review of the time series of TP concentrations (Figure 6e) shows generally high concentrations and large fluctuations over the historical time series but recent sampling events indicate a reduction in TP concentrations with levels in bore ME02 reaching background concentrations.

When comparing recent TP and T(I)N concentrations (Figure 6a, e) the similarities support the conclusion that the source of contamination is the same for both and consists of leachate rich in T(I)N and TP. The data also indicate that bore ME01 is differently impacted than the other bores, possibly due to its location.

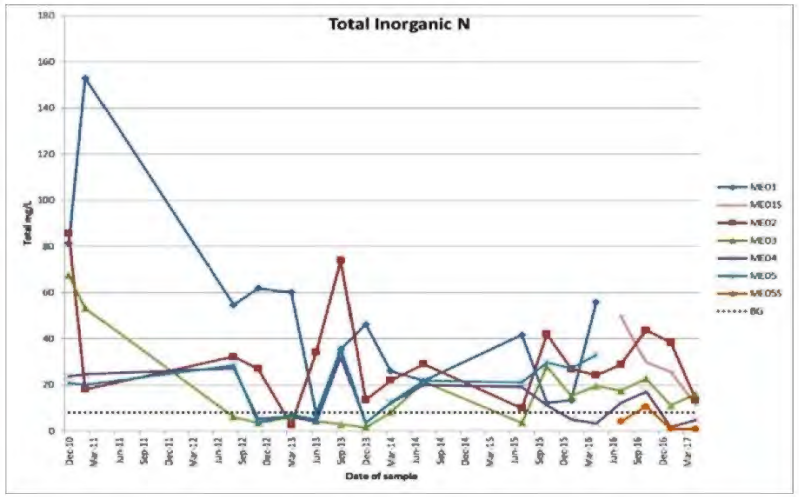
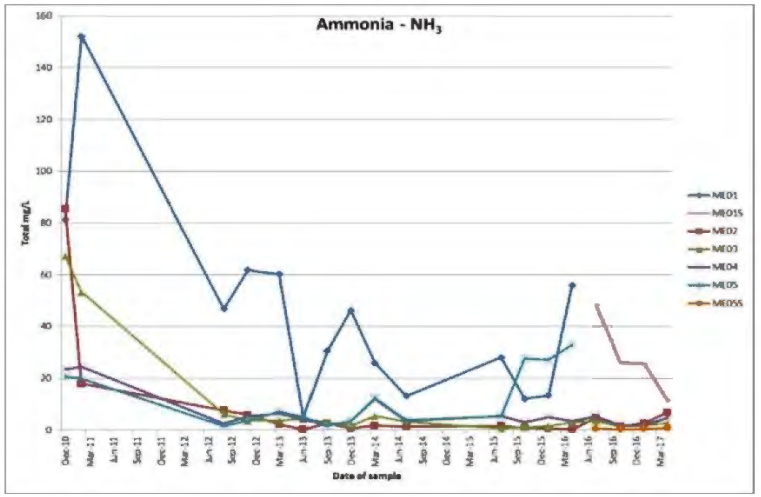
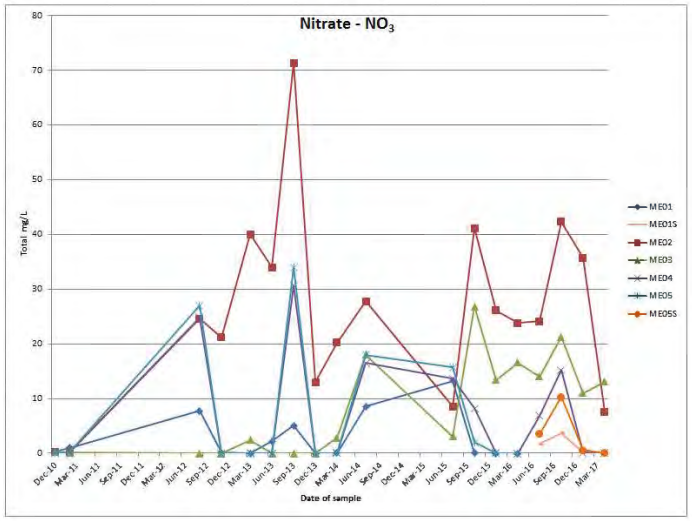
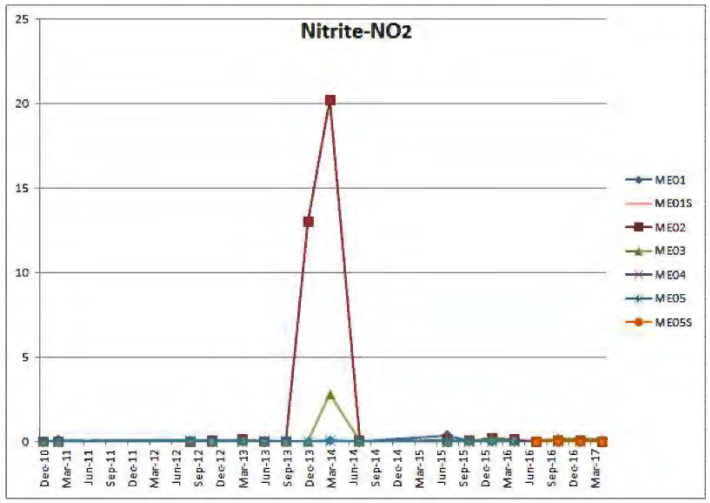
TDS levels in all bores show a declining trend over the long term historically. Most recent data appear to be somewhat stable (Figure 6f).

PH levels show a sudden decline in all bores between April 2016 and July 2016 but have been stable over the most recent period (Figure 6g).

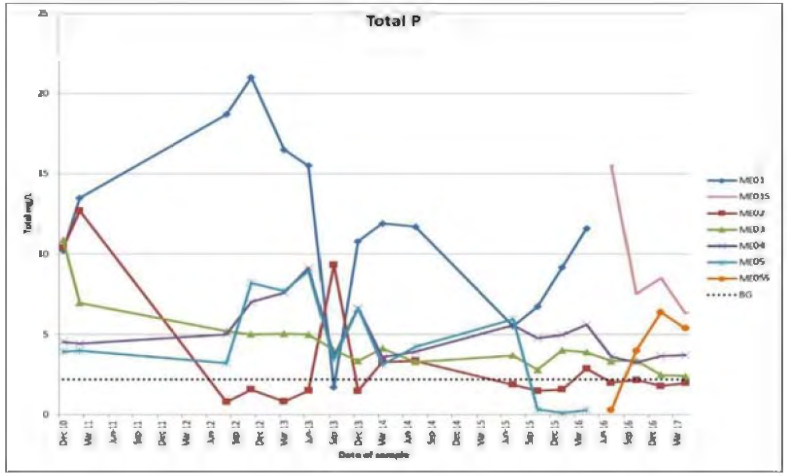
Key findings

The Delegated Officer has reviewed groundwater monitoring data from Mushroom Exchange bores illustrated in Figure 6 and concluded that:

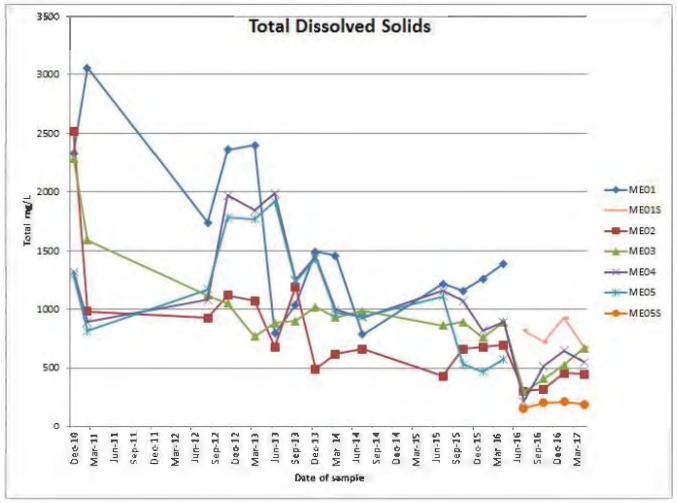
- *The submitted data has some gaps highlighting the importance to ensure that data quality and consistency is maintained in future submissions.*
- *High nutrient levels above background have been detected in multiple bores surrounding the Mushroom Exchange infrastructure indicating the likely presence of a nearby contamination source. It is therefore necessary to confirm through testing that containment infrastructure on site is effective.*

a) Total Inorganic Nitrogen in relation to BG	b) Ammonia concentrations
	
c) Nitrate concentrations	**d) Nitrite concentrations**
	

e) Total Phosphorus in relation to BG



f) Total Dissolved Solids concentrations



g) pH

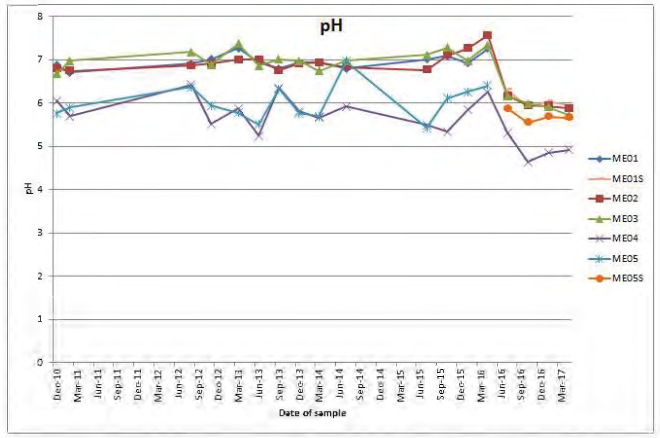


Figure 6: Groundwater monitoring data submitted by Mushroom Exchange, 2010 to 2017

Appendix 5: Odour Impact Analysis

1. Complaints

From October 2015 the then DER began to receive an increase in odour complaints which were recorded in the Department's Incident and Complaints Management system as potentially being related to the Nambeelup premises due to location, odour characterisation, similarity with complaints made at the same time and/or statements made by the complainant. Figure 1 shows the number of odour complaints recorded each month from August 2014 to January 2018 where the Nambeelup Farm were listed as a potential source.

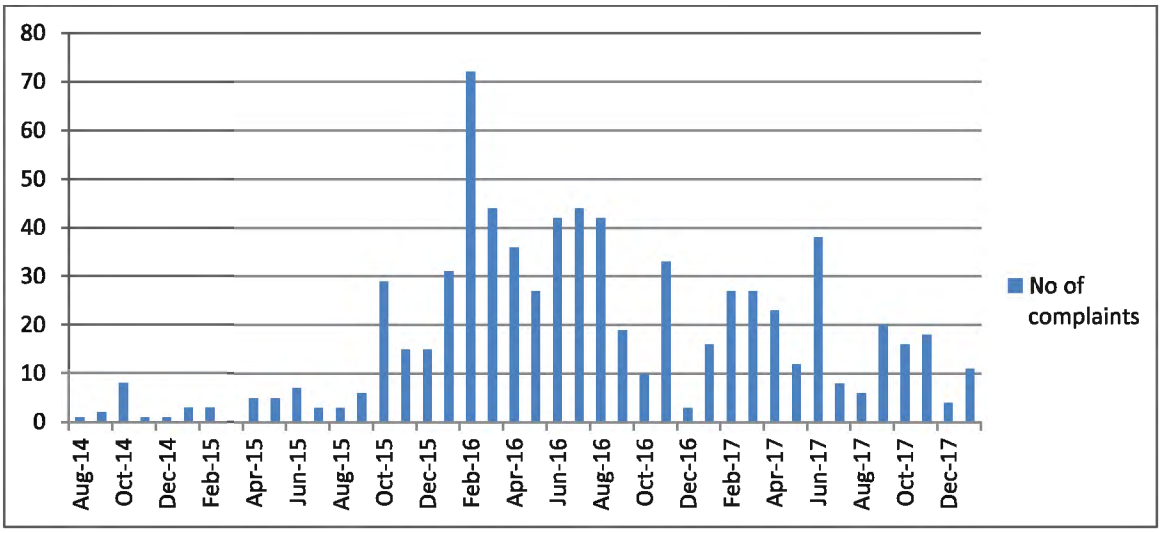


Figure 1: Complaints attributed to Nambeelup Farms

2. Desktop Assessment

Given the significant increase in complaints over the 2016 annual period, a desktop assessment was undertaken to determine whether the odour complaints could be reasonably attributed to the Nambeelup Farm area based on likely wind direction. This initial screening tool is based on wind direction averages from the Bureau of Meteorology.

Figure 2 demonstrates the suburbs where complaints were received from (where a suburb was given) and the dominant wind directions for the Mandurah area. The data indicates that the majority of complaints during 2016 were received from suburbs that are predominately downwind and in closest proximity of the Nambeelup Farm area.

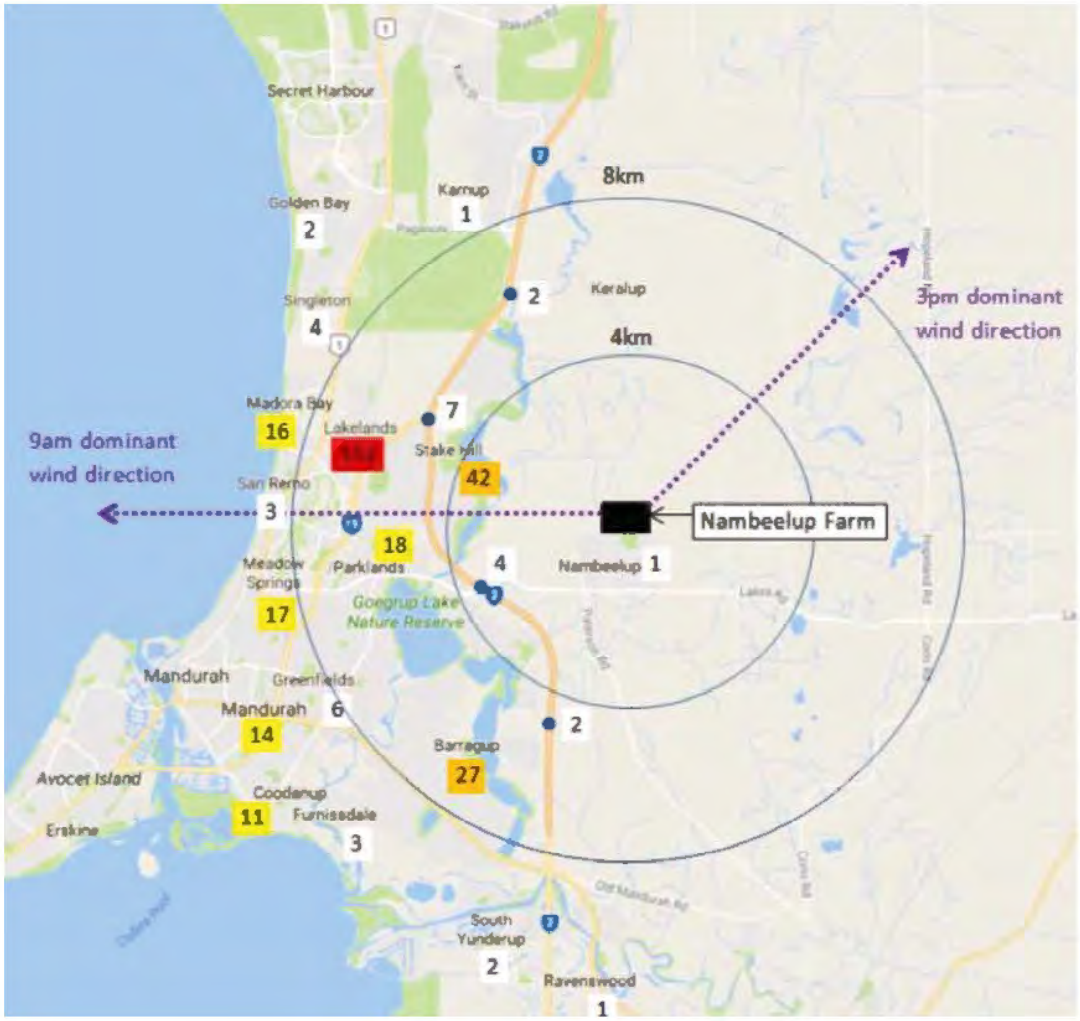


Figure 2: Number of complaints per suburb in 2016 (where suburb was provided at time of complaint)

On a number of occasions there were multiple complaints made on the same day. The meteorological data was analysed for these events which demonstrated that complaints were made at times when the suburbs were likely to be experiencing wind from the direction of the Nambeelup Farm. Figures 3 and 4 below demonstrate the location of complaints and the recent wind direction for complaints made on the 18 March and 11 April respectively.

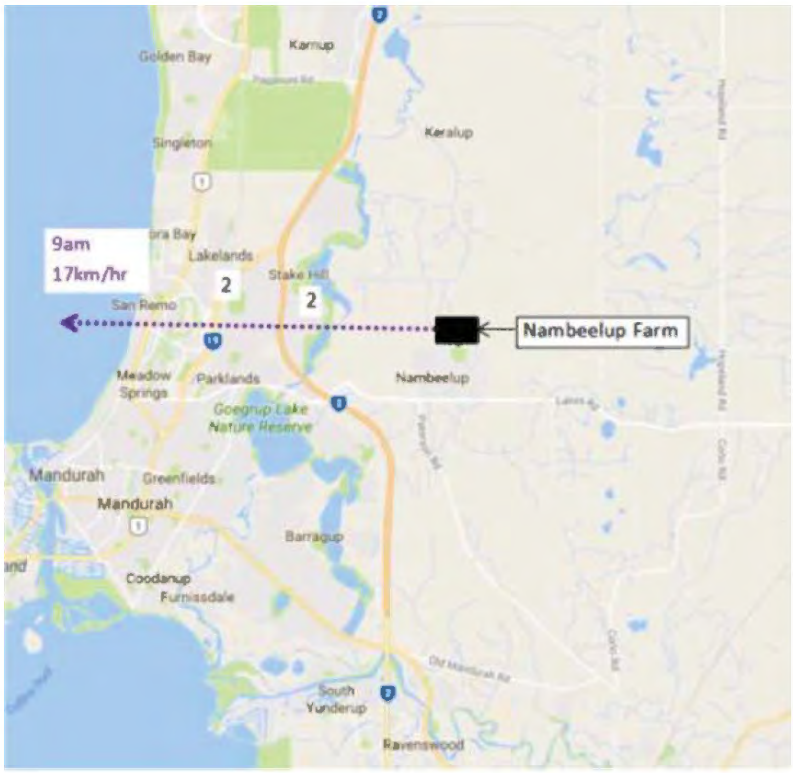


Figure 3: Four complaints made on the 18 March 2016

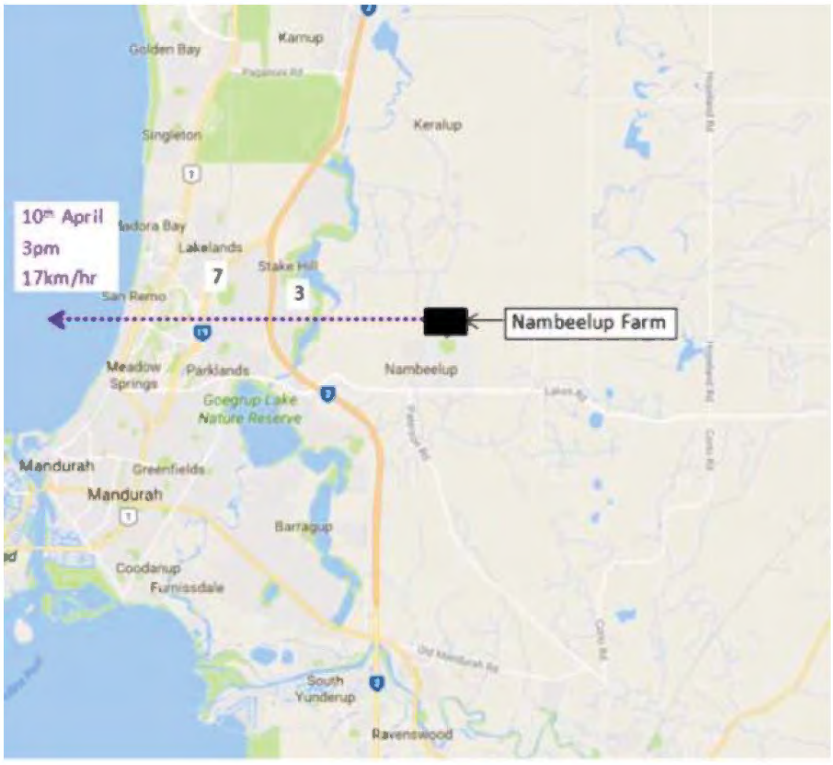


Figure 4: Ten complaints made on the 11 April 2016

The complaints data also demonstrates that the outlying suburbs more than 8 kilometres from the premises reported complaints at the time when recent wind directions were likely to place them downwind of the Nambeelup Farms. Figure 5 demonstrates complaints made near Karnup were received on the 18 February where morning winds were SSE and afternoon winds were SE.

Figure 5: Seven complaints made on the 18 February 2016

While the wind directions are averaged data for the area, it demonstrates that on many occasions the complaints were made in locations where the wind directions could reasonably attribute the Nambeelup Farm area as a potential source of odour, and indicate that there is a potential pathway for odours to travel from the premises to the receptor location.

4. Odour Investigation

As complaints began to increase at the end of 2015, the then DER conducted the Mandurah Odour Investigation at the start of 2016, with seven surveys conducted by DER officers during April to June of 2016. The purpose of the survey was to ascertain which odour sources were the major contributors to odour impacts in the Mandurah area and if possible, to determine the odour impact extent of those sources. The investigation was carried out independent of any complaints and was based on weather data provided by the Department of Agriculture with supplementary weather data taken by DER Officers on the ground at the point of assessment. The full investigation report is attached as Appendix 6.

The following Figures 6 and 7 are taken from file notes in support of the investigation and demonstrates that odours could be identified at over 8km from the premises, and that the assessment involved taking measurements upwind of the premises.

Figure 6: Location of odours observed 19 May 2016

Figure 7: Location of odours observed 2 June 2016 (blue dots indicate no odours observed upwind)

The findings of the report demonstrate that while there are a number of potential natural odour sources (lakes and rivers) as well as two other prescribed premises in the Mandurah area, in the majority of cases the odour observed by DER officers was attributable to the Nambeelup Farm. Odours from the Nambeelup Farms were also observed up to 8.5km from the premises which further correlates to a number of complaints made in suburbs over 8km away from the Nambeelup Farm.

3. Key findings

The Delegated Officer has reviewed the odour complaint information and has found:

1. *There is a potential pathway for odours to travel over 8km from the Nambeelup Farm premises*

5. Specific complaint validation

Verification of individual odour complaints on the ground is difficult due to the need to be in close proximity at the time of the complaint. On the 27 May 2016 DER Air Quality officers were in the Nambeelup area to conduct the Mandurah Odour Investigation and two complaints were received by DER at this time. DER officers were therefore able to validate these complaints by recording odours observed in the area just before the complaints were made and up to an hour after the complaints were made. These observations and shown in Figure 8. During the period of observation the one minute average wind directions at the Pinjarra weather station ranged between east north-easterly and south easterly, and the one minute average wind speeds ranged from 0.29m/s and 1.5m/s (data sourced from the Department of Agriculture and Food).

Figure 8: Odour complaints and DER observations – 27 May 2016

6. Key findings

The Delegated Officer has reviewed the information regarding the odour investigation and has found:

1. *Odour emissions observed in the Mandurah area are mainly attributable to the Nambeelup Farm premises*
2. *Odour impacts have been confirmed up to 8.5 km from the premises*

Appendix 6: Technical Expert Report – Mandurah Odour Investigation

Government of **Western Australia**
Department of **Environment Regulation**

REPORT

Technical Expert Report

Report on Mandurah Odour Investigation (MOI) Project

Version: Final

September 2016

DER2016/000081

Document control

Document version history

Date	Expert name / position	Version	Role
17/07/16	Philippe Najean Senior Air Quality Officer	Draft	Author
19/07/16	David Griffiths Senior Air Quality Officer	Final	Reviewer
29/08/16	Kerry Laszig Director Environmental Sciences	Final	Executive review

Corporate file information

File number and/or name	File owner or custodian	File location
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Expert's details

Personal details: Author

Name	Philippe Najean
Employer	Department of Environment Regulation
Position title	Senior Air Quality Officer
Classification level	SC3
Recognised field of expertise	The author is recognised as an expert by the Department of Environment Regulation (DER) in odour, process, chemical engineering and data analysis

Qualifications and experience

The qualifications and experience and technical capability relevant to the provision of this advice is as follows:

Qualification

Qualification	Year obtained	Additional comments
Master Degree, Chemical Process Engineering	1996	Graduated from Ecole des Mines St Etienne & Polytechnique Institute of Grenoble (France)
Environmental Engineering Degree	1996	Focus: process design and management of operations dedicated to waste, air, water and soil treatment

Professional experience

Employer	Position	Tenure
Department of Environment Regulation (including predecessor agencies)	Senior Air Quality Officer	2008 – present
IRSN Paris (French Institute for Radiological Protection and Nuclear Safety)	Olfactometry Laboratory Manager	2001 - 2007

Other – Publications/memberships/associations etc

Publications

DER Technical Report: Community Odour Monitoring Program (COMP) Leeming and Willetton, January to April 2011, Final Report – March 2012

DER Technical Report: Report 1 - Final reports from odour investigations around the Southern Metropolitan Regional Council's Regional Resource Recovery Centre in Canning Vale – October 2008

Refereed Papers / Conferences / Exhibitions

Najean P. (keynote speech), Odour Regulation & Odour Management: a possible and necessary synergy *OMCTS* Sept 2015 Toronto, Canada

Odour management: Challenges and Opportunities - An International Perspective, *Mini-Symposium Waste Management Association of Australia*, May 2013, Perth, Australia

Case studies: olfactometry and chemical odour source assessments, *ECRIN (French Environmental Association) Working Group*, 2006, Paris, France,

Case study: Limitations for olfactometry and chemistry assessments, *Envirorisk Exhibition*, Sept 2005, Aix-en-Provence, France

Case study & European Standard EN13725, *Eurodeur-Biorodeur*, June 2005, Paris, France

International odour regulation and French position, *National Technical Day, French Minister of Environment*, Feb 2005, Paris, France

Olfactometry and chemistry duality for odour assessment (poster and speech), *Envirorisk Exhibition*, Sept 2004, Lille, France

Odour Treatment Technologies, *Eurodeur-Biorodeur*, June 2004, Paris, France

Waste Water Treatment Plant case study: odour source assessment, *Eco-Industries Exhibition*, March 2004, Metz, France

Odour Nuisance Survey Methodologies, *Eurodeur-Biorodeur*, June 2003, Evreux, France

French Odour Standards, *Eurodeur-Biorodeur*, June 2002, Pau, France

Lectures

University of Western Australia – Project & Risk Management: an "odorous" case study, *University of Western Australia Master students, May 2013*, Perth, Australia

Odour Science Generalities and Case Studies, *Murdoch University Master students, May 2013*, Perth, Australia

Odour Science: generalities and case studies, *lecture to the Board and post-doc students of the Environmental Engineering Department of Murdoch University*, June 2012, Perth, Australia

Odour generalities, Case study: odour field survey SMRC 2008, Odour

Assessments: limitations and ways forward, *Department of Environment and Conservation internal workshop*, Feb. 2010, Perth, Australia

Introduction to the odour science, *Curtin University* Master students, May 2011, Perth, Australia

Odours: from subjectivity to objectivity, *Water Corporation WA*, March 2011, Perth, Australia

Odours: from subjectivity to objectivity, *Engineer Australia and Cheme*, Nov. 2010, Perth, Australia

Summary details

TO:	Germaine Healy, A/Director Compliance & Enforcement, DER
PREPARED BY:	Philippe Najean *
REVIEWED BY:	David Griffiths *
SUBJECT	Mandurah Odour Investigation Project

* The details of these experts is summarised below (see Expert's details).

This advice was prepared for Compliance and Enforcement to provide information on odour sources that may be contributing to the large number of odour complaints received from the Mandurah area in late 2015 and early 2016. I have coordinated and supervised the odour surveys and reported the results and interpretation according to the scope below.

Scope of advice
As per the authorised and approved project scope of the Mandurah Odour Investigations Project – Contentious Issues Management Group – 22 April 2016, DER officers conducted odour field surveys in the area of Mandurah between April and June 2016. Monitoring was conducted in public areas in Mandurah and its suburbs. Odour field surveys were carried by Air Quality Services officers and DER officers from other functional areas. Air Quality Services officers analysed the data and produced this technical expert report. The main focus of the project was to investigate the role of potential odour sources triggering odour complaints in Mandurah area.

In designing and implementing the project and preparing this report, I have also:

- Considered the VDI 3940 Part2.2006 standard "Measurement of odour impact by field inspection – Measurement of the impact frequency of recognizable odours – Plume measurement"
- Undertaken site inspections and field reconnaissance;
- Undertaken odour field measurement; and
- Undertaken comprehensive data processing and analysis

My technical expert report is as follows.

Executive Summary

DER has received intermittent complaints about odour in the Mandurah area since 2014. In 2015 and early 2016 complaints steadily increased, peaking at over 70 complaints in February 2016.

A number of industrial prescribed premises and natural sources of odour were identified as potentially having a role in contributing to odour impacts in the area. The Mandurah Odour Investigation (MOI) was proposed by DER to ascertain which odour sources were the major contributors to odour impacts in the Mandurah area and if possible, to determine the odour impact extent of those sources.

Odour field surveys were performed using odour assessors positioned at various locations and times in the vicinity of each of the identified potential odour sources.

The area to be surveyed was chosen following DER odour complaints analysis and locations of the identified potential odour sources.

Of the eleven prescribed premises initially identified that could potentially impact on the Mandurah area, the following five were retained for the surveys:

- The Waste Water Treatment Plant (WWTP) on Gordon Road;
- The Waste Transfer Station, Corsican Pl;
- A group of three premises, referred as Nambeelup Premises which include:
    - CM Farms – Nambeelup Derby Industries Pty Ltd;
    - Wandalup Farms - Mushroom Exchange Pty Ltd
    - C-Wise WA Composts Pty Ltd

Four major natural sites were identified as potential odour sources in this area:

- Paganoni Lake;
- Black Swan Lake;
- Goegrup Lake; and,
- The Serpentine River between Keralup and Goegrup Lake.

The sensitivity of the odour assessors used in the field was validated.

Survey times were based on meteorological forecasts showing appropriate conditions regarding wind direction (NE to SE pre-defined sector), wind speed below 10 m/s (likely dilution of any odours) and no rain.

Five odour field surveys were carried out early morning and two early evening between 7 April and 2 June 2016.

Assessors were initially dispatched downwind of the identified potential odour sources and performed odour surveys at pre-determined measurement points in their allocated zones. Further measurements were then taken at various locations determined during the course of the survey.

The keys findings are outlined below and presented on Figures B1 to B8 in Appendix B.

Odours from the natural sources including Black Swan Lake, Goegrup Lake and sections of the Serpentine River were recognised by assessors during a small number of single measurements. These odours were identified when close to the source (up to 450m for the lakes and 800m for the Serpentine River).

The April to June period of the year is not likely to be the period with highest odour emissions from the natural sources. During the summer season, dried and potentially odorous lake floors and river banks were in contact with air and sun with odours occurring via breakdown of organic matter. In March 2016, there were several episodes of rain resulting in higher water levels, flooding river and lake beds and banks, and consequently decreasing the potential for odour emissions from these sources.

Odours from the waste water treatment plant (WWTP) on Gordon Road were recognised at one measurement point only, very close to the plant.

Odours from the waste transfer station on Corsican Place were recognised between 50 and 800m for most measurements and at 1,200m during one single measurement. Odours were described as refuse, organic odour and garbage.

Odours from the Nambeelup Premises were recognised between 1,200 and 8,500m and were mainly described as putrid, compost, manure, organic and green waste odours. Verifications undertaken by the field operator and the panel were able to confirm that the Nambeelup Premises was the origin of those odours and that no other odour source with similar types of odour was present upwind of this site.

Objectives

This project aims to investigate which natural sources and industrial activities, among the potential odour sources identified in Mandurah area, may have a role in odour impacts in the Mandurah area, including the suburbs of Lakelands, Parklands, Stake Hill and Meadow Springs.

1.0 Introduction

DER has received intermittent complaints relating to odours in the Mandurah area since 2014. In 2015, complaints steadily increased peaking in February 2016 (Figure 1).

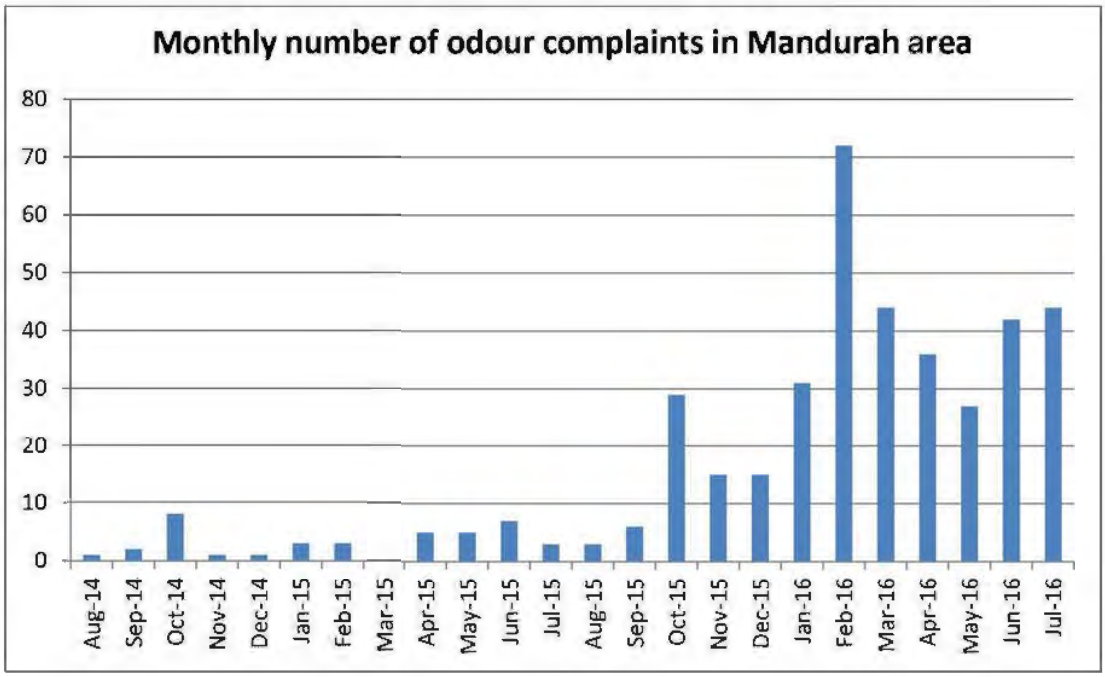


Figure 1: Monthly number of odour complaints reported to DER

A number of industrial prescribed premises and natural sources of odour were identified as potentially having a role in contributing to odour impacts in the area. The Mandurah Odour Investigation (MOI) was proposed by DER to ascertain which odour sources were the major contributors to these impacts and if possible, to determine the odour impact extent of those sources. The MOI was performed by odour assessors at various locations and times in the vicinity of the identified potential odour sources.

2.0 Project description

DER odour complaints were reviewed prior to planning the odour field surveys. This review was used to locate appropriate measurement points and determine appropriate wind directions and time periods to perform the odour field surveys.

Spatial distribution of odour complaints was mapped from DER's complaints database. Primary areas of interest for this odour survey were ascertained from this map.

The complaints analysis also identified early morning and late afternoon as suitable times to conduct the odour surveys.

There are eleven premises which hold licences under Part V Division 3 of the *Environmental Protection Act 1986* operating in the Mandurah area including, waste water treatment plants, waste transfer stations, composting operations, piggeries and liquid waste facilities. Every prescribed facility was inspected by DER officers in early 2016 to verify compliance with their licence conditions. Following inspections, five

prescribed premises were regarded as potential odour sources that may impact the surveyed area:

- The Waste Water Treatment Plant (WWTP) on Gordon Road;
- The Waste Transfer Station, Corsican Pl;
- A group of three facilities, referred to as the Nambeelup Premises which includes:
    - CM Farms – Nambeelup Derby Industries Pty Ltd;
    - Wandalup Farms - Mushroom Exchange Pty Ltd
    - C-Wise WA Composts Pty Ltd

Four major natural sites were identified as potential odour sources in this area:

- Paganoni Lake;
- Black Swan Lake;
- Goegrup Lake; and,
- The Serpentine River between Keralup and Goegrup Lake.

The locations of the identified potential odour sources are presented in **Figure A1** in **Appendix A**.

Owing to the numerous, and widely spread, potential odour sources identified, a large number of pre-located measurement points were required. They are presented on **Figure A2** of **Appendix A**.

The purpose of the surveys was to identify odour sources capable of generating downwind impacts in the field. Consequently, field odour assessments were carried out under North-Easterly (NE) to South-Easterly (SE) winds. This sector of wind gave the highest likelihood that at least some measurement points were located downwind of the potential odour sources.

Surveys were conducted by DER officers from April to June 2016.

3.0 Methodology

This project was drafted as an odour source investigation (OSI) to validate the role of the identified potential sources. The OSI was performed in the vicinity of the identified potential sources, following the general requirements of the VDI 3940 Part2 [1]. An OSI, although not as rigorous as an odour field assessment in regards to the methodology implemented and the results obtained, was suitable for the stated scope of the project.

DER assessors were selected and their sensitivity validated using n-butanol pens and following the St Croix Sensory procedures [2].

Assessors then performed odour field measurements while downwind of the identified potential odour sources and assessed whether emissions of those investigated sources were impacting the surroundings.

Five surveys were carried out early morning and two surveys early evening under various regimes of wind speed and directions. Survey dates, periods of the day, and average wind speeds and directions are presented in **Table 1**. Wind speed and wind

directions were recorded with a hand-held anemometer during the survey and represent current conditions at the times and locations of the survey.

Table 1: Dates and periods of odour surveys – average wind directions and speeds during the MOI

Survey #	Date	Period	Average wind speed range(m/s)	Average wind direction
1	7 April 2016	4.15am – 9.15am	0.5 – 2.5	ENE – ESE
2	15 April 2016	5.40am – 9.30am	1 - 2	SSE - ESE
3	10 May 2016	5am – 9.45am	0 - 2	NNE – E
4	19 May 2016	5am – 9.40am	0 – 1.5	ENE – ESE
5	27 May 2016	4.20am – 9.50am	0 – 1.5	NE - ESE
6	30 May 2016	4pm – 9.40pm	< 1	SSE - NE
7	2 June 2016	3.45pm – 10.10pm	0 – 1.5	E - ESE

As the purpose was to investigate if odours from a specific source can be recognised off-site, measurements were carried out at the level of recognition/no recognition of the odour from a specific source. Therefore, odour intensity was not recorded by the assessors. In addition, due to the low temperatures, both in the morning and evening surveys, five minute single measurements only were performed by assessors at each surveyed measurement point rather than the recommended ten minute single measurement.

Suitable forecast meteorological conditions (wind direction within the pre-defined sector, wind speed below 10 m/s (likely dilution of any odours) and no rain) were identified before each survey. All surveys were conducted with five to seven assessors.

Assessors were required to record their findings per measurement point. An example of a log-form is presented in **Figure A3** in **Appendix A**.

Assessors were located downwind of the various identified potential odour sources and performed odour surveys at various measurement points across allocated zones determined during the course of the survey.

4.0 Results and discussions

Results are presented in **Figures B1 to B8** of **Appendix B** with the Figure B1 legend showing the various graphical items used to represent the findings on the maps.

The purpose of the maps is to show the locations where the identified odour sources were recognised in order to investigate the odour impact extent of these source emissions.

A coloured dot indicates the detection of an odour attributed to an identified source during one or several single measurements of 5 minutes each. A white star indicates no odour or an odour other than those attributed to the identified potential sources was recognised during one or several single measurements of 5 minute each at the same measurement point. The majority of other odours recognised during those surveys were: exhaust fumes from passing vehicles, cooking food and chimney wood smoke from residences, vegetation, bush, cigarette smoke or asphalt from nearby roadworks.

Odours (if any) recognised for each identified potential source are discussed below.

Paganoni Lake & Black Swan Lake

Potential odours from both lakes were investigated during every survey except Survey #3.

No odour from Paganoni Lake was recognised (no orange dots on Figures B2 to B8).

Odours from Black Swan Lake were recognised by assessors during only a very small number of single measurements (pink dots on Figures B2, B3 and B6). When recognised, the odour was described as swamp, stagnant water and organic. Odours were recognised at a close distance from the lake (150m to 450m).

Serpentine River (section between Keralup and Goegrup Lake)

The wind regime present during the odour survey period enabled measurement points at Keralup and Stake Hill to be monitored during every survey.

Odours were recognised during a few single measurements only (blue dots on Figures B2 to B8). Odours were described as swampy, musty, peat, stagnant water and organic matter breakdown. Odours were recognised at fairly close distance from the river (50 to 800m). No odour from this source was recognised west of the Kwinana Freeway.

Goegrup Lake

Measurement points north and west of the lake were monitored during every survey.

Odours were recognised during a few single measurements only (green dots on Figures B2 to B8). Odours were described as stagnant water, rotting vegetation, damp, swampy, sewage, peat and decay or stale water. Odours were recognised at close distance from the lake (100 to 500m).

WWTP on Gordon Road

Measurement points north and west of the WWTP were monitored during every survey.

Odour from this source was recognised at one location only, this being at Corsican Place approximately 200m from the WWTP operations. Odours were described as sewage and dirty water.

Waste transfer station on Corsican Place

Measurement points west from the transfer station were monitored during every survey. Odour from this source was recognised at close measurement points mostly ranging from 50m – 800m. One measurement identified recognisable odour at 1,200m.

Odours were described as refuse, organic odour and garbage. Odours were all recognised during the five morning surveys and with no recognisable odours during the evening measurements.

Nambeelup Premises

Odours from this facility were recognised at various locations ranging from 1,200m to 8,500m from the operations.

Odours were described as putrid, compost, manure, organic, green waste, rotten, waste, silage, dung, soil lifter, rancid, fermented manure, pig, garbage and rubbish tip leachate.

Owing to the nature and distance at which this odour was recognised, further steps were undertaken for confirmation:

- Upwind patrol of the area east of Nambeelup Premises under easterly winds. The purpose was to assess whether there were other odour sources with similar odour types upwind the Nambeelup Premises. The patrolled area included Greyhound Retreat, Bush Retreat, Dirk Hartog Drive, Yangedi South Rd and Redheads Rd. No odour was recognised when patrolling these locations while odours were recognised downwind of the Nambeelup Premises that confirmed the likelihood of the Nambeelup Premises as the source of the odours.
- Odours from the Nambeelup Premises were recognised during the evening survey #7 by all assessors at various locations downwind of this source. At Gull Rd, west of the Nambeelup Premises, at the end of the survey, all assessors indicated they could recognise an odour similar to odours they had experienced earlier during the same evening or during previous surveys but stronger.

5.0 Limitations

The purpose of the project was to investigate whether odours from identified potential odour sources could be recognised in the field. The scope did not include recording of the number of times a specific odour was recognised during single measurements or survey days. Consequently, assessments of the frequency of odour recognition per odour type, per odour survey or per measurement point cannot be performed on the data. Similarly, the scope did not require recording of odour intensities recognised by assessors.

The April to June period of the year is not likely to be the period with the highest odour emissions from the natural sources such lakes and river. During the summer season, dried and potentially odorous lake floors or river banks were in contact with air and sun creating organic matter breakdown. In March, there were several episodes of rain. River levels rose during these episodes, flooding river and lake beds and banks; therefore decreasing the potential of odour emissions from these sources.

6.0 Summary

DER officers carried out seven odour field surveys between 7 April and 2 June 2016 in the Mandurah area. The Mandurah Odour Investigation (MOI) project was designed to confirm whether odour from seven sites identified as potential odour sources could be recognised in the Mandurah area. Of these sites, four were natural sites and five were

prescribed industrial premises.

A summary of the findings are outlined below:

- Odours from Black Swan and Goegrup Lakes and also sections of the Serpentine River were recognised on a few occasions, and at relatively close distances. Assessors described odours as swamp, stagnant water, organic, peat, musty, decay, stale water and damp.
- Odours from the WWTP on Gordon Road were recognised at one measurement point only, at approximately 200m from the plant.
- Odours from the waste transfer station on Corsican Place were recognised at distances generally between 50 and 800m. Odour was recognised at 1,200m during one single measurement. Odours were described as refuse, organic odour and garbage.
- Odours from the Nambeelup Premises were recognised at distances ranging from 1,200 and 8,500m and were described as putrid, compost, manure, organic, green waste, rotten, waste, silage, dung, soil lifter, rancid, fermented manure, pig, garbage and rubbish tip leachate. Verification actions undertaken were able to confirm that Nambeelup Premises was the origin of those odours and that no other odour source with similar types of odour was present upwind this site.

7.0 References

[1] VDI 3940 Part 2, 2006, Verein Deutscher Ingenieure - Measurement of odour impact by field inspection – Measurement of the impact frequency of recognizable odours

[2] Alice M. Lay, Charles M. McGinley, P.E., A Nasal Chemosensory Performance Test for Odor Inspectors, Water Environment Federation Odors and Air Emissions 2004 Bellevue, WA: 18-21 April 2004

8.0 Appendices

Appendix A: Identified potential sources, pre-located measurement points and odour log form

Figure A1: locations of the identified potential prescribed premises and natural odour sources

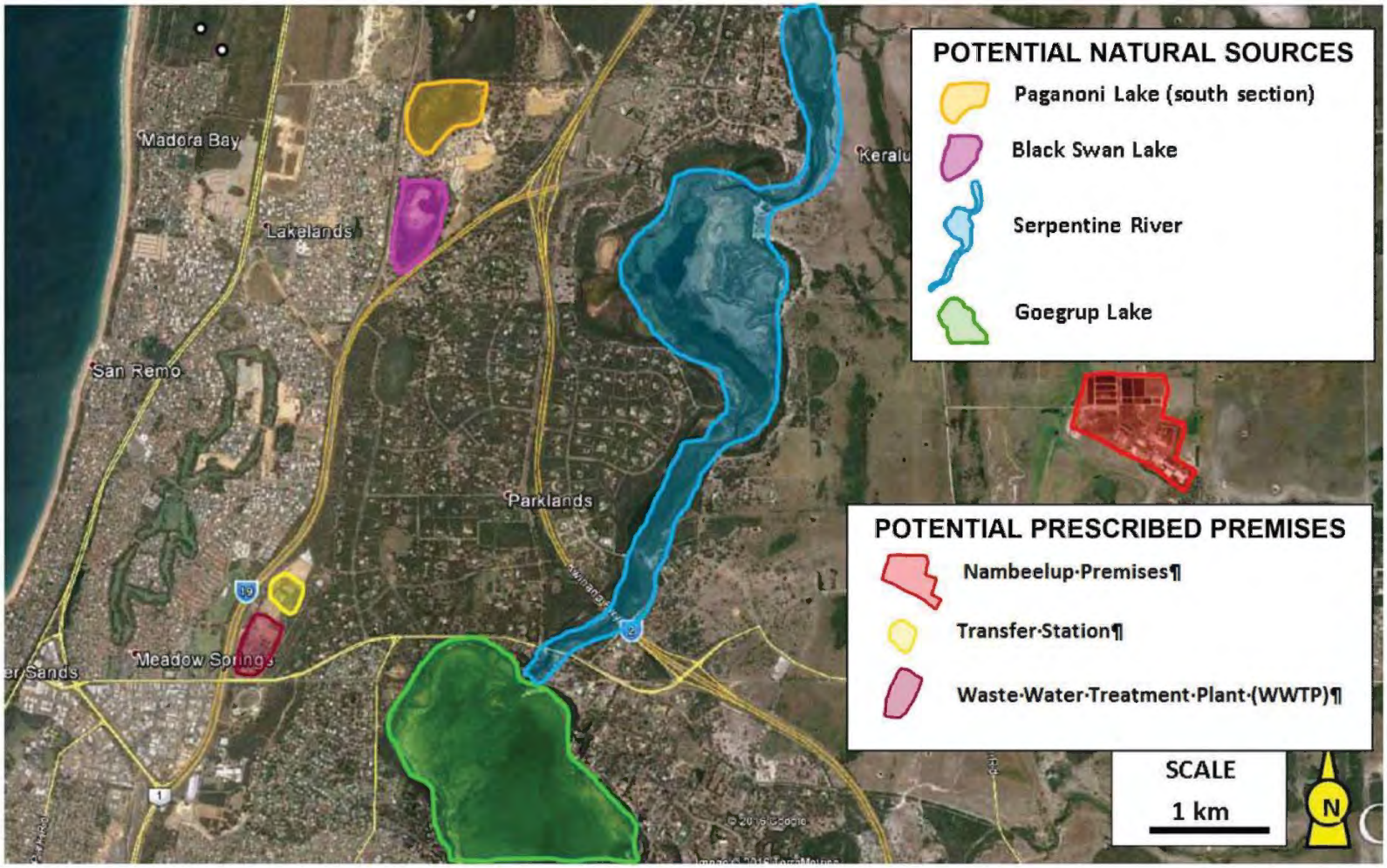


Figure A2: pre-located odour measurement points for the MOI

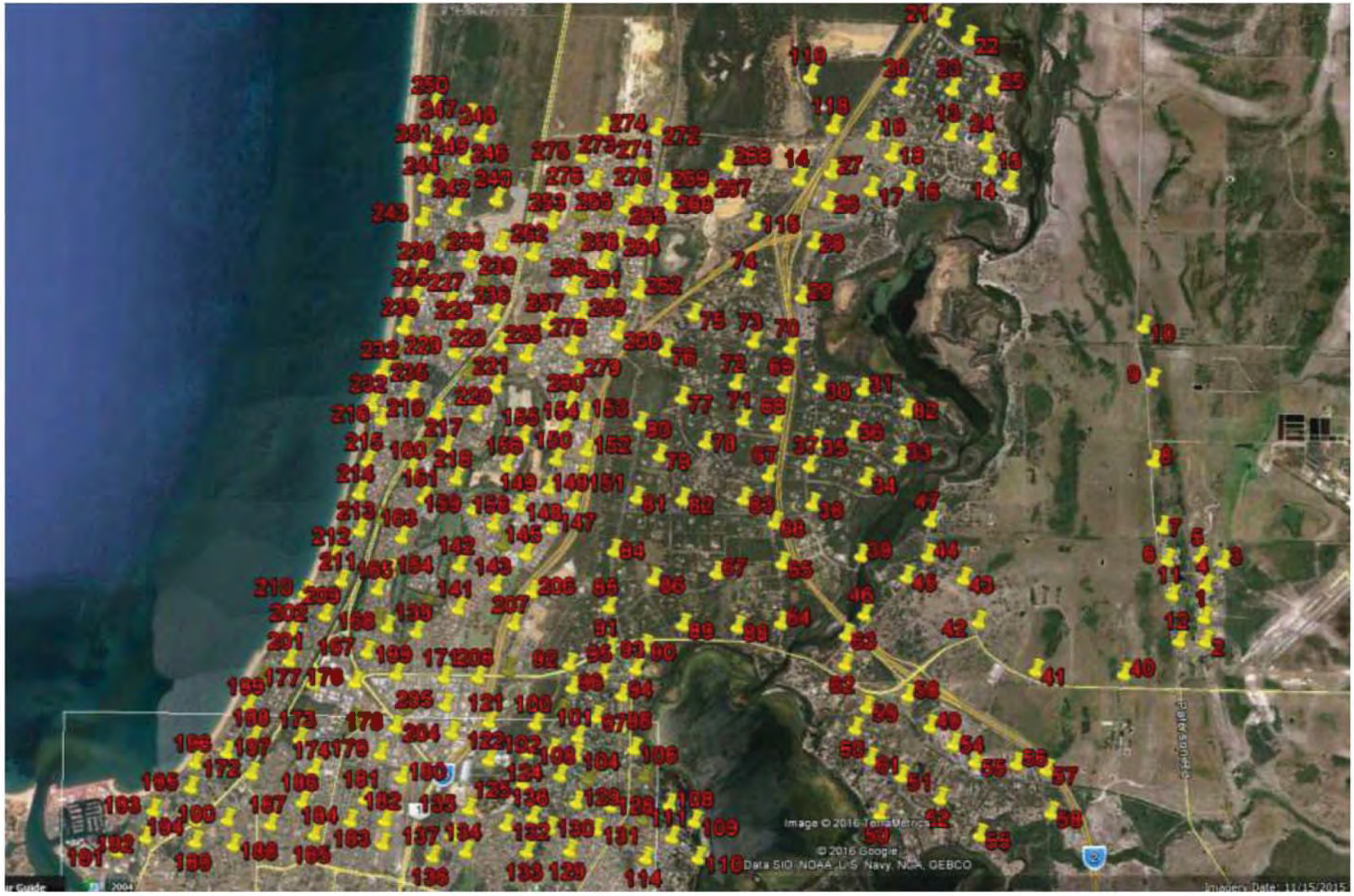


Figure A3: Odour log-form used by odour assessors during the MOI

Mandurah Odour Investigation Form DER / AQS

Assessor initial:________ Date: ____/____/____

Location: ____

Comments

Wind Direction

Start time: ___h ___min

Min	00 s	10 s	20 s	30 s	40 s	50 s
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						

Location: ____

Comments

Wind Direction

Start time: ___h ___min

Min	00 s	10 s	20 s	30 s	40 s	50 s
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						

Location: ____

Comments

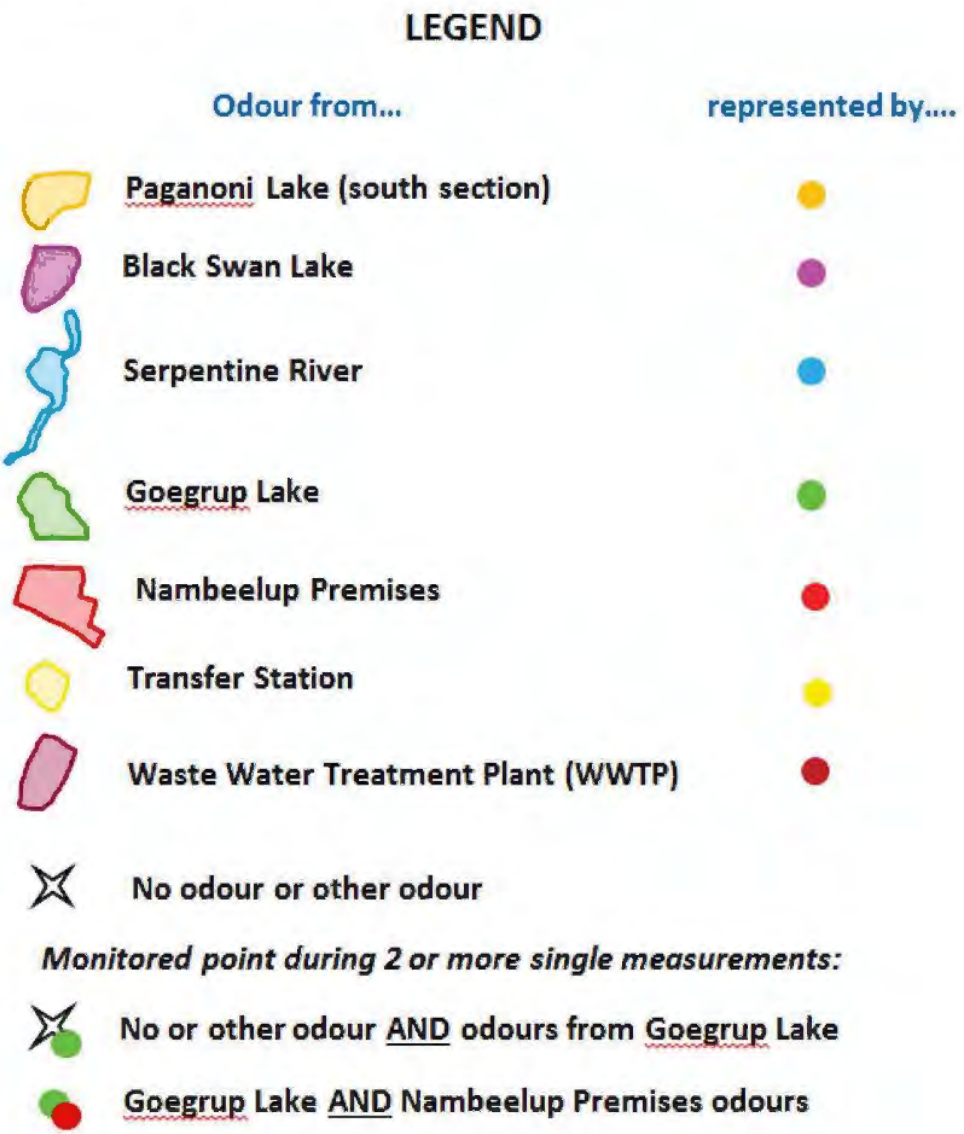
Wind Direction

Start time: ___h ___min

Min	00 s	10 s	20 s	30 s	40 s	50 s
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						

Appendix B: Results of the seven odour surveys carried out during the MOI

Figure B1: Legend of the odour survey findings



Note:

When an odour is indicated at a measurement point, this odour may have been recognised during one or several single measurements at this same point during the survey period

Cone of wind:

This arc indicates that winds were from North-East (NE) to South-East (SE) and were blowing towards the sector South-West (SW) to North-West (NW) during the survey period

Figure B2: Findings of Survey #1 - 7 April 2016

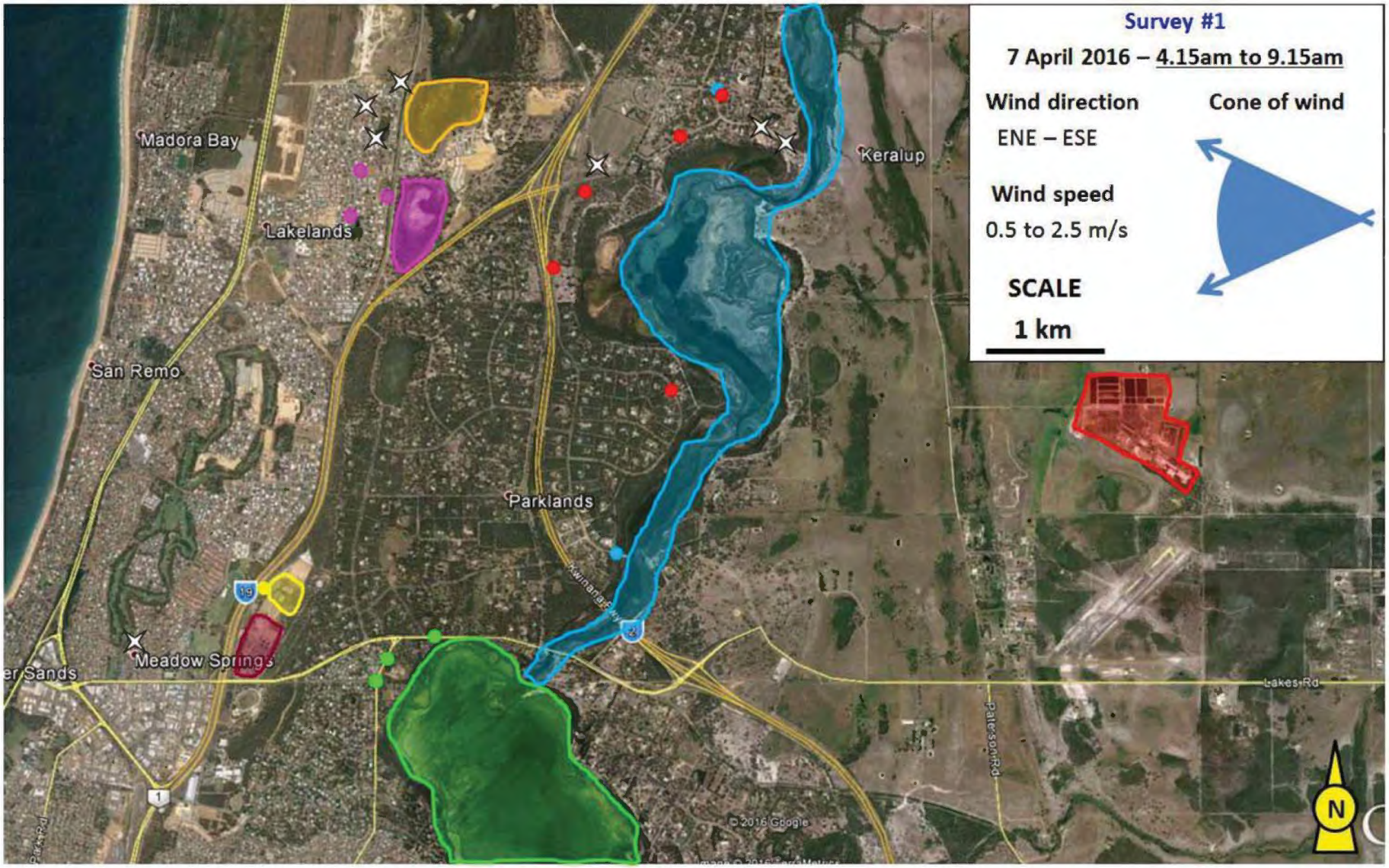


Figure B3: Findings of Survey #2 - 15 April 2016