Veolia Environmental Services (Australia) Pty Ltd

Woodlawn Bioreactor Expansion Project

Independent Odour Audit #11

October 2023

Final Report

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LIST OF ABBREVIATIONS & DEFINITION

2022 IEA	Ramboll – *Independent Environmental Audit – Veolia Woodlawn MBT Facility dated* 24 May 2022
2022 Recommended Responses	Veolia Environmental Services - *Woodlawn Eco-precinct Independent Odour Audit (IOA) 2022 Recommended Responses*, 2022
Additional H_2S Monitoring	Veolia Environmental Services - *Additional hydrogen sulphide monitoring data generated between March 2022 and March 2023*
AMD	acid mine drainage
AQGGMP	Air Quality and Greenhouse Gas Management Plan for Woodlawn Bioreactor Document Code: MAN-13299-2 dated 14 July 2023.
AS/NZS 4323.3	Australian/New Zealand Standard 4323.3: 2001: *Determination of odour concentration by dynamic olfactometry*
AS/NZS 4323.4	Australian/New Zealand Standard 4323.4:2009. *Stationary source emissions - Area source sampling - Flux chamber technique.*
ATF	Alterative Treatment Facility
Biofilter Manual	*The MBT Facility Biofilter System Operating & Maintenance Manual – Revision 0* dated November 2016
Biofilter Trial Report	*Report for the biofiltration trial at Woodlawn Bioreactor* dated March 2017
BOM	Bureau of Meteorology
BRS	Biological Refining System
BWMS	Bioreactor Waste Management System
C & D	construction & demolition
CLC	community liaison committee
COD	chemical oxygen demand

December 2020 ADC Report	*Veolia Environmental Services (Australia) Pty Ltd - Alternative Daily Cover – Odour Trial Study: December 2020 – Final Report*, 16 December 2020
DEM-S	Derived Smoothed Digital Elevation Model
DPIE	New South Wales Department of Planning and Environment
EA 2010	Environmental Assessment Woodlawn Expansion Report (August 2010)
ED1	Evaporation Dam 1
ED1 Review	GHD - *Woodlawn Eco-Precinct ED1 Review* dated 13 January 2023
ED3N	Evaporation Dam 3 North
ED3S	Evaporation Dam 3 South
EPL	Environment Protection License
Evaporator Manual	*Veolia Woodlawn Bioreactor Evaporation System Operation Manual* dated February 2023
FAOA	field ambient odour assessment
FOGO	Food Organics and Garden Organics
H_2S Study	*Project Report – Investigation and Assessment of H2S Gas emissions at the Woodlawn Bioreactor* dated 3 December 2021
HDPE Liner Assessment	Earth2Water Pty Ltd - *Woodlawn Bioreactor -- Coffer Dam 1 – HDPE Liner Assessment & Response* dated 30 December 2022 – E2W-0353 R001-v5
HRT	hydraulic retention time
IAC	impact assessment criterion
IFH	Isolation Flux Hood
IMF	Crisps Creek Intermodal Facility
IOA	Independent Odour Audit
KOPs	knock-out pots

Landfill Guideline	NSW EPA, Environmental Guidelines: Solid Waste Landfills dated 2016
LAP	Leachate Aeration Pond
Leachate & Water Management Audit	Jackson Environment and Planning - *Independent Audit 2022 Leachate and Water Management System* dated 19 July 2022
Leachate & Water Management Strategy	Engeny - *Woodlawn Eco-Precinct - Short to Medium Term Leachate and Water Management Strategy - N4002_002/001* dated 16 December 2022
LMS	Leachate Management System
LMS May 2016 Report	*Woodlawn Bioreactor Facility Odour Modelling Study - Proposed Addition of ED3S to Leachate Management System* dated May 2016 Report
LOM	Liquid Odour Method
LTD	Leachate Treatment Dam
LTP	Leachate Treatment Plant
May 2022 Emissions Testing Report	Ektimo - *Emission Testing Report Veolia Environmental Services (Australia) Pty Ltd Woodlawn Biogas Power Station, Tarago: R011837r* dated 24 May 2022
MBR	Membrane Bioreactor
MBT	Mechanical Biological Treatment
MBT OEMP	*Veolia Operational Environmental Management Plan – Woodlawn Mechanical Biological Treatment Facility* dated 14 July 2023
MLP	Measurement Location Point
MSW	municipal solid waste
MW	megawatts
MWOO	mixed waste organic material
NATA	National Association of Testing Authorities
NSW EPA	New South Wales Environment Protection Authority

NSW EPA Approved Methods	NSW EPA document titled *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* dated January 2022
NSW EPA Odour Guide	NSW EPA, *Guide to conducting field odour surveys* dated June 2022
NSW EPA Technical Framework	NSW EPA document titled *Technical Framework (and notes): Assessment and management of odour from stationary sources. Sydney: Department of Environment and Conservation* dated 2006
October 2022 Emissions Testing Report	Ektimo - *Emission Testing Report Veolia Environmental Services (Australia) Pty Ltd Woodlawn Biogas Power Station, Tarago: R013467* dated 24 October 2022
OER	odour emission rate
Previous Model	The original EA 2010 odour dispersion modelling study used in the *Odour and Dust Impact Assessment (Rev 5)* Report dated 2 August 2010
PTFE	polytetrafluoroethylene
RH	relative humidity
RL	reduced level
SCADA	supervisory control and data acquisition
SOER	specific odour emission rate
SRTM	Shuttle Radar Topography Mission
TADPAI	Tarago and district Progress Association Inc
TAPM	The Air Pollution Model
TARP	Trigger Action Response Plan
TOU	The Odour Unit Pty Ltd
tpa	tonnes per annum
TWL	Top Water Level
US EPA	United States Environment Protection Agency
USGS	United States Geological Survey

VENM	Virgin Excavated Natural Material
Veolia	Veolia Environmental Services (Australia) Pty Ltd
WALTER	Woodlawn Aerated Leachate Treated Effluent Refiner
WCA	Waste Covered Area
WIP 2020	Woodlawn Infrastructure Plan: 2020
Woodlawn ARC	Woodlawn Advanced Energy Recovery Centre
Woodlawn Facility	Woodlawn Bioreactor Facility, Collector Road, Tarago, NSW
WPIS5 2022	NSW Woodlawn Bioreactor Infrastructure Plan - Section 5 Operational Management Program – Version 2022

CHEMICAL NOMENCLATURE

CH_4	methane
CO_2	carbon dioxide
$Fe_2(SO_4)_3$	ferric sulphate
GIS	Geographic Information System
H_2S	hydrogen sulphide
H_2SO_4	sulphuric acid
N_2	nitrogen gas
NOx	nitrogen oxides
SO_3	sulphur trioxide

UNITS OF MEASUREMENTS

ha	hectare
km	kilometres
kW	kilowatts
L	litres
L/day	litres per day

L/min	litres per minute
L/s	litres per second
m	metres
mm	millimetres
m/s	metres per second
m^2	square metres
m^3	cubic metres
ou	odour concentration, as defined by AS/NZS 4323.3
$ou.m^3/m^2.s$	specific odour emission rate, SOER
$ou.m^3/s$	odour emission rate, OER
Pa	Pascals
ppb	parts per billion, by volume
ppm	parts per million, by volume
RH	relative humidity
µL	microlitres

1 INTRODUCTION

In February 2023, Veolia Environmental Services (Australia) Pty Ltd (**Veolia**) engaged The Odour Unit (**TOU**) to carry out the 11th Independent Odour Audit (**IOA**) of the Woodlawn Bioreactor Facility located at Collector Road, Tarago, New South Wales (**Woodlawn Facility**). The following report summarises the outcomes of the 11th IOA carried out at the Woodlawn Facility.

1.1 Woodlawn Waste Expansion Project Background and Context

In March 2010, Veolia issued an application to the New South Wales Department of Planning and Environment (**DPIE**) seeking approval to increase the maximum throughput rate of the Woodlawn Bioreactor from 500,000 to 1.13 million tonnes per annum (**tpa**). Simultaneously, Veolia was also seeking to increase the maximum throughput rate of the nearby Crisps Creek Intermodal Facility (**IMF**) to 1.18 million tpa. In addition to these items, the proposal application entailed:

- Installing additional lighting at the Woodlawn Facility;
- Extending the approved hours of operation at the Bioreactor and the IMF;
- Increasing the number of truck movements transporting waste to the Bioreactor from the IMF; and
- Increasing the amount of waste transported to the Woodlawn Facility by road from regional councils from 50,000 to 130,000 tpa.

Veolia received approval for the Woodlawn Waste Expansion Project on 16 March 2012.

1.2 Audit Objectives

The specific scope of work for the 11th IOA is detailed in *Condition 7* of *Schedule 4* of the *Specific Environmental Conditions - Landfill site* (DA 10_0012) and enforced by *Section 75J* of the *Environmental Planning and Assessment Act 1979* as part of the project approval for the Woodlawn Waste Expansion Project. As part of this project approval, Veolia is required to carry out an independent odour audit three (3) months from the date of project approval and annually thereafter, unless otherwise agreed by the Director-General. The 11th IOA must:

a. *Consult with the Environment Protection Authority and the Department of Planning, Industry and Environment;*

b. *Audit the effectiveness of the odour controls on-site in regard to protecting receivers against offensive odour;*

c. *Review the Proponent's production data (that are relevant to the odour audit) and complaint records;*

d. Review the relevant odour sections of the Air Quality and Greenhouse Gas Management Plan for the project and assess the effectiveness of the odour controls;

e. Measure all key odour sources on-site, including:

i. consideration of wet weather conditions providing all raw data used in this analysis;

ii. consideration of (but not limited to) all liquid storage area, active tipping faces, waste cover area, aged waste areas and recirculation of leachate into waste in the void; and

iii. a comparison of the results of these measurements against the predictions in the Environment Assessment.

f. Determine whether the project is complying with the requirements in this approval to protect receivers against offensive odour;

g. Outline all reasonable and feasible measures (including cost/benefit analysis, if required) that may be required to improve odour control at the Woodlawn Facility; and

h. Recommend and prioritise (mandatory and non-mandatory) recommendations for their implementation.

In addition to the above, *Condition 9* of *Schedule 5* under DA 10_0012 requires the 11th IOA to "…*include consideration of the Crisps Creek IMF site in any Independent Odour Audit required by Condition 7 in Schedule 4*." This is included as part of the 11th IOA. To that end, the following document is the eleventh (11th) Independent Odour Audit commissioned since the Woodlawn Waste Expansion project approval was granted.

1.3 COMPLIANCE WITH AUDIT OBJECTIVES

The 11th IOA consisted of the following key items, as required by the project approval for the Woodlawn Facility:

- **Fieldwork***:* the collection of odour samples from key sources (as per *Condition 7 (e)*), recording of relevant field observations, measurements, and discussions with Veolia personnel regarding the operations of the Woodlawn Facility, including the Bioreactor and IMF. The odour emissions inventory developed in previous IOAs was used as a basis for the sampling program in the 11th IOA;

- **Reviewing***:* a comprehensive review of all new or updated documentation materialised since the 10th IOA. For the 11th IOA, this review included the following documentation:

  - Landfill gas capture and trend since the 10th IOA;

- The status of the long-term leachate management solution via the construction and commissioning of the Leachate Treatment Plant (**LTP**);

- Leachate quality data for the Leachate Management System (**LMS**);

- Surface gas monitoring results between April 2022 and March 2023;

- Record of received waste tonnage per month;

- Odour complaints register and responses by Veolia since the 10th IOA;

- Veolia - *Air Quality and Greenhouse Gas Management Plan for Woodlawn Bioreactor Document Code: MAN-13299-2* dated 14 July 2023 (**AQGGMP**);

- External studies that have relevance or impact on odour, including:

  - Earth2Water Pty Ltd - *Woodlawn Bioreactor -- Coffer Dam 1 – HDPE Liner Assessment & Response* dated 30 December 2022 – E2W-0353 R001-v5 (**HDPE Liner Assessment**);

  - Jackson Environment and Planning - *Independent Audit 2022 Leachate and Water Management System* dated 19 July 2022 (**Leachate & Water Management Audit**);

  - Engeny - *Woodlawn Eco-Precinct - Short to Medium Term Leachate and Water Management Strategy - N4002_002/001* dated 16 December 2022 (**Leachate & Water Management Strategy**);

  - GHD - *Woodlawn Eco-Precinct ED1 Review* dated 13 January 2023 (**ED1 Review**); and

  - Ramboll – *Independent Environmental Audit – Veolia Woodlawn MBT Facility* dated 24 May 2022 (**2022 IEA**).

- Ektimo - *Emission Testing Report Veolia Environmental Services (Australia) Pty Ltd Woodlawn Biogas Power Station, Tarago: R011837r* dated 24 May 2022 (**May 2022 Emissions Testing Report**);

- Ektimo - *Emission Testing Report Veolia Environmental Services (Australia) Pty Ltd Woodlawn Biogas Power Station, Tarago: R013467* dated 24 October 2022 (**October 2022 Emissions Testing Report**);

- Veolia Woodlawn Manual titled *Evaporation of Treated Leachate* undated and received in February 2023 (**Evaporator Manual**);

- *The MBT Facility Biofilter System Operating & Maintenance Manual – Revision 0,* dated November 2016 (**Biofilter Manual**);

- *Operational Environmental Management Plan – Woodlawn Mechanical Biological Treatment Facility* dated 14 July 2023 (**MBT OEMP**);

- *Woodlawn Eco-precinct Independent Odour Audit (IOA) 2022 Recommended Responses*, Veolia Environmental Services, 2022 (**2022 Recommended Responses**);

- *Leachate Management in the Landfill Void – Woodlawn Landfill* dated 15 July 2022 (**Leachate Assessment**);

- Additional hydrogen sulphide monitoring data generated between March 2022 and March 2023 (**Additional H_2S Monitoring**);

- Waste Infrastructure Plan – 13 October 2020 (**WIP 2020**); and

- NSW Woodlawn Bioreactor Infrastructure Plan - *Section 5 Operational Management Program* – Version 2022 (**WIPS5 2022**).

- **Modelling**: the undertaking of an update and re-run of the site-specific odour dispersion model for the Woodlawn Facility used as part of the project approval process; and

- **Reporting**: a comprehensive summary of all aspects of the 11th IOA, complying with the objectives specified in **Section 1.2**.

It should be noted that some of the referenced documents are commercial-in-confidence and have been utilised by TOU under privilege to assist with the undertaking of the 11th IOA. All relevant information has been extracted and reproduced as required in the 11th IOA. Where documentation is not included in the **Appendices** of the **Final Report** for the 11th IOA, a request to Veolia seeking the relevant documents of interest can be made.

1.3.1 Consultation with DPIE and NSW EPA

As required in *Condition 7 (A)* of the project approval, TOU initiated a consultation process with both the New South Wales Environment Protection Authority (**NSW EPA**) and the DPIE on 7 February 2023 via email correspondence. A copy of the electronic correspondence issued to the NSW EPA and DPIE and related responses are appended as **Appendix A**.

1.3.2 Additional Work to Audit Requirements

In addition to the project approval requirements specified in **Section 1.2**, the following work components were included in the 11th IOA:

- Consider specific mitigations and changes that have occurred to address odour in the period since the previous audit was undertaken and their effectiveness;

- Consider the results of Veolia's monthly surface gas monitoring program and the efficacy of their Trigger Action Response Plan (**TARP**) for dealing with exceedances;

- Consider the overall landfill gas mass balance for the Woodlawn Facility, including any gas generation calculations/estimates made for the purposes of the National Greenhouse and Energy Reporting Scheme;
- Assess the operability and odour performance of the biofilter-based odour control system at the Mechanical Biological Treatment (**MBT**) Facility, with the objective of continuous improvement in odour mitigation and optimisation performance;
- Completion of a field ambient odour assessment (**FAOA**) survey during the Odour Audit. The FAOA surveys were conducted before 0730 hrs and after 2100 hrs, as well as midday;
- Assessment of Evaporation Dam 1 (**ED1**), which may have received discharges of stormwater from the landfill void and from Evaporation Dam 3 South (**ED3S**) 1 (formerly ED3S);
- Assessment of ED3S1, which receives stormwater from the landfill void that may have come into contact with waste;
- Assessment of the odour potential for all the leachate evaporation dams, i.e., Evaporation Dam 3 North (**ED3N**)-1, ED3N-2, ED3N-3, ED3N-4, ED3S2 (formerly ED3S-S), and ED1 Coffer Dam;
- Assessment of the odour potential from specific elements of the membrane bioreactor (**MBR**) LTP and inclusion in the emissions inventory;
- Collection of liquid samples of treated leachate stored in the evaporation lagoons for odour laboratory analysis prepared using the Liquid Odour Method (**LOM**) as described in **Section 4.3**;
- Assess the effectiveness of initiatives reported on Veolia's public website, namely:
    - Oxygen production and organics reduction measurements after installation of portable aeration unit on an identified storage dam; and
    - A trial of two (2) portable carbon filter units that can be used on the waste surface to draw in air and treat odour from problematic areas.
- Re-run of the Woodlawn Facility-specific odour dispersion model (as completed in the 10th IOA) with the latest operational conditions and measured data as obtained in the 11th IOA. This includes the Woodlawn Bioreactor and MBT Facility;
- Note the NSW EPA comments on the modelling issues raised in its submission on the Woodlawn ARC Project EIS and include a sensitivity analysis to understand potential impacts associated with variable odour emission scenarios and odour sources excluded from sampling and assessment;

- Assess and comment on the effectiveness of strategies developed to optimise landfill gas extraction and leachate management to minimise the fugitive gas/odour emission as outlined in the WIP 2020 and WIPS5 2022; and

- Review of meteorological and hydrogen sulphide (**H_2S**) ambient monitoring results conducted at NSW EPA points 9, 71 and 72 in the Tarago region in accordance with the requirements of environment protection licence (**EPL**) 11436.

1.3.3 Declaration of Independence

As required by the project approval, TOU can declare that all staff who are involved in the 11th IOA at the Woodlawn Facility are not:

- related to any proponent, owner, operator, or other entity involved in the delivery of the project. Such a relationship includes that of employer/employee, a business partnership, sharing a common employer, a contractual arrangement outside an Independent Audit, or that of a spouse, partner, sibling, parent, or child;

- have any pecuniary interest in the project, proponent, or related entities. Such interest includes where there is a reasonable likelihood or expectation of financial gain (other than being reimbursed for performing the audit) or loss to the auditor, or their spouse, partner, sibling, parent, or child;

- have provided services (not including independent reviews or auditing) to the project with the result that they audit work performed by themselves or their company, except as otherwise declared to the Department prior to the Independent Audit;

- an Environmental Representative for the project; and

- accepted any inducement, commission, gift or any other benefit from auditee organisations, their employees, or any interested party, or knowingly allow colleagues to do so.

A signed declaration of independence is provided in **Appendix A**.

2 THE WOODLAWN FACILITY

2.1 WOODLAWN BIOREACTOR FACILITY BACKGROUND

The Woodlawn Facility is located 250 kilometres (**km**) south of Sydney, within the 6,000 hectares (**ha**) Woodlawn Eco-Precinct, in the Southern Tablelands near Goulburn in New South Wales. An aerial view of the Woodlawn Facility, highlighting the key areas as they currently stand, is shown in **Figure 2.1**.

Prior to waste operations, the Woodlawn Facility operated as base metals open-cut mine site during the 1970s and 1990s, processing copper, lead, and zinc. Since September 2004, the mine void has been operated as an in-situ Bioreactor, historically receiving putrescible waste solely from the Sydney metropolitan area via the Clyde Transfer Terminal Facility. Since early 2012, receival of waste from local regional areas has commenced.

Waste received and contained within the Bioreactor undergoes anaerobic decomposition, resulting in the production of landfill gas. The landfill gas, predominately rich in methane (**CH_4**) and carbon dioxide (**CO_2**), is continuously extracted from the Bioreactor and directly processed via purpose-built landfill gas-fired engines that form the Woodlawn Facility's power plant. Each landfill gas-fired engine can generate up to 1.065 Megawatts (**MW**) of 'green' electricity. All electricity generated is exported to the main grid. The Bioreactor process is described in further detail in **Section 2.2**.

Aside from generating electricity from waste at the Woodlawn Facility, Veolia is also undertaking mine rehabilitation works and has established aquaculture and horticulture projects within the Eco-Precinct. In early-October 2018, Veolia also commenced operation of its long-term leachate management solution via the commissioning and optimisation of the LTP at the Woodlawn Facility, which falls under a separate development consent and EPL - at the time of the 11th IOA; this continues to be in the process-proving stage to optimise extraction and treatment capacity. To that end, the 11th IOA has provided commentary on the implication of the LTP in the context of leachate management and odour emissions (refer to **Section 2.4.6** and **Section 9.2.1.1**). The existing leachate treatment dam (**LTD**) is still operating concurrently with the LTP, providing on-going leachate treatment capacity for the Bioreactor operations at the Woodlawn Facility.

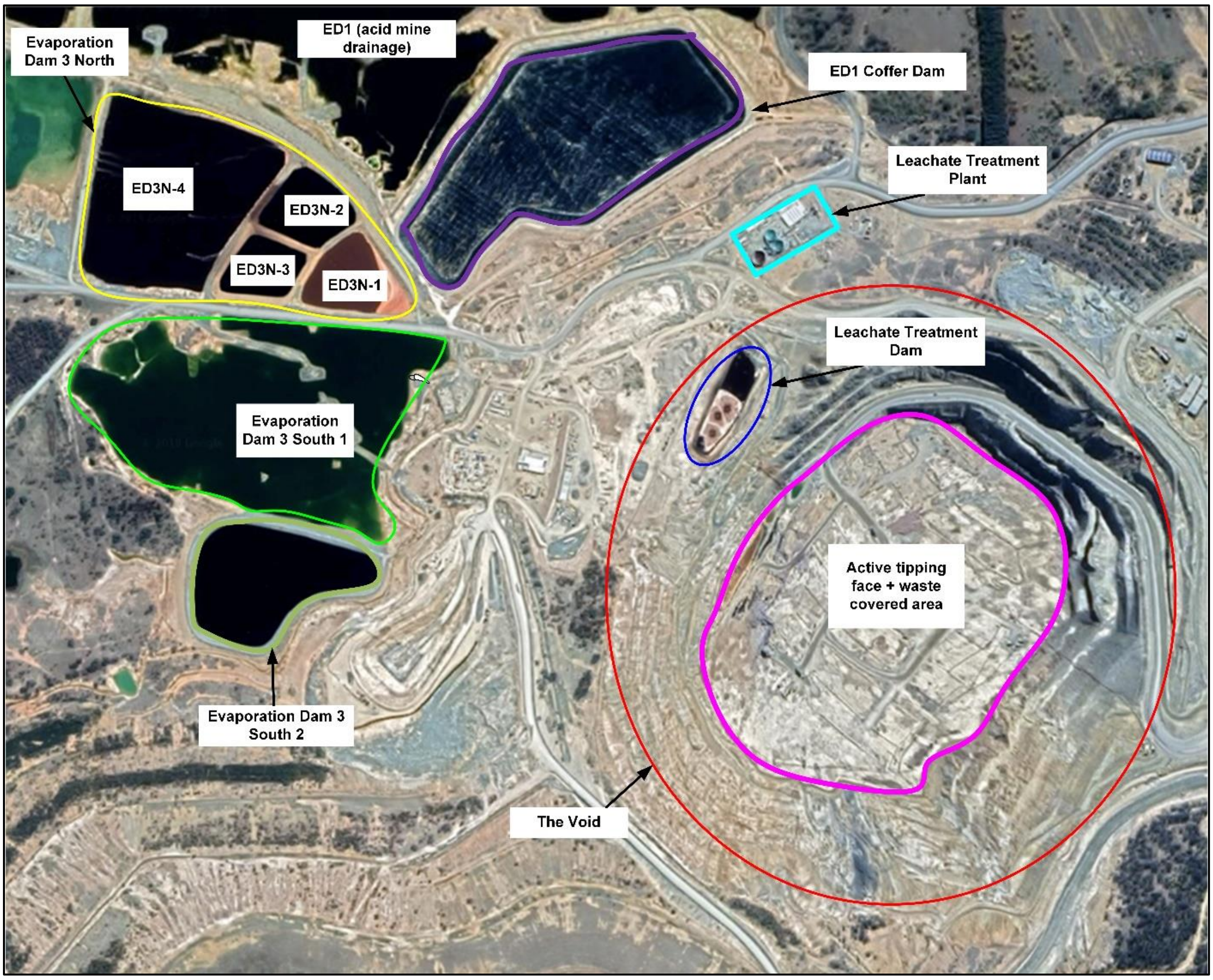


Figure 2.1 – An aerial view illustrating the layout of the Woodlawn Facility as of the 11th IOA (**Map source:** Google Earth®)

2.2 PROCESS OVERVIEW

The Woodlawn Facility has the approval to operate between 0600 hrs to 2200 hrs on Mondays to Saturdays, with no activities on Sundays, Good Friday, or Christmas Day. For the 11th IOA, the operational processes at the Woodlawn Facility have been categorised under two primary management systems, namely:

1. The Bioreactor Waste Management System (**BWMS**); and
2. The LMS.

The above management systems are described in concise detail in **Section 2.3** & **Section 2.4**, respectively. Further details regarding these systems are contained in the *Environmental Assessment Woodlawn Expansion Report* dated August 2010 (**EA 2010**).

2.3 BIOREACTOR WASTE MANAGEMENT SYSTEM

The Bioreactor surface layout consists of the following key features:

- An active tipping face (**ATF**);

- Waste covered areas, including daily cover, intermediate cover, and biocover;
- A mobile tipping platform;
- Leachate extraction, transfer, and reinjection via the LMS. The reinjection feature of the LMS is very rarely used, but the extraction and transfer are actively utilised (refer to **Section 2.3.2**);
- Stormwater management; and
- A gas extraction system.

For the effective operation of the Bioreactor, there is a complex network of infrastructure, operational procedures, and management protocols to streamline tipping, covers, capping, in-situ installation of equipment, landfill gas extraction, leachate transfer and extraction, and stormwater diversion. A consequence of this operational complexity and strongly interconnected infrastructure is a constantly evolving and dynamic Bioreactor layout that varies temporally, spatially, and operationally. With this in mind, the infrastructure and operational management of the Bioreactor at the Woodlawn Facility consist of the following key features:

- the requirement of covering areas of waste;
- the timing and necessary provisions for a given waste lift;
- the landfill gas collection system, including:
    - the strategic placement and maintenance of the vertical landfill gas extraction wells gridded system;
    - landfill gas collection pipe network;
    - condensate management and the leachate removal system; and
    - individual gas wells in the waste to manage high-risk areas prone to the release of fugitive landfill gas emissions from the surface of the Void;
    - setup of the leachate extraction and recirculation system;
    - stormwater management in the Void, including catchment management and stormwater captured within the Void perimeter; and
    - application of biocover material to manage fugitive landfill gas emissions, as outlined in the WIP 2020 and WIPS5 2022 (refer to **Section 10.2.4.1.1** for further details).

The Void layout and operations prevalent at the time of the 11th IOA are shown in **Figure 2.2**.

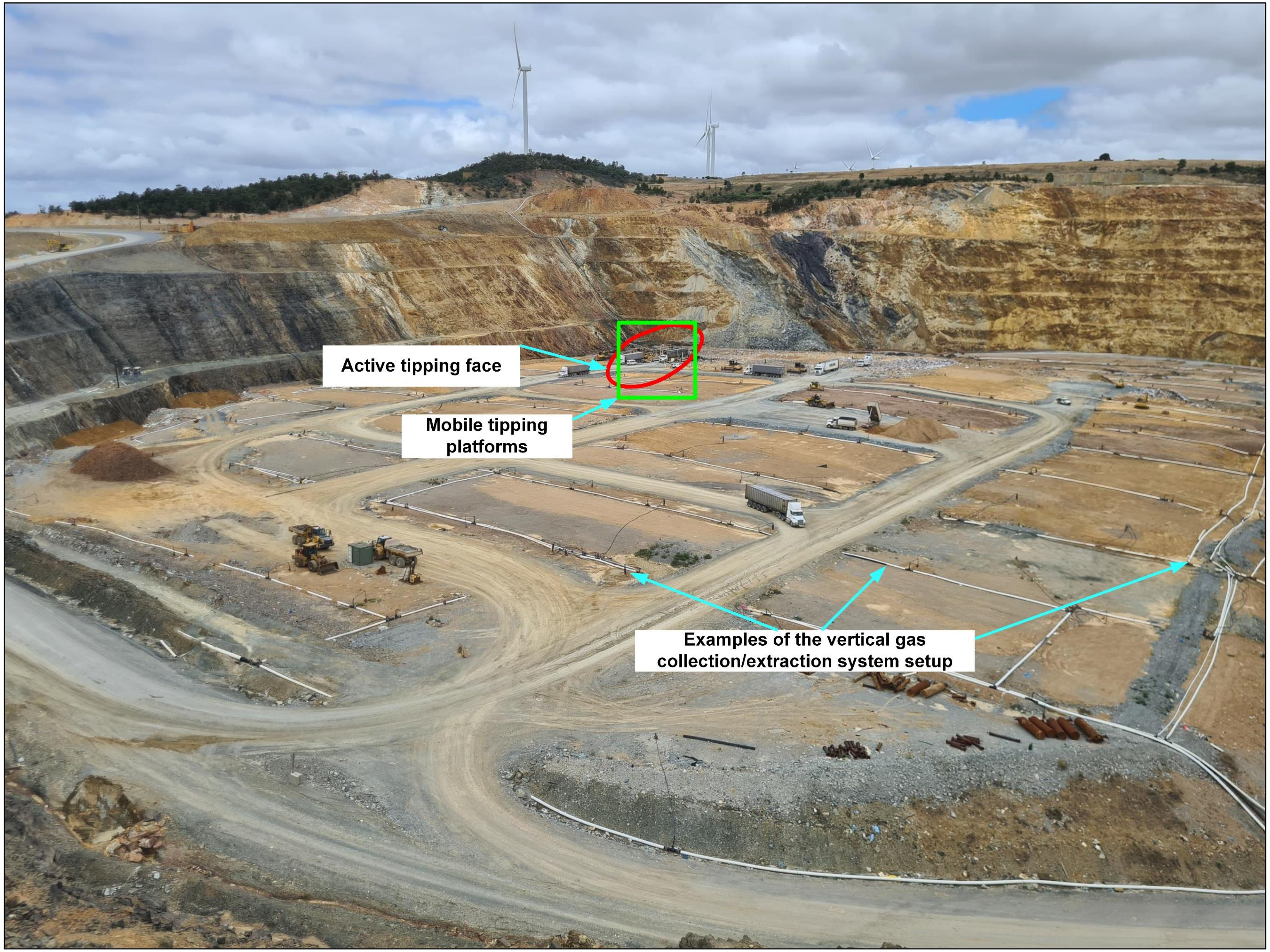


Figure 2.2 – Void layout and operations: 23 February 2023

2.3.1 Bioreactor Operation

The current procedure for operating the Bioreactor consists of the receival of putrescible waste transported to Woodlawn by rail from Sydney after being containerised at one of the Veolia-operated transfer terminal facilities located at Clyde and Banksmeadow. The fully sealed containerised waste is received at and transported by a series of trucks to the Bioreactor, where waste is unloaded via a mobile tipping platform and subsequently transported by a dozer prior to compaction at the ATF area (as highlighted in **Figure 2.2**). The ATF area is progressively covered daily. As advised by Veolia in previous audits, covering the ATF is an on-going operational process, although the daily active tipping area will vary depending on positioning in the Void, gas infrastructure and weather conditions.

As described in the WIPS5 2022, the progress of tipping operations is planned to use the mass of the waste incoming, the available area, the designed finish level, as well as the consideration of landfill gas infrastructure movement. The principle is to minimise the active tipping area to reduce the potential odour emission and reduce the offline duration of landfill gas extraction wells. Once the tipping plan is established, the tipping operation is guided by a global positioning system in the compactor to finish the designed area to the planned elevation. The tipping road construction, related landfill gas infrastructure and stormwater system are also disconnected and reconnected accordingly. It was evident in the 11^{th} IOA that the size of the ATF remains well below the area size specified in the EA 2010 (further discussed in **Section 9.2.1.1.1**).

2.3.1.1 Hydrogen Sulphide Emission Control and Management

When required, it is understood by the 11^{th} IOA that the tipping process is supplemented by H_2S emission control and management measures, including:

- Capture and combustion of landfill gas. This results in the thermal oxidation of the landfill gas prior to atmospheric release;
- Provision to add metal oxide (haematite and/or magnetite) to the waste;
- Provision to apply biocover material to the Bioreactor surface, particularly for the management of discrete areas identified as a pathway for landfill gas release in an uncontrolled manner (operationally referred to as ‘hot spots’); and
- The current procedure for operating the Bioreactor restricts leachate recirculation due to its previously documented impact on landfill gas extraction through leachate pooling effects within the waste mass of the Bioreactor. In effect, this is a form of H_2S emission control by mitigating landfill gas release from the surface in an uncontrolled manner.

Overall, the infrastructure to operationally manage landfill gas extraction and leachate transfer/extraction is critical to the effective management of H_2S emission control and management. This plays a significant role in the management of odour emissions from the Bioreactor operations.

2.3.2 Leachate Extraction and Transfer via the LMS

In the context of the Bioreactor operations, the LMS comprises of three (3) major aspects:

1. Leachate extraction and transfer, including extraction pumps, ring main and tank transfer system, all of which are located within the Void. Leachate reinjection (or recirculation) is a back-up option for leachate transfer within the Void;

2. Leachate treatment via the LTD and LTP (refer to **Section 2.4.4.2** and **Section 2.4.6**, respectively); and

3. Treated leachate management via evaporation, which is discussed in **Section 2.4.1** to **Section 2.4.3.1**.

The 11th IOA notes that if leachate recirculation is utilised within the Void, this is completed via a direct method into dedicated reinjection wells. This has the effect of minimising the exposure of leachate partitioning from the liquid phase to the gas phase through aerosol generation and/or evaporation pathways, which can subsequently lead to the generation of odorous emissions. As the leachate percolates through the upper layers of waste, a proportion of the liquid is retained in the upper layers of waste. Veolia had previously utilised covered reinjection trenches as part of the leachate recirculation process; however, this is understood to remain discontinued as part of the normal operations of the Bioreactor.

As of the 11th IOA, and based on the WIP 2020 and WIPS5 2022, the use of leachate recirculation is no longer needed to maintain effective steady-state operations within the waste mass of the bioreactor. It is only used or required during exceptional circumstances. As such, there is only one reinjection infrastructure being kept as a contingency leachate management method when the leachate transfer system experiences any failure or requires maintenance. Subject to the waste lift status and Void profile, the nominated reinjection point location is connected to the ring main and is normally in the closed position. In the circumstance of leachate transfer system failure or any downtime due to maintenance schedule, e.g., pump failure or pipe damage, the valve between the reinjection point and the ring main will be opened to allow the extracted leachate to be re-injected to the waste. The reinjection will be stopped once the leachate transfer system is back to normal operation. The leachate reinjection operational contingency is discussed in **Section 9.2.1.1.1**.

2.3.2.1 Leachate Reinjection Contingency

As part of operational contingency, it is noted in the WIPS5 2022 that another reinjection point will be setup to supplement the main reinjection point. This will use the whole subsurface rock trench as the leachate storage reservoir. This reinjection trench will only be used when the leachate transfer system fails and will serve to keep the bund area dry and avoid equipment damage. During this operational scenario, repair actions will be conducted as soon as possible. This supplementary reinjection point is intended to only be used for no more than a day to enable repair/remedial works to be completed.

2.3.3 Landfill Gas Extraction

The landfill gas collection system is constantly expanded to promote better gas capture as waste filling progresses around the Void. The operational management and instalment of landfill gas extraction infrastructure in the Void are extensively described in the WIP 2020, WIPS5 2022, and previous Woodlawn Infrastructure Plans reviewed by the 11th IOA team. The configuration during placement of waste on the surface of the Void and a waste lift is designed to ensure streamlined gas (and leachate) extraction. All extracted landfill gas is directed to the on-site power station, with moisture removal undertaken via a series of single or double knock-out pots (**KOPs**, as referenced in the WIP 2020 and WIPS5 2022) along the landfill gas flow lines and the main header line.

2.4 LEACHATE MANAGEMENT SYSTEM

The key features of the LMS include the following:

- ED3N, also known as evaporation lagoon 1-4;
- ED3S2;
- LTD; and
- The LTP.

Each of these listed features is described in **Section 2.4.2** to **Section 2.4.6**, respectively. Further details regarding the LMS at the Woodlawn Facility are documented in *Chapter 8* of the EA 2010. All key modifications and upgrades since the EA 2010 are documented as part of the 11th IOA, with technical details provided in the WIP 2020 and WIPS5 2022.

2.4.1 Volume Reduction of Treated Leachate

It is a condition of the Woodlawn Facility's EPL that no leachate (treated or untreated) can be directly discharged from the Woodlawn Facility. The only means of volume reduction is through mechanical and/or natural evaporation processes.

The treated leachate is stored in evaporation dams, and the volume reduction is managed by natural evaporation and assisted/mechanical evaporation systems. The natural evaporation at the Woodlawn Facility is approximately twice the amount of rainfall (average annual rain of 535 mm since 1995) based on historical records as advised by Veolia. Therefore, the volume reduction from the pond sources with a large surface area and an assisted/mechanical evaporation system is considered a practical approach to managing liquid volume for the Woodlawn Facility (except for wet weather conditions – refer to **Section 2.4.7**). The assisted/mechanical evaporation system is composed of pumps and sprays. These systems operate by pumping and spraying liquid into the atmosphere, during which the total liquid surface area (where the evaporation happens) can be significantly enhanced, hence increasing the evaporation – this process drives a volume reduction outcome for pond sources at the Woodlawn Facility.

The details about the mechanical evaporation process of treated leachate are discussed in **Section 2.4.2.1**.

2.4.2 Evaporation Dam 3 North (ED3N)

ED3N pond system covers a total surface area of 6.1 hectares (**ha**), at top water level (**TWL**), and is divided into four (4) discrete lagoons, namely:

1. **ED3N-1:** receives treated leachate from the leachate treatment dam. The pond surface area, as of the 11th IOA, is approximately 0.75 ha. At the time of the 11th IOA, there was no current survey information available for the floor of dam ED3N-1. Therefore, no volume can be determined;

2. **ED3N-2***:* receives treated leachate from the LTD. The pond surface area, as of the 11th IOA, is approximately 0.70 ha. This is equivalent to approximately 76% of the volume storage capacity;

3. **ED3N-3**: receives treated leachate from the LTD. The pond surface area, as of the 11th IOA, is approximately 0.70 ha. This is equivalent to approximately 95% of the volume storage capacity; and

4. **ED3N-4**: receives treated leachate from the LTD. The pond surface area, as of the 11th IOA, is approximately 41.0 ha, equivalent to approximately 99% of the volume storage capacity. There are up to five mechanical evaporators available that draw treated leachate from ED3N-4 to promote evaporation as a means of volume reduction. Further details on the mechanical evaporation process at the Woodlawn Facility are described in **Section 2.4.2.1**.

Note: The surface areas and volumes of ED3N were as of March 2023 and provided by Veolia. The surveying is completed by an external contractor. At least 0.5 metres (**m**) of freeboard is always maintained in the ED3N pond system. However, ED3N-4 was recorded to be above the freeboard by 0.46 m on this occasion.

2.4.2.1 ED3N – Mechanical Evaporation System

The Evaporator Manual outlines the internal protocol and procedures for the operation of the mechanical evaporation system for the ED3N pond system.

2.4.2.1.1 Evaporation System A

A mechanical evaporation system is currently active at the Woodlawn Facility to manage the growing need for volume reduction in the ponds to retrieve storage capacity. The mechanical evaporation system is described and operated as per the WIP 2020 and WIPS5 2022. For ED3N-4, the mechanical evaporation system at the Woodlawn Facility consists of four (4) Turbomist® evaporation units driven by a common pump system. It is understood that the actual operating performance of the evaporation units is approximately 840-900 litres per minute (**L/min**). This evaporation mechanism is known as System A and is shown in **Figure 2.3**.

2.4.2.1.2 Evaporation System B

System B, which is a surface spray evaporator system, is composed of six (6) sprays floating in the middle of the dams and controlled by a weather station. The operation of

System B is in accordance with the feedback provided by the weather station, including temperature, humidity, wind direction and wind speed. Each of the sprayers is controlled independently, with setpoints based on weather conditions. As the humidity and temperature conditions vary across the seasonal cycles, the setpoint for wind speed is modified accordingly. The Woodlawn Facility regularly reviews the operation and effectiveness of System B, and setpoints are optimised as required. A photo showing the operation of the surface spray evaporator system is shown in **Figure 2.4**.

Figure 2.3 – Evaporation System A (**Source:** WIP 2020)

Figure 2.4 - An example of Evaporation System B adopted at the Woodlawn Facility (21 February 2023)

2.4.2.1.3 Middle Bank Evaporation System

To further enhance mechanical evaporation capability and volume reduction at the Woodlawn Facility, an evaporation system is installed in the ED3N area, located in the middle bank, as shown in **Photo 2.1** and **Figure 2.5**. An electric pump is set up and moved between ED3N-2 and ED3N-4, discharging into the spray system on the middle bank of the ponds. As the spray is at a modest distance from the external boundary of the ED3N area and the injection spray height is low, this system has the capacity to operate under most weather conditions. It is only turned on manually, weather-dependent. During active operation, this spray system is controlled by a timer that operates based on seasonal conditions.

Photo 2.1 - A view of the ED3N middle bank spray evaporation system (outlined in red): 21 February 2023

Figure 2.5 – The ED3N middle bank spray evaporation system (**Source**: WIP 2020)

2.4.3 Evaporation Dam 3 South 2 (ED3S2)

ED3S2 receives treated leachate from the LTD. At the time of the 11th IOA, ED3S2 was at approximately 98% volume storage capacity, equivalent to a water surface area of approximately 2.1 ha. Note: The surface areas and volumes of ED3S2 were as of March 2023 and provided by Veolia. The surveying is completed by an external contractor. At least 0.5 m freeboard is always maintained in the ED3S2 pond system.

2.4.3.1 Mechanical Evaporation System

The Evaporator Manual outlines the internal protocol and procedures for the operation of the mechanical evaporation system for the ED3S2 pond system. The mechanical evaporation layout for ED3S2 is illustrated in **Figure 2.6**.

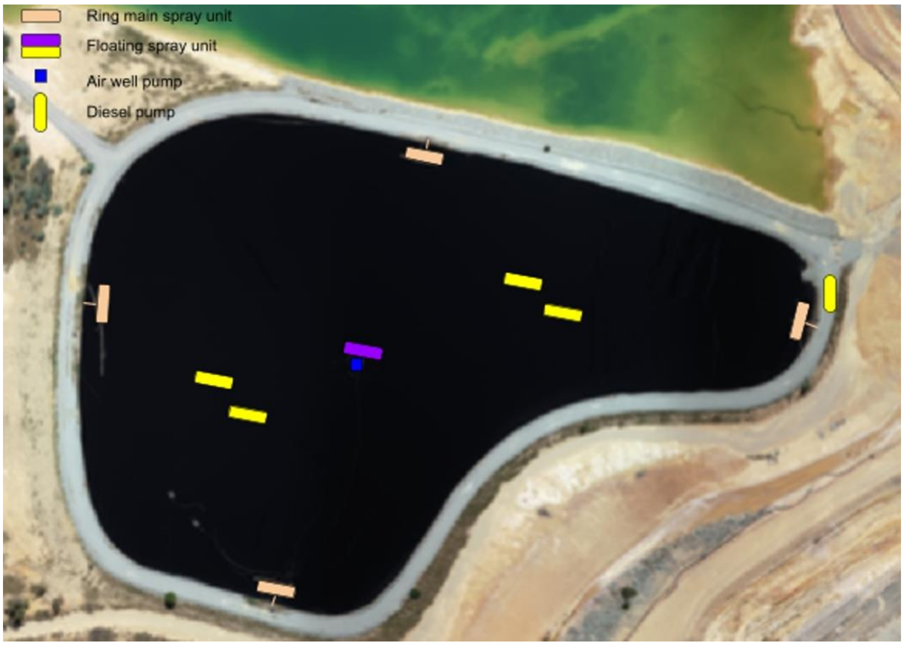


Figure 2.6 – ED3S2 mechanical evaporation layout (**Source**: Evaporator Manual)

As shown in **Figure 2.6**, a ring main evaporation system is installed away from the bank of ED3S2. A total of four (4) spray bars, each bar with five (5) to six (6) nozzles, are installed at the north, west, south, and east of ED3S2, respectively, approximately 2 m away from the bank. The spray nozzles are controlled by an in-situ weather station and operate only when the wind is blowing from a certain direction, i.e., behind the bank into the dam. In addition to the ring main evaporation system, ED3S2 has four (4) floating surface spray evaporators, similar to that described in **Section 2.4.2.1.2**.

The operation of the surface spray evaporators occurs only during the daytime on weekdays and based on weather conditions.

2.4.4 Evaporation Dam 1 Coffer Dam

The ED1 Coffer Dam stores treated effluent from the LTP. At the time of the 11th IOA, ED1 Coffer Dam was at approximately 71% volume storage capacity, equivalent to a water surface area of approximately 62.1 ha.

2.4.4.1 Mechanical Evaporation System

The Evaporator Manual outlines the internal protocol and procedures for the operation of the mechanical evaporation system for ED1 Coffer Dam. A similar ring main evaporation system to that installed in ED3S2 (refer to **Section 2.4.3.1**) is installed in the ED1 coffer dam. Due to the shape configuration of the ED1 coffer dam, there are five (5) spray stations, as shown in **Figure 2.7**. The spray system works on the discharge pump from LTP, so the spray system will activate when LTP is discharging. In addition to the ring main evaporation system, ED1 Coffer Dam has six (6) floating surface spray evaporators (System B), similar to that described in **Section 2.4.2.1.2**.

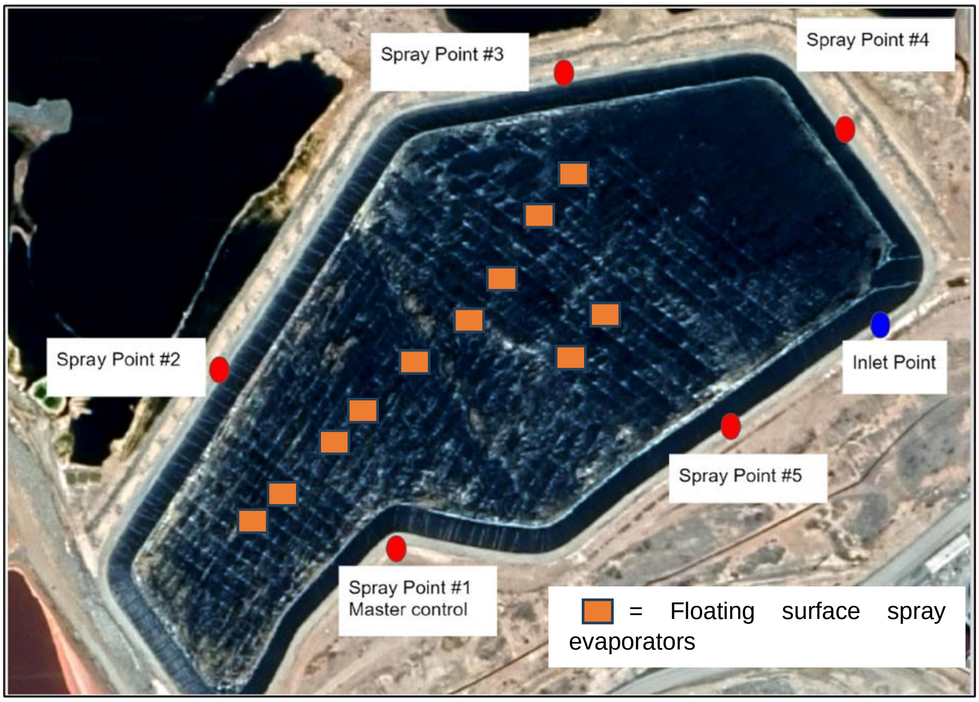


Figure 2.7 – ED1 Coffer Dam: Evaporation Spray System (**Source**: WIP 2020 with updates reflected in the Evaporator Manual)

2.4.4.2 Contingency Storage Capacity

As previously mentioned, effluent from the LTP is transferred to the ED1 coffer dam for storage and evaporation. ED1 coffer dam needs to maintain a minimum freeboard of 0.5 m. As outlined in the WIP 2020 and WIPS5 2022, a new dam for the LTP effluent is intended to be constructed once the ED1 coffer dam reaches 80% of the volume storage capacity. This setpoint was exceeded during the 10th IOA (i.e., 93% volume storage capacity), and Veolia should proceed with the design and planning of additional storage capacity via the construction of a new dam.

2.4.5 Leachate Treatment Dam

The LTD is in the upper north-western edge of the Void and is an integral part of the LMS at the Woodlawn Facility. Leachate from the Void is pumped directly to the LTD as required. Since the IOA in 2012 (the **1st IOA**), the LTD was upgraded from a batch-based wastewater treatment system to a continuous configuration. The upgraded system was commissioned in April 2013. Following this upgrade, the LTD process was modified to consist of anoxic and aeration zones to increase the efficiency of the leachate treatment process. **Photo 2.2** shows the LTD as it occurred during the 11th IOA, and **Figure 2.10** illustrates the current continuous treatment configuration for the LTD.

The LTD has a hydraulic retention time (**HRT**) of 33 days (dependent on treatment flow) and is capable of the continuous treatment of approximately 259,000 – 346,000 litres per day (**L/day**) of untreated leachate, equivalent to a current maximum treatment capacity of 3-4 litres per second (**L/s**). The raw leachate is pumped from the Void and discharged into the anoxic zone of the LTD for denitrification. Following treatment in the anoxic zone, the leachate migrates to the aeration zone to promote mixing, oxygen transfer, and nitrification. The effluent from the aeration zone of the LTD is dosed in-situ with ferric sulphate (**$Fe_2(SO_4)_3$**) and a polymer to facilitate coagulation and flocculation processes before passing through a settling tank known as the Woodlawn Aerated Leachate Treated Effluent Refiner (**WALTER**). Under this treatment configuration, the LTD requires desludging at a frequency that is determined by Veolia experts. The sludge from the settling tank is returned to the LTD as required. Any sludge from the desludging process (and any excess sludge that may be generated) is transported and returned to the waste in the Void, where it is buried and covered. A process flow schematic for the LTD is shown in **Figure 2.10**.

Photo 2.2 – A view of the LTD: 22 February 2023

2.4.6 Leachate Treatment Plant

As previously mentioned in **Section 2.1**, the Woodlawn Facility has constructed and commissioned the LTP as the long-term leachate management strategy, which is continuing to undergo process-proving, optimisation, and stabilisation. As indicated in the WIP 2020, the LTP is in the process proving stage, which includes but is not limited to, biomass growth, biological process tuning and process optimisation. The 11th IOA was advised that this continues to be the case.

The LTP is located on the northern side of the Void, between the Bioreactor and Evaporation Dam 1 (as shown in **Figure 2.1**), and consists of an MBR treatment system with a design capacity of approximately 4 L/s. The MBR system has been designed as a modified activated sludge biological process to treat the main parameters found in the raw leachate extracted from the Bioreactor to a higher quality effluent. A view of the MBR is shown in **Photo 2.3**. A process flow schematic of the LTP is provided in **Figure 2.11,** and a flow schematic of the upgraded leachate management system at the Woodlawn Facility is shown in **Figure 2.12**.

The key treatment process stages of the LTP include:

1. A primary treatment stage, including screening to remove gross solids, large materials, and other pollutants;
2. A balance tank to regulate treatment flow;
3. Anoxic Tanks;
4. Aeration Tanks; and
5. An ultrafiltration membrane system.

The product of the process stages above is a high-quality effluent that will be stored in the ED1 coffer dam. Given that the LTP continues to undergo process-proving, optimisation, and stabilisation, the critical control points and limits are continuously monitored with alarms and automatic shutdown using a dedicated Supervisory Control and Data Acquisition (**SCADA**) controls system if critical limits are reached. A view of the LTP is shown in **Photo 2.4**. A process flow schematic and diagram of the LTP is shown in **Figure 2.11** and **Figure 2.12**. An overview of the LTP flow concept is shown in **Figure 2.13**.

Overall, from an odour emissions viewpoint, the 11th IOA has obtained leachate treatment data of the effluent from the LTP and can comment that it is of a quality that will contribute negligible levels of odour. At the time of the 11th IOA visit, ED1 coffer dam was at approximately 71% volume storage capacity, as shown in **Photo 2.5**.

Photo 2.3 – A view of the surface of the MBR: 21 February 2023

Photo 2.4 – A view of the LTP (**Source**: 10th IOA)

Photo 2.5 – ED1 Coffer Dam: 21 February 2023

2.4.7 Wet Weather Management

The LTD and LTP are currently operated simultaneously at the Woodlawn Facility, providing an improvement in leachate management and treatment capacities from the Void, particularly in managing wet weather conditions. As noted in the Leachate & Water Management Strategy, Veolia continues to optimise and implement targeted leachate extraction to reduce leachate volumes in the Void and to increase the depth of the unsaturated zone. This continues to be achieved via the deployment of additional infrastructure such as mobile pumps and sumps/dams/drainage in the Bioreactor, which also serve to facilitate in addressing wet weather periods. The complexity of this setup is illustrated in **Figure 2.8** and further discussed in **Section 9.2.1.15**.

The short-to-medium term strategies for the optimisation and continuous treatment of excess leachate from the Void is further discussed in **Section 9.2.1.2**.

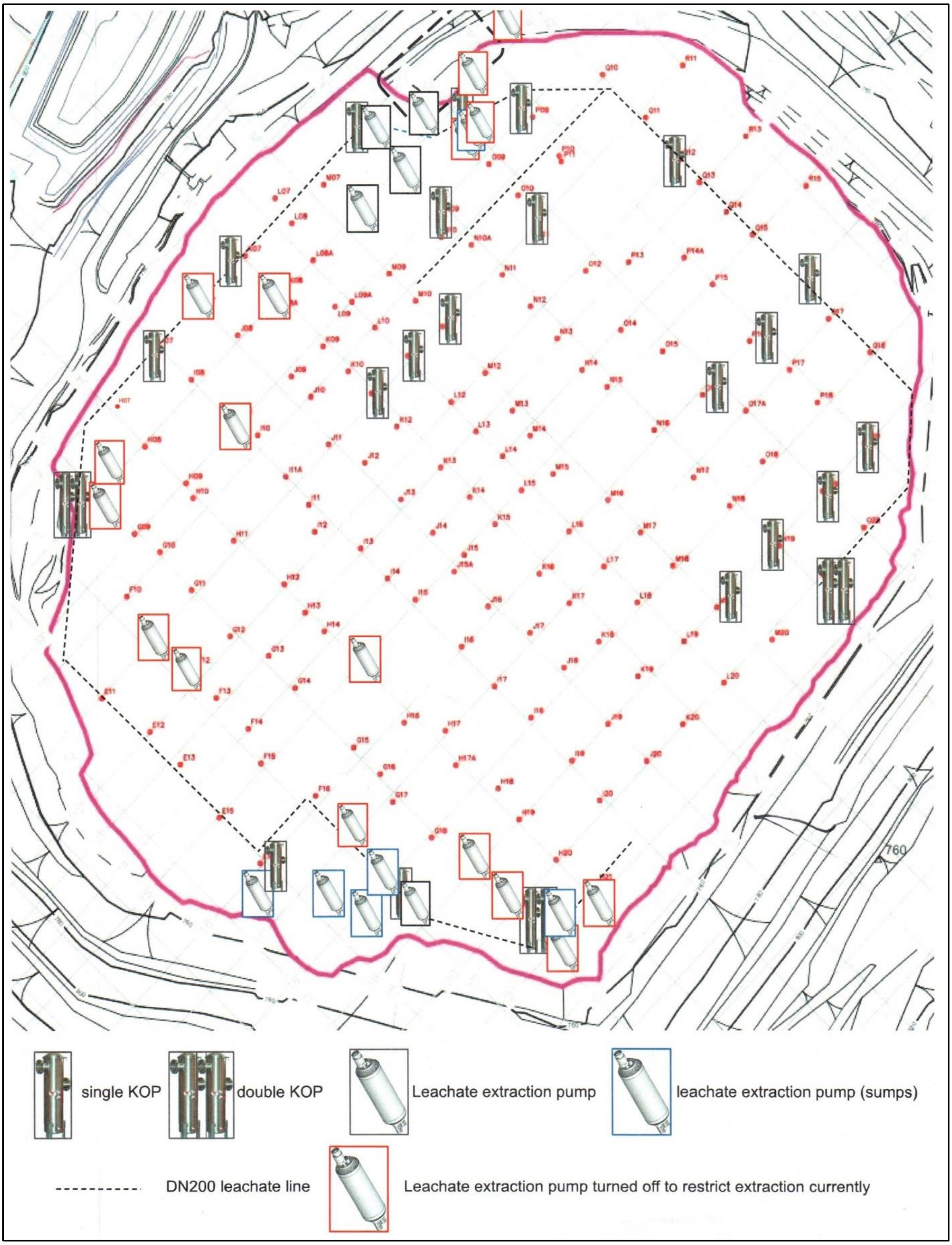


Figure 2.8 – The leachate extraction pump network in the Void as of 11th IOA

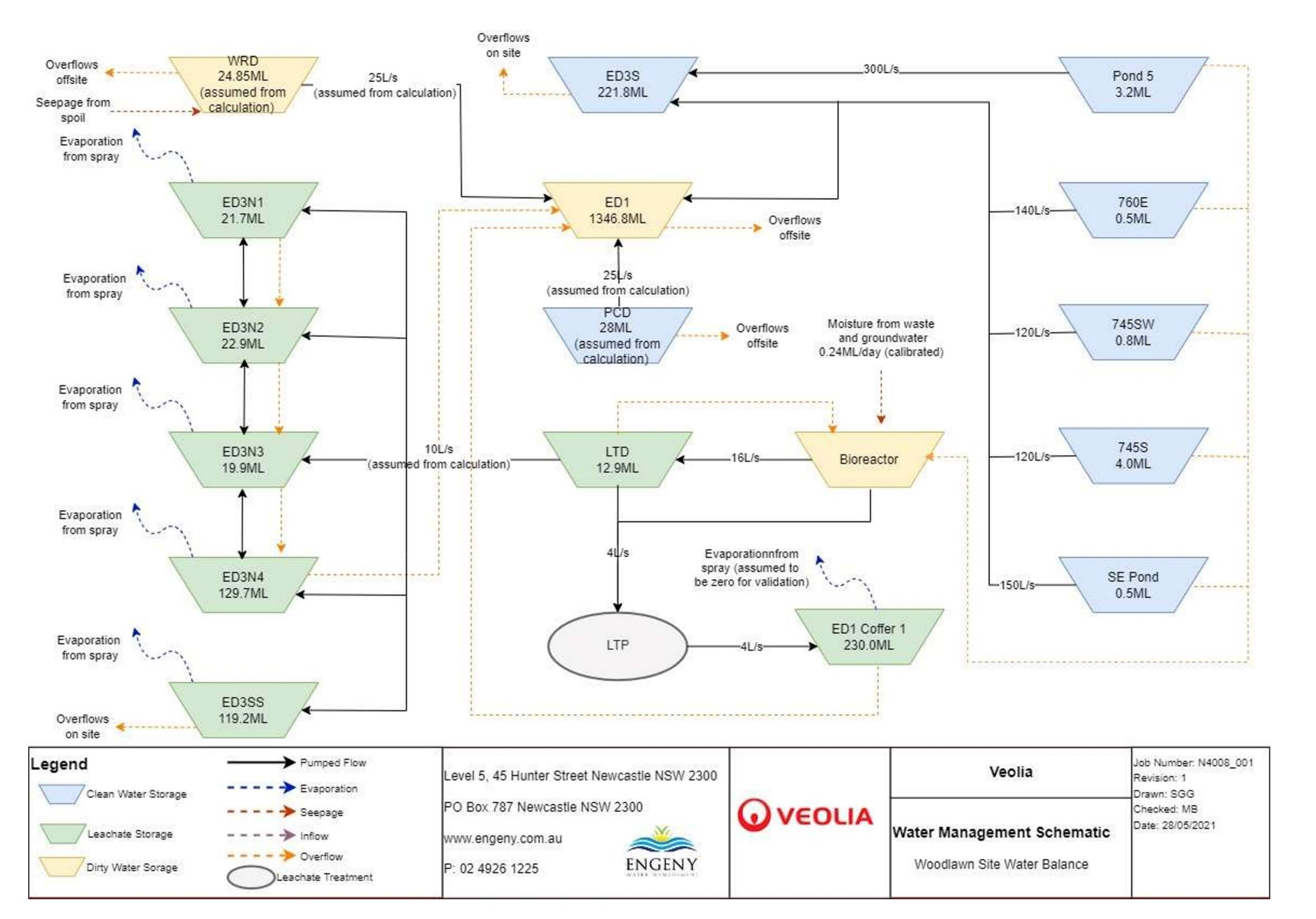


Figure 2.9 – The water balance for the Bioreactor operations at the Woodlawn Facility (**Source**: Leachate & Water Management Strategy)

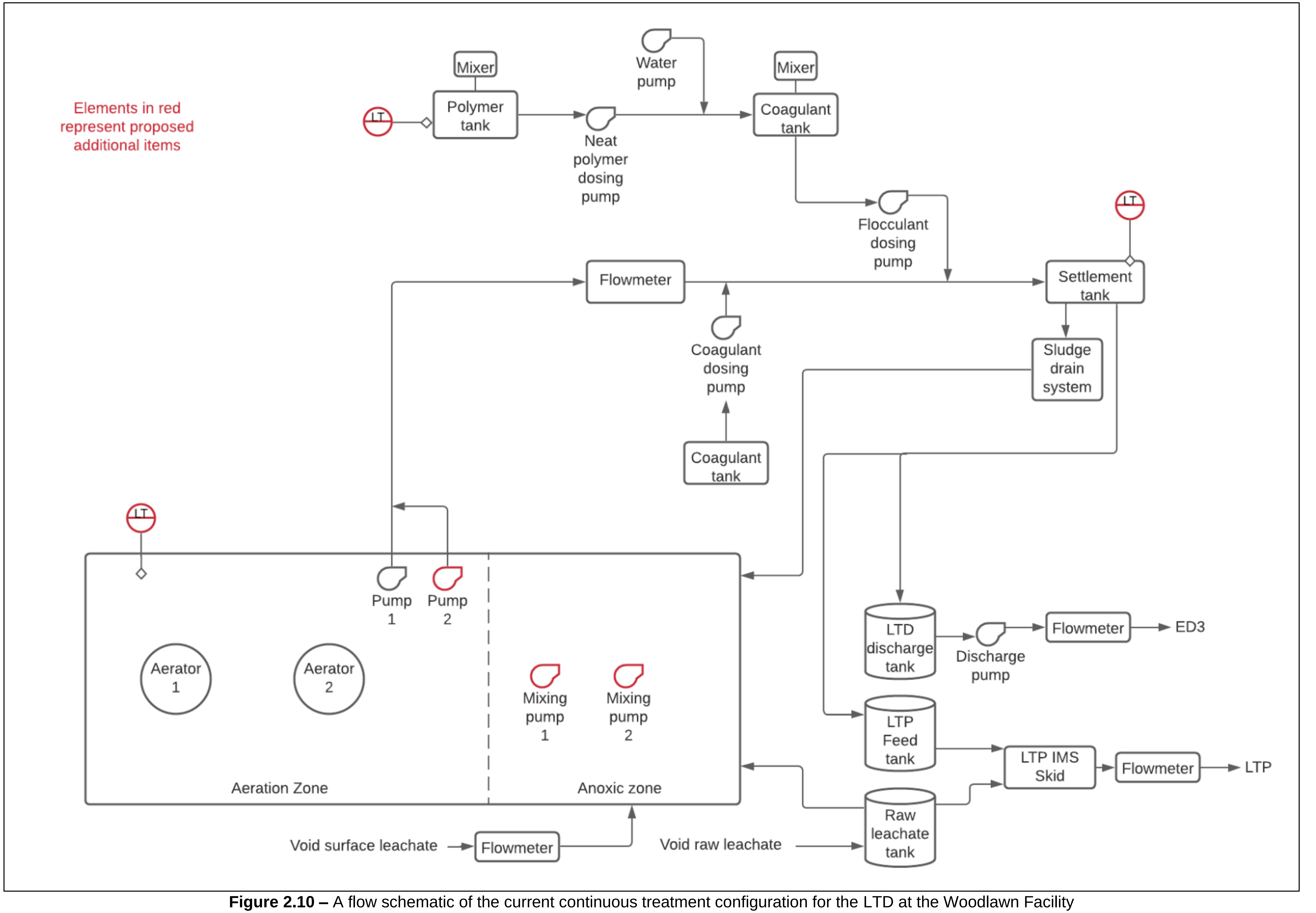


Figure 2.10 – A flow schematic of the current continuous treatment configuration for the LTD at the Woodlawn Facility

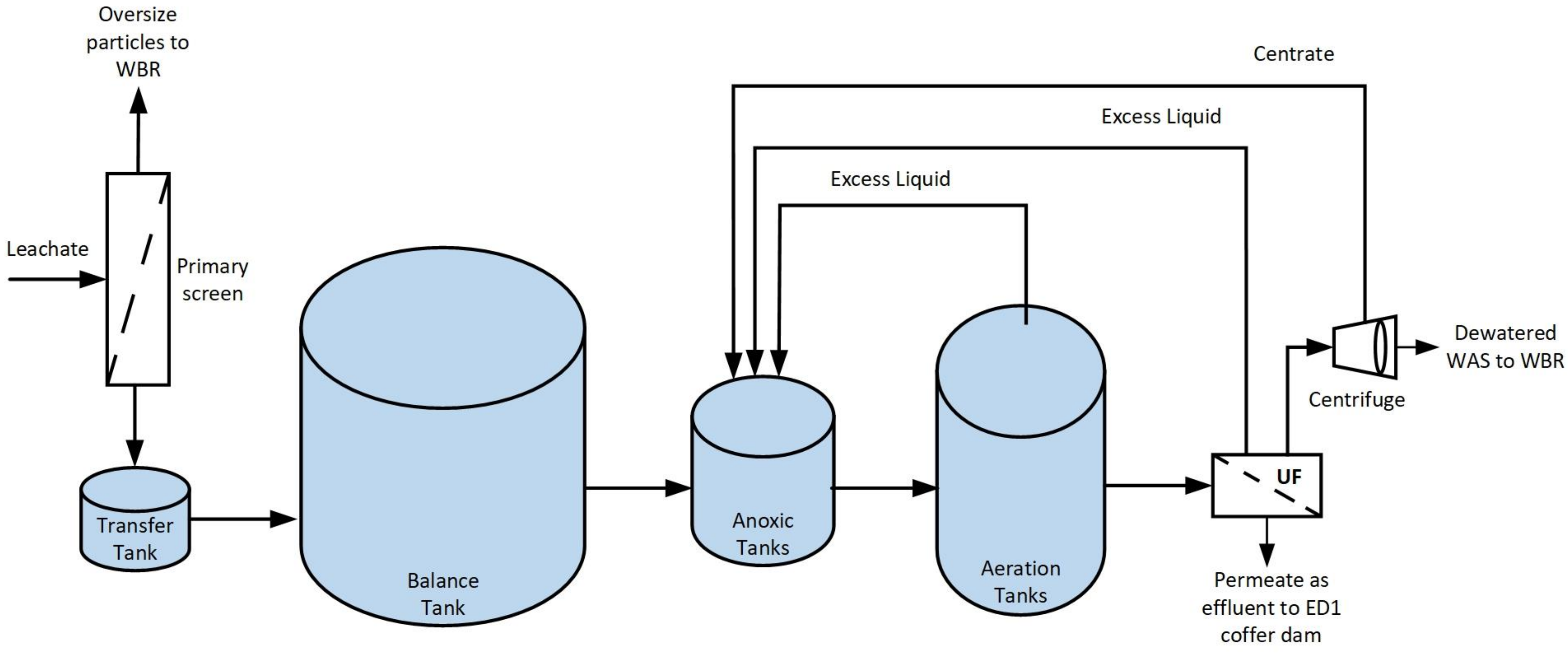


Figure 2.11 – Process flow diagram for the LTP at the Woodlawn Facility

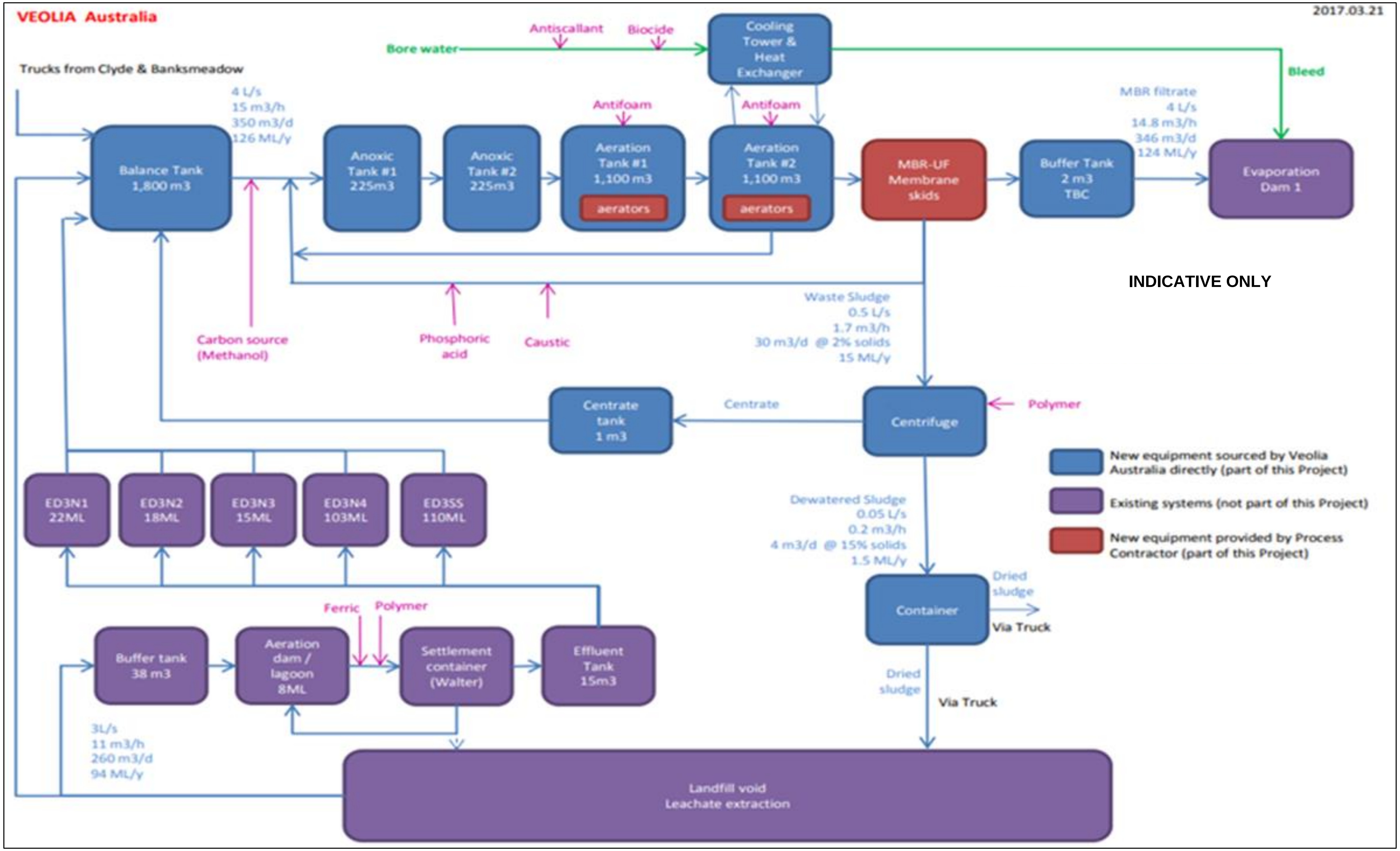


Figure 2.12 – A flow schematic of the upgraded leachate management system at the Woodlawn Facility (**Source:** 8th IOA)

Figure 2.13 - Concept layout of the LMS for the Bioreactor at the Woodlawn Facility (**Source:** WIP 2020)

2.5 STORMWATER MANAGEMENT

2.5.1 ED3S1 Stormwater

Evaporation Dam 3 South 1 (**ED3S1**) continues to receive stormwater runoff which is managed as acid mine drainage (**AMD**). At the time of the 11th IOA, ED3S1 was at approximately 83% volume storage capacity, equivalent to a water surface area of approximately 8.1 ha.

2.5.2 Stormwater Infrastructure in the Void

During stormwater events, all stormwater pumps operate to ensure stormwater water is transferred to ED3S1. According to the WIP 2020, the Void has been divided into multiple sub-catchment areas, as shown in **Figure 2.14**. Each sub-catchment has either natural or engineered drainage and flow control infrastructure, such as concrete dish drains, clay berms, pumps, and pipes to manage stormwater captured in the area. These systems minimise the amount of stormwater flow from the Bioreactor walls onto the waste surface of the Void and, in turn, the potential generation of excess leachate from stormwater flows. At the current stage, as shown in **Figure 2.15**, the stormwater management system comprises seven (7) on-duty pumps, seven (7) buffer ponds, and the related water drain, diversion, and delivery pipework system.

A schematic of this stormwater management protocol is demonstrated in **Figure 2.16**.

2.5.2.1 Management of Contaminated Surface Water

Any surface water collected from a covered landfill surface is drained to temporary storage ponds. Where it is suspected that leachate may have contaminated surface water, a sample is collected to test ammonia (a key indicator for contamination) to demonstrate that the water quality is suitable for discharge to ED3S1. If it is found that the surface water has encountered waste or leachate, the water will be managed as leachate through the established treatment pathways of the LMS.

2.5.2.2 Management of High Rainfall Events

Any stormwater into the Void, especially the portion that directly falls on the waste surface of the Void and the run-off from the upper benches, is one major source of excess leachate generation. As documented in the WIP 2020, it is indicated that leachate generation is very sensitive to high rainfall events due to the large, increasing catchment area and partial stormwater interception (the implication of this is discussed in **Section 9.2.1.15**).

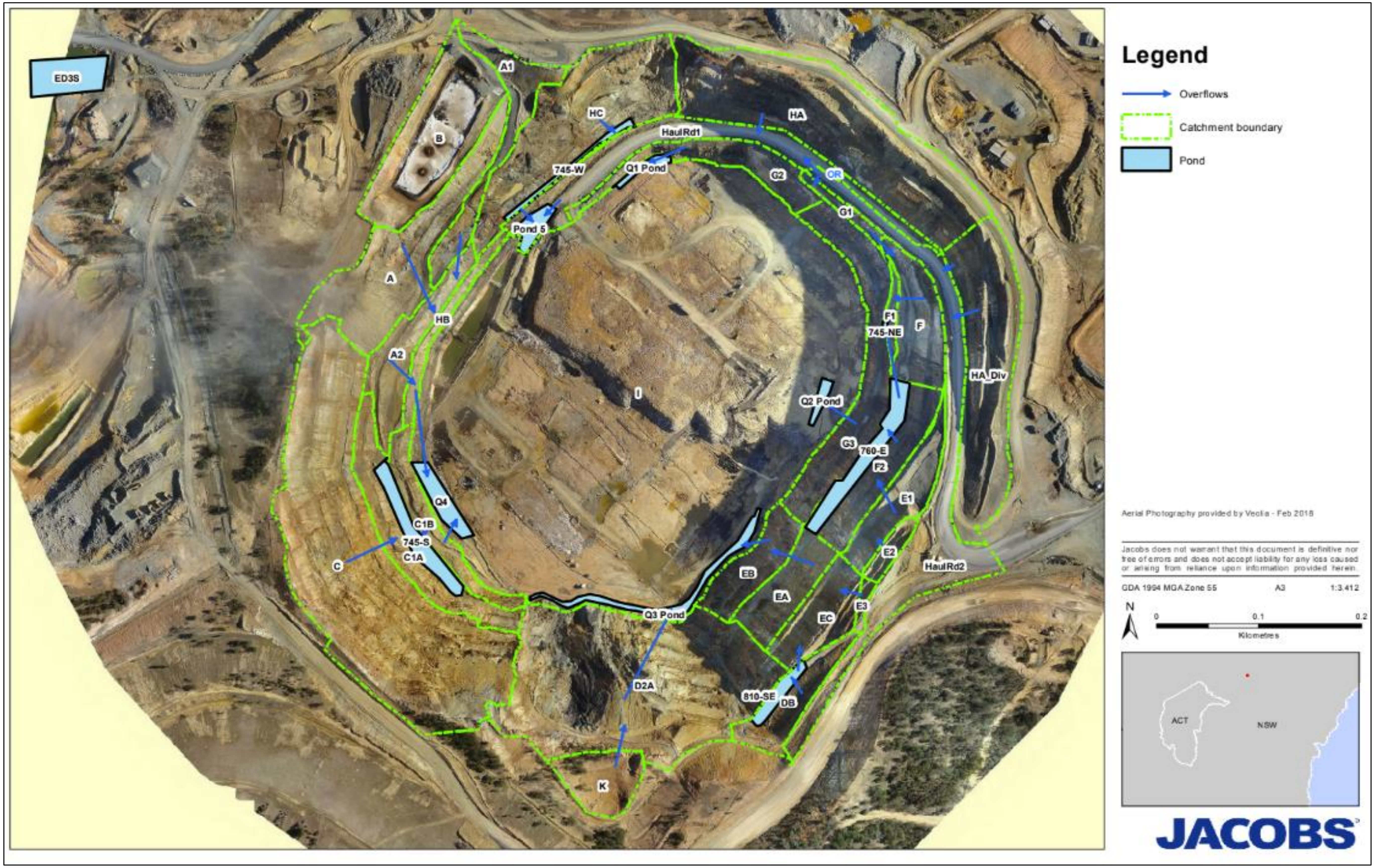


Figure 2.14 – Surface water management strategy in the Void as outlined in the WIP 2020

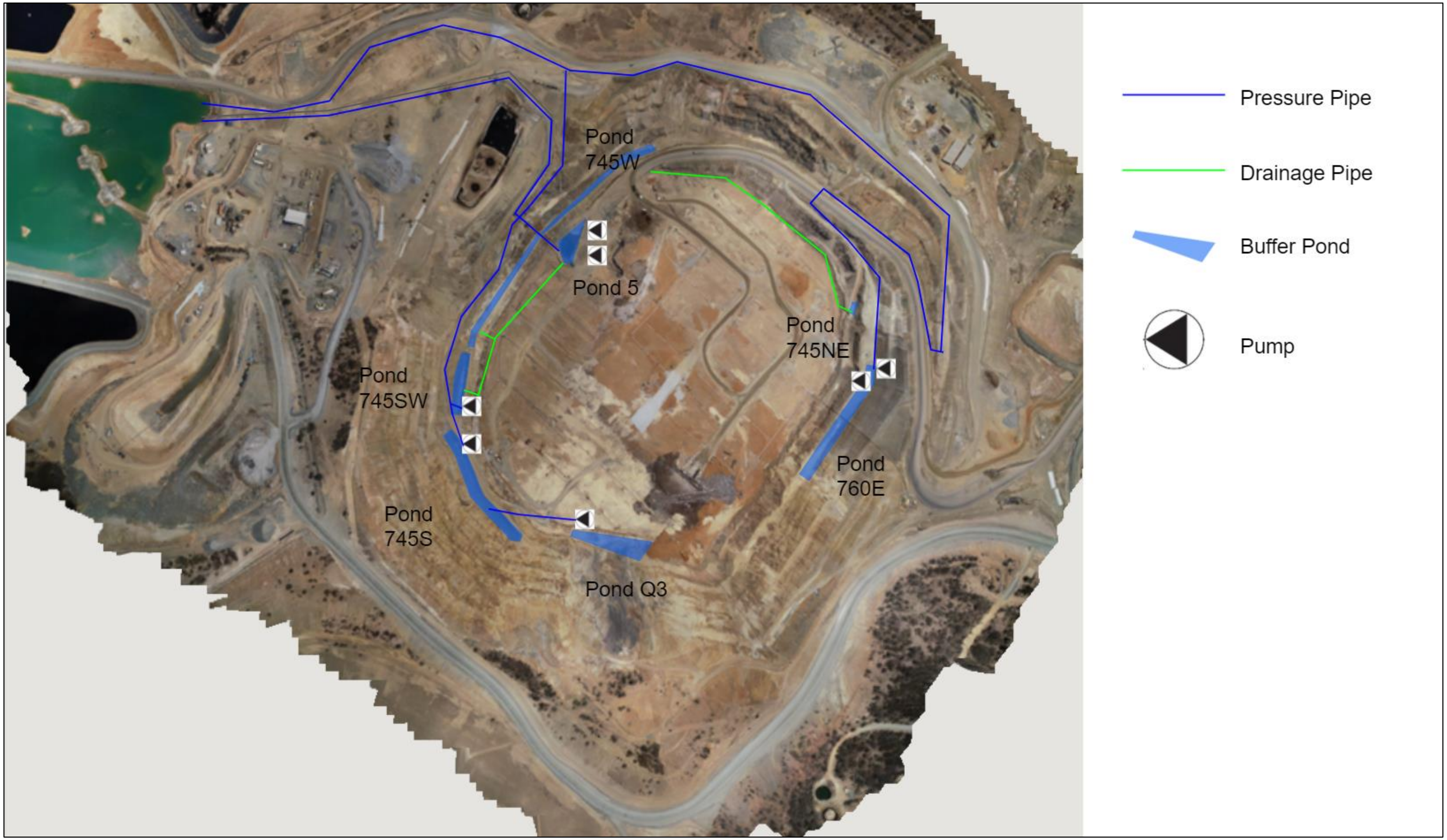


Figure 2.15 - Current stormwater management system servicing the Void (**Source**: WIP 2020)

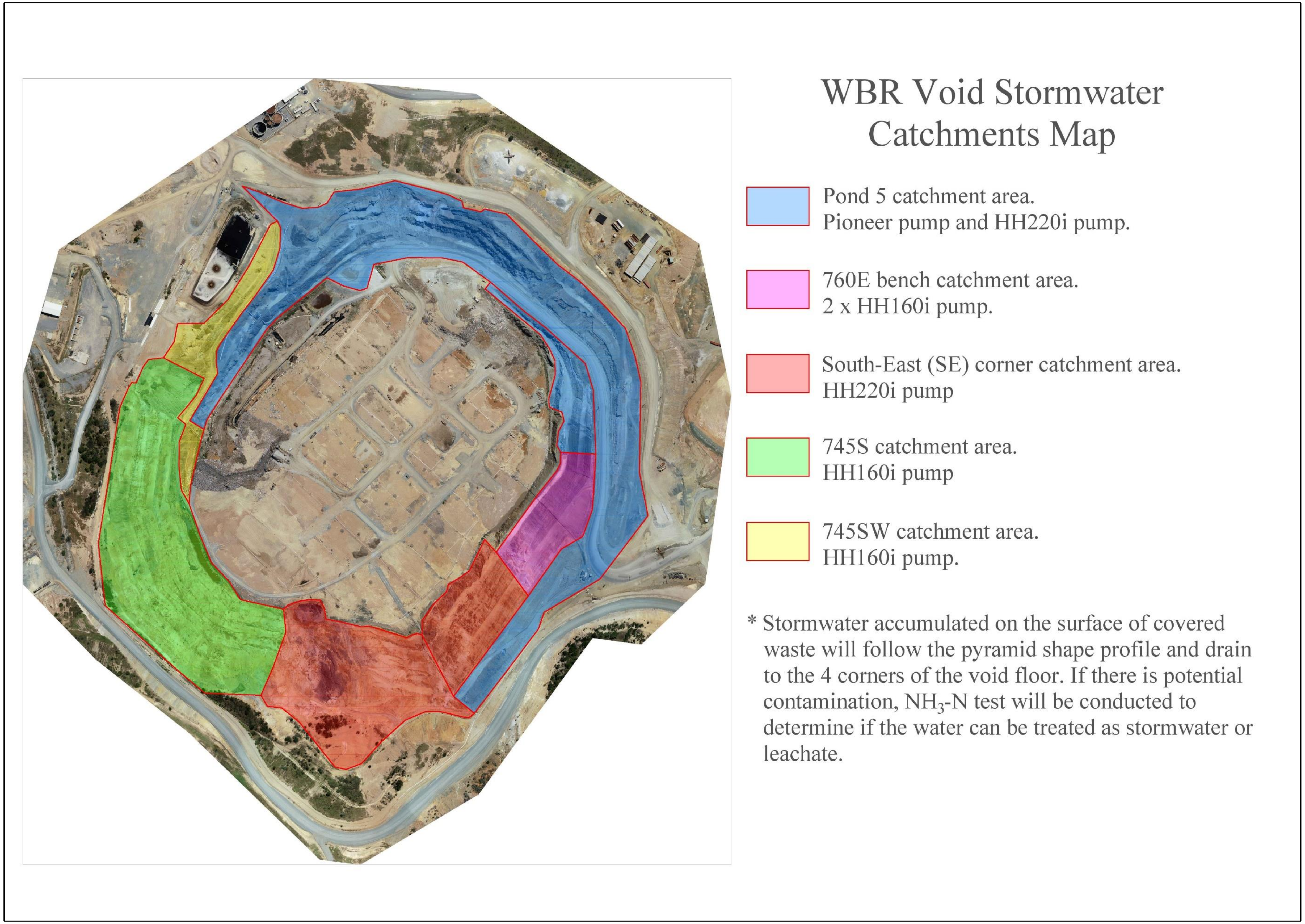


Figure 2.16 - Void Stormwater Catchment Map (**Source**: Veolia)

2.6 MBT FACILITY OPERATIONS

The MBT Facility at the Woodlawn Facility operates under a separate EPL (20446) to the Bioreactor operations and is approved to process up to 240,000 tpa of mixed waste and 40,000 tpa of garden waste. The existing MBT Facility infrastructure is capable of processing up to 144,000 tpa of putrescible waste. To that end, the MBT Facility includes the following infrastructure for its operations:

- An access road for waste trucks (entering and exiting the facility from Collector Road);
- Car parking, weighbridge, and amenities;
- Reception building and associated infrastructure;
- Biological Refining System (**BRS**) drums;
- Refining building;
- Organic buffer storage building;
- Fermentation building;
- Maturation pad storage area; and
- An odour control facility based on biofiltration technology (refer to **Section 2.6.3** for details).

Operationally, the MBT Facility includes the receipt of solid waste from municipal, commercial, and industrial sources within the Sydney Metropolitan Area. As of the 9th IOA, the MBT Facility received consent to accept 20,000 tpa of Food Organics and Garden Organics (**FOGO**) as part of its existing approval that permits it to process up to 240,000 tpa of mixed waste and 40,000 tpa of garden waste. There was no change required to the infrastructure at the MBT Facility to enable FOGO material to be processed. All municipal solid waste (**MSW**) and FOGO streams are transported in a similar manner to the Bioreactor, which is via the IMF. The MSW and FOGO streams consist of different process flows through the MBT Facility – this is described in **Section 2.6.1** and **Section 2.6.2**, respectively.

2.6.1 MSW Process Flow

Upon receipt at the MBT Facility, the MSW stream is processed in the following manner:

- Waste is accepted, weighed, and unloaded on the Reception Building pit of the waste processing building, where it is screened for conforming waste;
- Waste is then loaded to the BRS drums in batches to ensure a maximum residence time of 3-4 days;
- The waste from BRS drums is transferred to Refining Building for mechanical sorting with equipment, such as trommels, to separate waste into different-sized

fractions, magnets to remove ferrous material and ballistic separators to segregate light organic material from inorganic material for composting. The refined and screened organic material is provisionally stored in the Organic Buffer Storage Building;

- The refined and screened organic material is transferred from the Organic Buffer Storage Building to the Fermentation Building for composting. Aerated stockpiles of the organic material are formed in specially designed cells through an automated delivery system. Temperature and airflow are regulated through a dedicated SCADA system to ensure optimum and controlled conditions for composting to occur. The process of fermentation will effectively create a biologically stable product, at the end of which the compost produced will be moved into the Maturation Storage Pad Area, located adjacent to the fermentation buildings, until required for use; and
- Recovered ferrous metals are captured in the bin located outside the Refining Building and transported off-site. Any residual material is sent to the Bioreactor for disposal.

The MSW process flow schematic at the MBT Facility is provided in **Figure 2.17**.

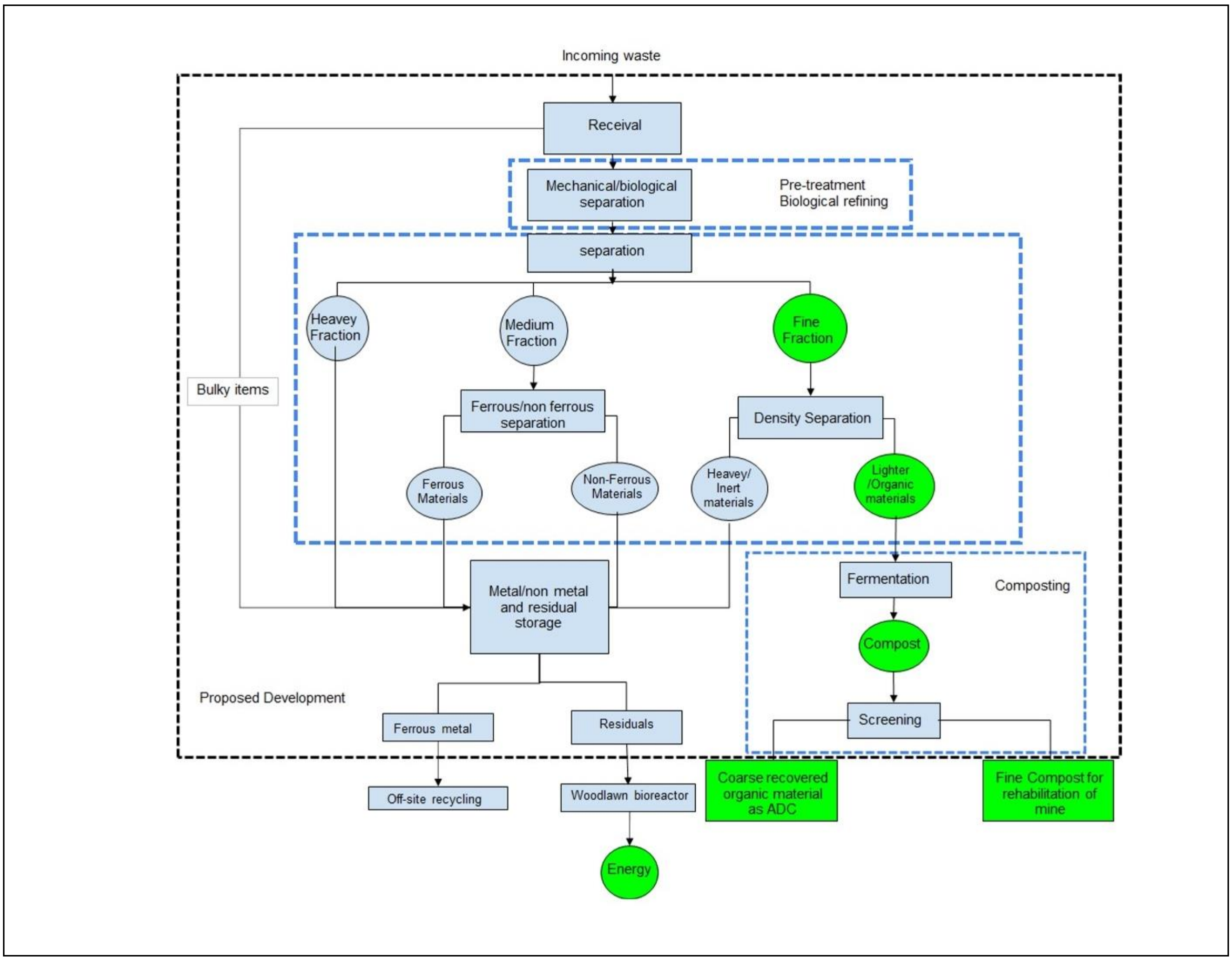


Figure 2.17 – MSW process flow at the MBT Facility (**Source**: MBT OEMP)

2.6.2 FOGO Process Flow

As mentioned in **Section 2.6**, the FOGO material is received at the MBT Facility in sealed waste containers similar to the current waste transportation method used for mixed and garden waste. The number of FOGO containers is approximately 2-3 per day, equivalent to 60 to 90 tonnes per day. Upon receipt at the MBT Facility, the FOGO stream is processed in the following manner:

- the containerised FOGO material is tipped directly into the Organic Storage Buffer Building for processing. No unprocessed FOGO will be stored outside the operational hours of the MBT Facility. It takes approximately 45 minutes to move a container load of material to the organic buffer storage building for processing; and

- Once processed within the organic buffer storage building, the FOGO material is processed in a similar manner to the current MSW streams received at the MBT Facility (refer to Section 2.6.2).

The FOGO process flow schematic at the MBT Facility is provided in **Figure 2.18**.

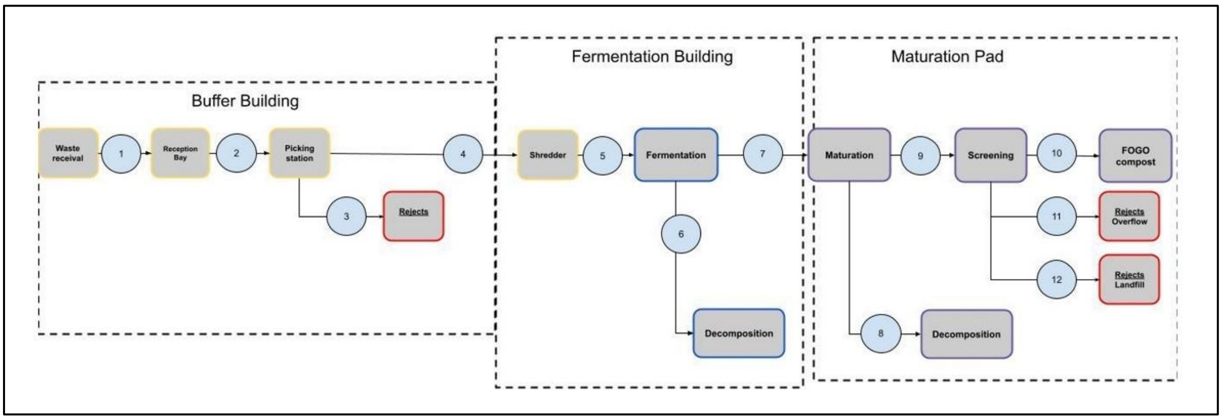


Figure 2.18 – FOGO process flow at the MBT Facility (**Source**: MBT OEMP)

2.6.3 Odour Control System

The MBT Facility has been designed with a purpose-built biofilter-based odour control system to facilitate operations from an odour management perspective. There are two biofilter systems at the MBT Facility, namely:

- **Odour Control System 1** is responsible for treating process and building airflow from the reception building and BRS drum system. The design airflow for Odour Control System 1 is 81,200 m^3/hr; and

- **Odour Control System 2** treats the process and builds airflow from the Organic Buffer Storage, Fermentation Building, and Refining Building. The design airflow for Odour Control System 2 is 175,500 m^3/hr.

The 11th IOA understands that the design philosophy for both odour control systems was identical in that consideration was given to the type of processes that will be occurring in the MBT Facility, the potential for each of these processing areas to generate odours, the layout of the MBT Facility site, the proximity of the Woodlawn Facility to potential odour receptors, and experience base from several other large in-vessel composting facilities across Australia. The product of this process resulted in a design that achieves the following objectives:

- Capture and/or containment of all odours generated at key processing areas, including the Reception Building, BRS Drum System, Refining Building, and Organic Buffer Storage Building;
- The maintenance of negative pressure conditions in the above areas under normal operating conditions;
- The capture of the bulk of the odours generated in the Fermentation Building, without necessarily achieving negative pressure conditions; and
- Treatment of all odour captured by the two independent collection systems in a pair of up-flow, open-bed biofilters, each equipped with a foul air humidification system.

2.6.3.1 Refurbishment of Biofilter System

The 11th IOA notes that the biofilters servicing Odour Control System 1 and Odour Control System 2 underwent a complete refurbishment between November 2022 and March 2023. This reflects the first refurbishment in the life cycle of the biofilters at the MBT Facility.

2.6.4 MBT Odour Emissions Identification and Characterisation

An operational odour analysis was undertaken to identify and characterise all key emission points at the MBT Facility to facilitate the sampling program conducted in the 11th IOA. This analysis resulted in the following key sources of interest:

- The biofilter system performance outlet discharge cells; and
- The maturation storage pad area.

All other locations are considered negligible, provided the odour control system infrastructure, operating setpoints, and design practices are followed and adequately maintained.

2.6.5 Leachate Aeration Pond

The 11th IOA understands that the Bioreactor operations and MBT Facility are required to manage leachate independently, i.e., no extraction, transfer, or storage between the two operations). As such, the MBT Facility consists of a leachate aeration pond (**LAP**) responsible for managing leachate from the following areas:

1. Maturation Pad; and
2. Biofilter System.

The northern end of the Maturation Pad consists of a V-drain designed to intercept leachate prior to flowing to the LAP. An example of the V-drain is shown in **Photo 2.6**. A view of the LAP as found during the 11th IOA is shown in **Photo 2.7**. Similar to the Bioreactor operations, volume reduction can be achieved via either natural or mechanical evaporation (limited) as well as reused in the MBT Facility operations (if required).

The management protocol for the LAP is based on an aerobic treatment process using several venturi aerators. In this design, there is a loop to draw leachate from the pump and introduce the leachate into a venturi aerator. The venturi effect creates a vacuum and the air is pushed into the leachate, which promotes favourable mixing with the leachate, prior to discharge in the LAP. This process increases the dissovled oxygen level of leachate promoting and maintaining favourable aerobic conditions pond. A concept design schematic of the LAP treatment process is shown in **Figure 2.19**.

2.6.5.1 Volume Reduction Process

Similar to the Bioreactor operations, the treated leachate from the LAP is either naturally or mechanically evaporated. For the mechanical evaporation capacity, the design details were unavailable to the 11th IOA at the time of writing. However, given the size of the LAP relative to the LMS for the Bioreactor operations, it is not considered to be a significant contributor to odour emissions provided optimum aerobic conditions are maintained. As such, no further analysis is conducted on this feature of the LAP at the MBT Facility.

Photo 2.6 – A view of the V-drain servicing the Maturation Pad at the MBT Facility: 22 February 2023

Photo 2.7 – A view of the LAP at the MBT Facility: 22 February 2023

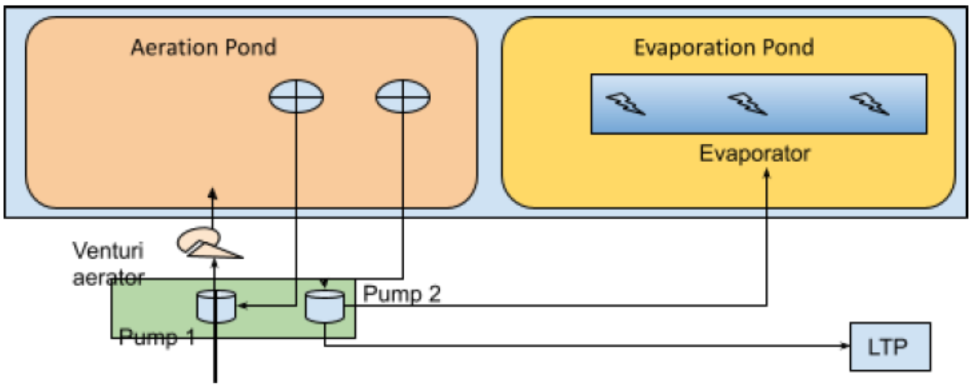


Figure 2.19 – A concept design schematic of the LAP at the MBT Facility

3 SAMPLING PROGRAM

As per *Condition 7 (e)* of *Schedule 4* in the *Specific Environmental Conditions - Landfill site,* the 11th IOA measured all current and key sources at the Woodlawn Facility. As previously highlighted in **Section 1.3**, the odour emissions inventory developed in previous IOAs was used as a basis for the sampling program in the 11th IOA and updated where required.

3.1 Sampling Scope

The 11th IOA involved the collection of a total of seventy-seven (77) odour samples, namely:

- Fifty (50) gas samples for odour concentration measurement; and
- Twenty-seven (27) liquid samples for odour concentration measurement testing using an in-house National Association of Testing Authorities (**NATA**) accredited Liquid Odour Concentration Determination Method (refer to **Section 4.3** and **Appendix B** for details). The liquid samples, whilst not being a requirement for the 11th IOA, were collected from the pond sources containing treated leachate, including ED3N-1, ED3N-2, ED3N-3, ED3N-4, EDS1, EDS2, ED1 Stormwater/AMD, ED1 Coffer Dam, LTD, LAP and V-drain to quantify the odour emissions caused by the natural or mechanical evaporation of the lagoons liquid contents (refer to **Section 9.2.1.8** for further details and results).

3.2 Sampling Schedule

The sampling program schedule for the 11th IOA is summarised in **Table 3.1.** As shown in **Table 3.1**, there are several key sampling locations at the Woodlawn Facility. This includes:

- The Bioreactor;
- ED3N System;
- ED3S System;
- The LTP;
- ED1 Coffer Dam; and
- The MBT Facility.

The sampling program schedule includes all key sources requested in *Condition 7 (e) of Schedule 4 in the Specific Environmental Conditions - Landfill site* with the following exceptions:

- **Leachate recirculation***:* Since the 2012 IOA, the 11th IOA has been unable to observe and thus collect representative samples for this scenario. Since the completion of EA 2010, Veolia has developed a leachate recirculation system that involves direct injection of leachate into the waste, which eliminates the need for spraying over the surface (refer to **Section 9.2.1.1.1**). The 11th IOA understands that this will continue to remain a normal practice. Therefore, no suitable access points for the collection of odour samples from this source is – and will continue to be – possible. Notwithstanding this, as previously mentioned in **Section 2.3.2**, there is only a main reinjection infrastructure being maintained in the Bioreactor as a contingency/back-up option for leachate management when the leachate transfer system experiences any failure. This is supplemented by an additional reinjection point for operational contingency and providing no more than a day to enable repair/remedial works to be completed of the main reinjection point (refer to **Section 2.3.2.1**). Therefore, the leachate recirculation technique is not used extensively as part of the normal operation of the Bioreactor. On this basis, it is not considered to be a significant source of odour. Subsequent IOAs will continue to assess the circumstances relating to leachate recirculation within the Void and document any variation in leachate recirculation practices as required.

3.2.1 Wet Weather Conditions

It is understood that the Woodlawn Facility encountered drier-than-average conditions in February. There were some limited rainfall totals recorded in Goulburn in the days leading up to and during the 11th IOA visit period. As a result, the 11th IOA did not collect odour samples under significant wet weather conditions. It is noted that the collection of gas samples under wet weather conditions can pose access and safety concerns.

3.2.2 Crisps Creek Intermodal Facility

No samples were collected from the IMF as all waste transportation is a fully contained process until the displacement of the contents into the Void via the mobile tipping platform. Instead, as per previous IOAs, an olfactory assessment (refer to **Section 9.2.1.13**) and FAOA survey monitoring program (refer to **Section 7**) were adopted to evaluate the odour performance of the IMF in the 11th IOA.

3.2.2.1 Waste Container Management

The 11th IOA notes that it is a requirement that all waste containers are to be designed, constructed, and maintained to prevent the emission of odour and be watertight to prevent the leakage of leachate from waste containers during transport and handling activities. This is a condition of consent for the Clyde Transfer Terminal Facility and Banksmeadow Transfer Terminal Facility, where waste containerisation occurs. As such, and as per previous IOAs, the 11th IOA classifies the IMF as a very low-risk source regarding odour. Moreover, as per previous IOAs, there are virtually no active pathways for odour emission release from this operation that can be practically measured under normal operations. Therefore, as discussed in **Section 9.2.1.13**, the IMF continues to be a negligible contributor to the Woodlawn Facility's overall operational odour emissions footprint under normal conditions.

Table 3.1 – The 11th IOA sampling program schedule as conducted between 20 February 2023 and 23 February 2023		
Location	**Source Type^**	**Number of samples collected**
The Bioreactor		
ATF	Area source	4
Waste Covered Area	Area source	9
Leachate Treatment Dam		
LTD	Area source	2
ED3N Pond System		
ED3N-1	Area source (2) + Liquid odour measurement (3)	5
ED3N-2	Area source (2) + Liquid odour measurement (3)	5
ED3N-3	Area source (2) + Liquid odour measurement (3)	5
ED3N-4	Area source (2) + Liquid odour measurement (3)	5
ED3S Pond System		
ED3S2	Area source (2) + Liquid odour measurement (3)	5
ED3S1	Liquid odour measurement	1
Leachate Treatment Plant		
Anoxic	Liquid odour measurement	1
Aerobic	Liquid odour measurement	1
Balance	Liquid odour measurement	1
ED1 Coffer Dam		
ED1 Coffer Dam	Area source (2) + Liquid odour measurement (2)	4
ED1 Stormwater / AMD		
ED1 Stormwater / AMD	Area source (2) + Liquid odour measurement (2)	4
MBT Facility		
MBT Biofilter 1 System	Point source	4
MBT Biofilter 2 System	Point source	5
MBT Maturation Pad	Area source	8
LAP and V-drain	Area source (4) + Liquid odour measurement (4)	8
TOTAL		**77**

^ refer to **Section 4** for details

4 SAMPLING METHODOLOGY

The sampling methodologies described in this section are associated with the '*Source Type*' descriptions presented in **Section 3.2 - Table 3.1**. Given the nature and characteristics of the emission sources sampled, the following sampling techniques are adopted in the 11th IOA:

- Point source sampling, as detailed in **Section 4.1**;
- Area source sampling, as detailed in **Section 4.2**; and
- LOM, as detailed in **Section 4.3**.

All odour sampling and testing completed in the 11th IOA were undertaken in accordance with the NSW EPA guidelines and standards, including:

- NSW EPA document titled *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* dated January 2022 (the **NSW EPA Approved Methods**);
- NSW EPA document titled *Technical Framework (and notes): Assessment and management of odour from stationary sources. Sydney: Department of Environment and Conservation* dated 2006 (the **NSW EPA Technical Framework**);
- AS/NZS 4323.3 titled *Stationary source emissions – Determination of odour concentration by dynamic olfactometry* dated 2001 (**AS/NZS 4323.3**); and
- AS/NZS 4323.4 titled *Stationary source emissions - Area source sampling - Flux chamber technique* dated 2009 (**AS/NZS 4323.4**).

The exception is the preparation of gas samples using the LOM. There is currently no guidance or standard for the LOM as it is an in-house technique developed by TOU (refer to **Section 4.3** for details).

4.1 POINT SOURCE SAMPLING METHOD

The method used for the collection of gas samples from the inlet and outlet locations of the biofilter systems at the MBT Facility involved the use of a point source sampling, consisting of the drum and pump method. This method involves the drawing of the sample air through a polytetrafluoroethylene (**PTFE**) sampling tube into a single-use, Nalophan sample bag. The bag was housed within a container (sampling drum) that was evacuated with a vacuum pump, and the sample collected by induced flow. The "lung method", by which this sampling procedure is known, allowed the sample air to be collected without encountering any potentially odorous material. **Figure 4.1** illustrates a schematic of the point source sampling method. This method is defined as *OM-7* in the NSW EPA Approved Methods.

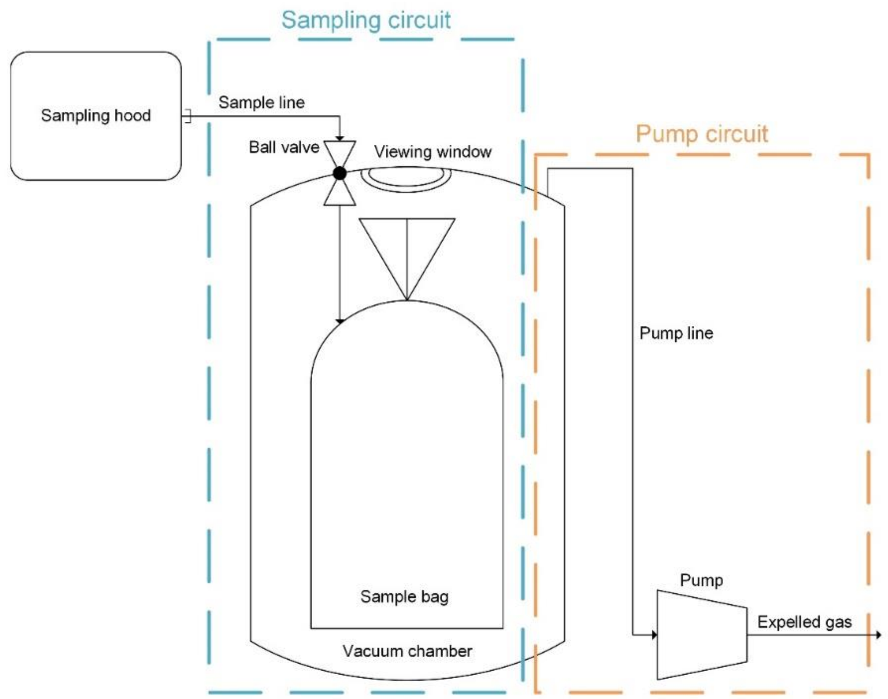


Figure 4.1 - Schematic of point source sampling

4.2 AREA SOURCE SAMPLING METHOD

The objective of the area source sampling was to collect representative odour samples from both solid and liquid surface areas at the Woodlawn Facility. This was undertaken using an isolation flux hood (**IFH**). All sampling using the IFH was carried out according to the method described in the United States Environment Protection Agency (**US EPA**) technical report '*EPA/600/8-86/008*', from which AS/NZS 4323.4 is based upon and is defined as *OM-8* in the NSW EPA Approved Methods.

TOU's IFH adheres to the design specifications, materials of construction and supporting equipment that the US EPA report '*EPA/600/8-86/008*' defines. The IFH has a diameter of 0.406 m, a chamber surface area of 0.126 square metres (**m^2**) and a chamber volume of 30 litres (**L**), equivalent to 0.03 cubic metres (**m^3**), when the skirt of the hood is inserted into the liquid or solid surface by the specified 25 millimetres (**mm**). Dry nitrogen is then introduced to the IFH at a sweep rate of 5 L/min.

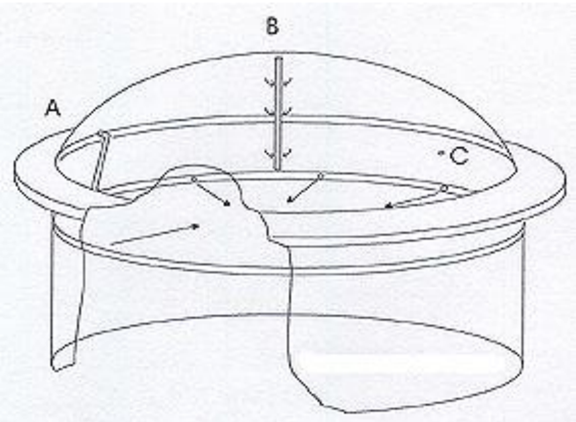
As these area sources are open to the atmosphere, wind is a major factor in the release of odorous pollutants from the surface and conveying the pollutant from the source to areas beyond the boundary. The IFH system is designed to simulate the transfer of odorous pollutants by the wind, resulting in a controlled and consistent sampling environment. This is achieved by the flux of near pure nitrogen gas into the IFH that is positioned on the liquid or solid surface. On a liquid surface, this is achieved by floating the IFH within an inflated tyre inner tube. The nitrogen gas then transports the odour from the surface in the same way the wind does, albeit at a very low sweep velocity. This odorous air is then collected for odour and/or chemical analysis.

As the IFH has a constant 5 L/min inflow of nitrogen gas to it, the sampling chamber remains under positive pressure and produces a net outflow through the vent on top of the IFH, therefore eliminating any chance of contamination of external air from the atmosphere. The IFH's volume of 30 L and the 5 L/min nitrogen sweep rate results in a gas residence time of six minutes. The US EPA method prescribes a minimum of four (4) air changes to achieve optimum purging and equilibrium in the hood, and therefore a total of 24 minutes is allowed before sampling commences. The sample is then collected over a 10-minute period to obtain a 20 L sample for odour and/or chemical analysis.

The method adopted by TOU is summarised as follows (and as described in the schematic of the sampling equipment shown in **Figure 4.2** and **Figure 4.3**):

- Dry nitrogen is directed into the IFH via odour-free PTFE tubing until it has reached equilibrium. The nitrogen is channelled to a manifold fitted with small outlets above the surface, which direct the air towards the centre of the surface;
- The nitrogen flow (5 L/min) purges the flux hood with a residence time of four times the chamber volume occurring before sampling begins; and
- The odorous sample is drawn through a Teflon tube into a single-use, odour-free Nalophan sample bag secured inside a drum that is under vacuum. The balance of the gas flow is vented to the atmosphere.

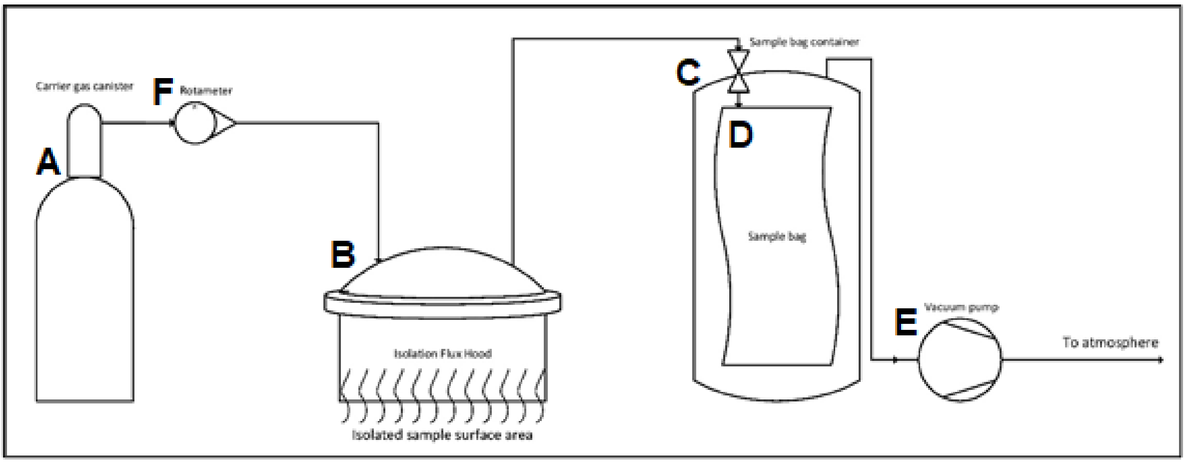
The IFH is manufactured from acrylic resin to ensure it does not contribute to the odour sample. All other surfaces in contact with the sample are made from PTFE or stainless steel. An example of IFH sampling on a solid surface and a liquid surface is shown in **Photo 4.1** and **Photo 4.2**, respectively.



Key

A	Inlet gas from the gas cylinder.
B	Outlet to sample bag.
C	Additional gas outlet points for other sampling, or temperature and moisture monitoring.

Figure 4.2 – Details of the isolation flux hood chamber



Key

A	Cylinder of nitrogen gas.
B	Isolation Flux Hood (a detailed diagram is shown in **Figure 4.2**)
C	Lung chamber (sampling drum)
D	Nalophan sampling bag
E	Sampling pump
F	Air flow meter

Figure 4.3 - Schematic of the isolation flux hood setup

Photo 4.1 - An example of IFH sampling on a solid surface (Maturation Pad Stockpile at the MBT Facility) as occurred on 22 February 2023

Photo 4.2 - An example of IFH sampling on a liquid surface (ED1 Stormwater/AMD, North of ED1 Coffer Dam) as occurred on 21 February 2023

4.3 LIQUID ODOUR METHOD

4.3.1 Overview

The LOM was developed by TOU for measurement of the odour release potential from process liquors, which is universally applicable to aqueous solutions containing odorous substances. In simple terms, it measures the odour released when an odorous liquid evaporates. It is directly relevant to the mechanical evaporation units in use at the Woodlawn Facility and natural evaporation processes for volume reduction of treated leachate (refer to **Appendix D** for details on methodology).

4.4 PHYSICAL MEASUREMENTS

A series of measurements were collected at the MBT Facility to evaluates the physical performance of the biofilter system. This data facilitated in the contextualisation of the odour testing results from the biofilter system. The physical measurement parameters of the inlet airstream flowing to the biofilter system as collected in the 11th IOA included airflow, inlet duct pressure, and temperature/moisture content. The measurement details are provided in **Section 4.4.1**, **Section 4.4.2**, and **Section 4.4.3**, respectively.

4.4.1 Airflow Measurements

The airflow measurements from the biofilter inlet were recorded by inserting a hot-wire anemometer into a pre-drilled hole in ductwork for Biofilter System 1 and Biofilter System 2 at the MBT Facility. The collection of these airflows was necessary to enable an Odour Emission Rate (**OER**) to be calculated (refer to **Table 6.3**).

4.4.2 Duct Pressure Measurements

The biofilter system inlet duct pressure was measured at the same location used for flow measurement, as in **Section 4.4.2**. Pressure was measured using a digital manometer and reported as the differential pressure between the duct pressure and atmospheric pressure. The measurements were recorded in Pascals (**Pa**).

4.4.3 Temperature and Relative Humidity Measurements

Relative humidity (**RH**) was measured using a two-channel digital thermometer, using Type K thermocouple probes. One probe was equipped as a wet-bulb thermometer, with the other a dry bulb probe. RH and moisture readings were calculated using a psychrometric chart. The RH/moisture level of the inlet airstream to the biofilter system is considered critical to achieving sustainable and effective performance. The Biofilter Manual specifics that a RH target of 85% or higher is necessary for sustainable and effective biofilter system performance.

5 ODOUR LABORATORY MEASUREMENT METHOD

5.1 ODOUR MEASUREMENT LABORATORY

All samples collected for the 11th IOA were analysed at TOU's NATA Accredited Odour Laboratory in Mascot, New South Wales.

5.1.1 Odour Concentration Measurement

TOU's odour laboratory operates to the AS/NZS 4323.3, which prescribes a method for sample analysis that provides quality assurance/quality control and ensures a high degree of confidence in the accuracy, repeatability, and reproducibility of results.

The concentration of the gaseous odour samples was measured using a technique known as dynamic olfactometry. Dynamic olfactometry involves the repeated presentation of both a diluted gaseous odour sample and an odour-free air stream to a panel of qualified assessors through two adjacent ports on the olfactometer (known as the Odormat™). TOU utilises four to six trained assessors (or panellists) for sample analysis, with the results from four qualified panellists being the minimum allowed under the AS/NZS 4323.3.

The method for odour concentration analysis involves the odorous gas sample initially being diluted to the point where it cannot be detected by any member of the panel. The assessor's step- up to the olfactometer, in turn, takes a sniff from each port, then choose which port contains the odour and enters their response. At each stage of the testing process, the concentration of the odorous gas is systematically increased (doubled) and re-presented to the panellists. A round is completed when all assessors have correctly detected the presence of the odour with certainty. The odour is presented to the panel for three rounds and results taken from the latter two rounds, as stated in AS/NZS 4323.3.

The results obtained give an odour measurement measured regarding odour units (**ou**). One (1) ou is the concentration of odorous air that can be detected by 50% of members of an odour panel (persons chosen as representative of the average population sensitivity to odour). It is effectively the concentration of an odour at the detection threshold level. The odour concentration of a sample expressed in odour units is the number of times the sample must be diluted to elicit a physiological response (the detection threshold level) from a panel. For example, twenty (20) odour units would mean that the odour sample will need to be diluted 20 times for the concentration to be at the detection threshold level. This process is defined within AS/NZS 4323.3.

The odour units determined from olfactometry laboratory analysis can be subsequently multiplied by an emission rate or volumetric flow to obtain an OER or a specific odour emission rate (**SOER**) for area source samples collected using the IFH method (refer to **Section 4.1** & **Section 5.1.2**).

5.1.2 Specific Odour Emission Rate

For area source samples collected using the IFH method, the results from odour concentration testing, derived in odour units (refer to **Section 4.1** for details), is multiplied by an emission rate to obtain a SOER. SOER is a measure of odour released from a representative point at a source. The SOER is multiplied by the area of the source to obtain the OER or the total odour released from each source, that is:

- SOER (ou.m^3 m^{-2} s^{-1}) = OC × Q / A; and
- OER (ou.m^3 s^{-1}) = SOER × area of source (m^2)

where:

- OC = odour concentration of compound from air in the chamber (ou)
- Q = sweep gas volumetric flow rate into chamber (m^3 s^{-1})
- A = sample source total surface area (m^2)

The SOER is presented in the units ou.m^3/m^2.s as per convention, and as referred to in the document – Klenbusch, M.R., 1986. USEPA Report No. EPA/600/8-86/008 '*Measurement of gaseous emission rates from land surfaces using an emission isolation flux chamber, - Users Guide'*. The OER is presented in the units' ou.m^3/s as referenced in the AS/NZS 4323.3.

5.1.3 Odour Measurement Accuracy

The repeatability and odour measurement accuracy of the Odormat™ is determined by its deviation from statistically reference values specified in AS/NZS 4323.3. This includes the calculation of instrumental repeatability (r), where r must be less than 0.477 to comply with the standard criterion for repeatability. Its accuracy (A) is also tested against the 95^{th} percentile confidence interval, where A must be less than 0.217 to comply with the accuracy criterion as mentioned in the AS/NZS 4323.3. The Odormat™ V04 complied with all requirements set out in the AS/NZS 4323.3 (refer to **Appendix B** – Result sheets: *Repeatability and Accuracy*). The calibration gas used was 51.0 parts per million (**ppm**), by volume, n-butanol in nitrogen gas (**N_2**).

6 ODOUR TESTING RESULTS

The following section addresses the following audit requirement as outlined in **Section 1.2**, namely:

e. *Measure all key odour sources on-site including:*

   i. *consideration of wet weather conditions providing all raw data used in this analysis;*

   ii. *consideration of (but not limited to) all liquid storage area, active tipping faces, waste cover area, aged waste areas and recirculation of leachate onto waste in the Void;*

   iii. *a comparison of the results of these measurements against the predictions in the EA.*

All key odour sources at the Woodlawn Facility were measured in the 11th IOA, with the results presented in several tables, as follows:

- **Table 6.1** summarises the odour emission results obtained from the 11th IOA and compares the results against the EA 2010 predictions. As there are no EA 2010 predictions for the ED3S Pond System or ED1 Coffer Dam, the results are compared with the emissions data used in the odour modelling study titled *Proposed Addition of ED3S to Leachate Management System* and dated 30 May 2016 (the **LMS May 2016 Report**);

- **Table 6.2** summaries the global mean SOER results derived in the 11th IOA and compares these results to those derived in the previous IOAs conducted between 2012 and 2022;

- **Table 6.3** summarises the MBT Facility biofilter system odour emission results;

- **Table 6.4** and **Table 6.5** summarises the odour emission results for the MBT Facility Maturation Storage Pad Area and LAP, respectively; and

- **Table 6.6** and **Table 6.7** summarises the liquid odour measurement results (note: the mechanical evaporation rates for the LAP were not available to the 11th IOA – refer to **Section 2.6.5** for details).

In **Table 9.4** of **Section 9.5,** a summary of the OERs from all sources amenable to quantitative measurements are provided. These sources have been ranked in descending order. The results in **Table 9.4** do not include potential gas pathways and other fugitive emission sources from the waste surface, due to the difficulty in assigning an appropriate emission area for these sources to calculate an OER derived from the SOER and the area. This was a similar constraint in the previous IOAs. As such, it continues to remain a focus of the 11th IOA with respect to odour emission reduction and management from the Bioreactor operations.

Table 6.1 - The 11th IOA odour emission testing results obtained between 20 February 2023 and 23 February 2023 compared with that adopted in EA 2010						
Source	**The 11th IOA**				**EA 2010**	
Sample Location	**TOU Sample Number**	**Odour Concentration (ou)**	**SOER (ou.m³/m².s)**	**Odour Character**	**SOER Range (ou.m³/m².s)**	**SOER Model Input (ou.m³/m².s)**
Bioreactor (The Void)						
Active Tipping Face (ATF)						
ATF: AC1 (Active Cover)	SC23113	4,470	2.89	garbage	1.0 – 7.3*	7.3 (wet fresh waste emission adopted)
ATF: AC2 (Active Cover)	SC23114	2,660	1.72	garbage		
ATF: DC1 (Daily Cover)	SC23111	64	0.0378	musty vanilla		
ATF: DC2 (Daily Cover)	SC23112	609	0.339	pineapple		
Aged Waste	n/m**				0.5	
Waste Covered Area (WCA) – refer to Figure 6.1						
Bioreactor: BC1 (Bio-cover)	SC23104	256	0.16	rotten pineapple, garbage	0.1 - 0.2* (covered) 7.5 – 23.9*** (fugitive emissions)	0.2 (covered) 23.9*** (fugitive emissions)
Bioreactor: BC2 (Bio-cover)	SC23105	166	0.10	stagnant water, dirty		
Bioreactor: CC1 (Capped)	SC23102	166	0.109	sour pineapple, garbage		
Bioreactor: CC2 (Capped)	SC23103	304	0.199	rotten pineapple, garbage		
Bioreactor: IC1 (Intermediate)	SC23110	91	0.0611	rubber		
Bioreactor: IC2 (Intermediate)	SC23109	17	0.0109	musty		
Bioreactor: IC3 (Intermediate)	SC23108	19	0.0107	musty		
Bioreactor: IC4 (Intermediate)	SC23107	16	0.00954	musty		
Bioreactor: IC5 (Intermediate)	SC23106	35	0.02	musty		

***** includes dry and wet covered waste
** unable to be sampled in the 11th IOA due to access and safety concerns prevailing at the time
*** represents potential gas pathways
n/m = not measured

Table 6.1 (continued) - The 11th IOA odour emission testing results obtained between 20 February 2023 and 23 February 2023 compared with that adopted in EA 2010						
Source	**The 11th IOA**				**EA 2010**	
Sample Location	**TOU Sample Number**	**Odour Concentration (ou)**	**SOER ($ou.m^3/m^2.s$)**	**Odour Character**	**SOER Range ($ou.m^3/m^2.s$)**	**SOER Model Input ($ou.m^3/m^2.s$)**
Bioreactor (The Void)						
Leachate Treatment Dam						
Leachate Treatment Dam (Aerated Zone)	SC23100	85,000	52.9	rotten egg, sewage	0.1 - 7.4*	3.6
Leachate Treatment Dam (Anoxic Zone)	SC23101	13,800	8.58	rotten egg		
Leachate recirculation system						
Leachate recirculation system	n/m				1.6 – 2.5	2.5
Landfill Gas Extraction System						
Landfill gas inlet	n/m				n/a	
Catchment Pond (leachate)^^						
Storage Pond 7	n/m				2.1 – 8.8	8.8
Catchment Pond (stormwater)^^						
Storage Pond 3 (Stormwater)	n/m				n/a	

* includes partially / fully treated leachate (dependent on the treatment stage of the process at the time samples were collected)
n/m = not measured
n/a = not applicable
^^ no longer in use

Table 6.1 (continued) - The 11th IOA odour emission testing results obtained between 20 February 2023 and 23 February 2023 compared with that adopted in EA 2010

Source	The 11th IOA				EA 2010	
Sample Location	**TOU Sample Number**	**Odour Concentration (ou)**	**SOER ($ou.m^3/m^2.s$)**	**Odour character**	**SOER Range ($ou.m^3/m^2.s$)**	**SOER Model Input ($ou.m^3/m^2.s$)**
Evaporation Dams						
ED3N Pond System						
ED3N-1	SC23078	83	0.0525	dirty, muddy water	2.1 – 8.8	8.8
	SC23079	395	0.24	dirty, muddy, water, sour, onion		
ED3N-2	SC23080	12,400	7.66	rotten egg, dirty, muddy	0.1 – 7.4	0.2*
	SC23081	17,900	10.8	rotten egg, muddy water		
ED3N-3	SC23082	197	0.12	ammonia, muddy water		
	SC23083	181	0.11	ammonia, muddy water		
ED3N-4	SC23084	11,600	7.12	rotten egg, muddy water	0.1 – 0.7	0.7**
	SC23085	25,300	15.5	rotten egg, muddy water		
ED3S Pond System						
ED3S1	SC23088	49	0.0315	muddy water	0.0 - 0.5	0.5
ED3S2	SC23090	790	0.482	sour, rotten	0.159***	
	SC23091	1,330	0.839	sewage, rotten		
LTP System						
ED1 Coffer	SC23086	128	0.0758	dirty, muddy water.	n/a	
	SC23087	32	0.0189	musty, muddy water.		
ED1 Stormwater/AMD System						
ED1	SC23089	45	0.028	musty water	n/a	

* partially / fully treated leachate
** includes groundwater and fully treated leachate
*** not obtained from the EA. Source of emission data is *Table 2.1* in the LMS May 2016 Report:
n/a = not applicable
n/m = not measured
n/d = not determined

Table 6.2 – Global mean SOER results: Comparison between the 11th IOA and previous IOAs

Source	The 11th IOA	10th IOA	9th IOA	8th IOA	7th IOA	6th IOA	5th IOA	4th IOA	3rd IOA
Location	**TOU SOER (ou.m³/m².s)**								
ED3N-1	0.146	2.57	n/a (empty)	n/a (empty)	0.356	0.132	0.130	0.132	0.017
ED3N-2 & 3^	4.67	0.877	0.361	0.0745	0.102	0.129	0.175	0.118	0.049
ED3N-2	9.23	1.72	0.0867	0.0881	0.169	0.120	0.148	0.145	0.066
ED3N-3	0.115	0.0349	0.635	0.0609	0.035	0.139	0.20	0.091	0.032
ED3N-4	11.3	0.045	0.522	0.0856	0.095	0.163	0.248	0.269	0.023
Active Tipping Face	1.25	2.20	3.24	5.26	7.59	9.52	8.16	7.51^^^^^	4.28
Leachate Treatment Dam	30.7	0.415	3.07	9.19	0.186	0.243	0.27	0.276	0.026
Construction and Demolition Tip Face	n/a	n/a	n/a	n/a	n/a	n/a	n/m	0.326	n/a
ED3S1	0.0315	n/m	n/m	0.094	0.058	0.116	0.277	n/a	n/a
ED3S2	0.661	0.0526	2.19	0.554	0.13	1.97	0.437	n/a	n/a
Stormwater Pond 3^^	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Storage Pond 7^^	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/m^^	n/a#
Source	**The 11th IOA**	**2nd IOA**	**1st IOA**	**--**	**--**	**--**	**--**	**--**	**--**
Location	**TOU SOER (ou.m³/m².s)**								
ED3N-1	0.146	0.30	394	--	--	--	--	--	--
ED3N-2 & 3^	4.67	11.6 ^^^^	0.29	--	--	--	--	--	--
ED3N-2	9.23	20.1 ^^^	0.21	--	--	--	--	--	--
ED3N-3	0.115	0.2	0.37	--	--	--	--	--	--
ED3N-4	11.3	0.0604	0.41	--	--	--	--	--	--
Active Tipping Face	1.25	3.04	8.36	--	--	--	--	--	--
Leachate Treatment Dam	30.7	0.323	0.46	--	--	--	--	--	--
Construction and Demolition Tip Face	n/a	0.293	n/a	--	--	--	--	--	--
ED3S1	0.0315	n/a	n/a	--	--	--	--	--	--
ED3S2	0.661	n/a	n/a	--	--	--	--	--	--
Stormwater Pond 3^^	n/a	n/a	n/a	--	--	--	--	--	--
Storage Pond 7^^	n/a	n/a#	85	--	--	--	--	--	--

^ as specified in the EA 2010
^^ no longer exists
^^^ represents the sub-optimal pond contents that have now been treated (refer to 3rd IOA Report for details)
^^^^ bulk of emissions originating from ED3N-2 (refer to 3rd IOA Report for details)
^^^^^ includes testing results reflecting sampled areas with the polymer slurry applied
# There was no designated area for this location (refer to 4th IOA Report for details)
n/a = not applicable
n/m = not measured

Table 6.3 – MBT Facility: Biofilter System Results: 20 February 2023 and 23 February 2023

Sample Location		TOU Sample Number	Odour Concentration (ou)	Odour Emission Rate (ou.m^3/s)	Odour character	Inlet Airflow (m^3/h, actual)
MBT Biofilter 1						
MBT Biofilter 1	Western Cell Section (Composite)	SC23069	609	5,740	garbage, dirt, soil	--
	Middle Cell Section (Composite)	SC23070	430	4,060	dirt, soil, garbage	
	Eastern Cell Section (Composite)	SC23071	609	5,740	dirt, soil, garbage	
	Common Inlet	SC23073	609	8,930	garbage	64,600
MBT Biofilter 2						
MBT Biofilter 2	Southwest Cell Section (Composite)	SC23065	861	3,160	dirt, soil, garbage, sour	--
	Southeast Cell Section (Composite)	SC23066	1,450	5,310	fermented, garbage, dirt, soil	
	Northwest Cell Section (Composite)	SC23067	3,160	11,600	garbage, dirt, soil	
	Northwest Cell Section (Composite)	SC23068	664	2,430	dirt, soil, garbage, sour	
	Common Inlet	SC23072	4,870	138,000	garbage	129,000

Table 6.4 – MBT Facility: Maturation Storage Pad Area Results: 20 February 2023 and 23 February 2023

Age (days)	Sample Location	TOU Sample Number	Odour Concentration (ou)	SOER (ou.m^3/m^2.s)	Odour character
MBT Maturation Storage Area					
Mature	FOGO unscreened pile (1 of 2)	SC23092	17	0.00985	musty water
Mature	FOGO unscreened pile (2 of 2)	SC23093	21	0.0122	musty
Mature	FOGO screened pile (1 of 2)	SC23094	27	0.016	musty water
Mature	FOGO screened pile (2 of 2)	SC23095	23	0.0135	musty
Mature	Biocap pile (1 of 2)	SC23096	64	0.0381	garbage water, rotten
Mature	Biocap pile (2 of 2)	SC23097	23	0.0137	musty water
Mature	MSW pile (1 of 2)	SC23098	279	0.164	vanilla
Mature	MSW pile (2 of 2)	SC23099	197	0.116	vanilla

Table 6.5 – MBT Facility: Leachate Aeration Pond Results: 20 February 2023 and 23 February 2023

Sample Location	TOU Sample Number	Odour Concentration (ou)	SOER (ou.m^3/m^2.s)	Odour character
LAP				
Leachate dam (W) far from inlet	SC23074	724	0.476	ammonia, rotten
Leachate dam (E) near to inlet	SC23075	1,450	0.953	ammonia, rotten
Leachate dam (W) near to inlet	SC23076	861	0.565	ammonia, rotten
Leachate dam (E) far from inlet	SC23077	1,120	0.733	ammonia, rotten

Table 6.6 – LOM derived odour emission rates for mechanical evaporation methods: As collected on 23 February 2023 ^^^^

Sample Location	TOU Sample Number	Odour Concentration (ou)	Calculated Liquid Odour Potential (ou/mL)	Mechanical Evaporation Rate (L/min) per evaporator^ η = 20% / 30%	Mean Odour Emission Rate ($ou.m^3/s$) per evaporator η = 20% / 30%	Mean Odour Emission Rate ($ou.m^3/s$) ALL evaporators^^^ η = 20% / 30%
ED3N-1	SC23115	76	4.6	45 / 70	System A is not used for ED3N-1, ED3N-2 and ED3N-3, refer to **Section 2.4.2.1.1**. The OER for the surface spray evaporators has not been quantified in the 11th IOA, as their contribution is considered negligible in the context of other on-site emission sources.	
	SC23116	41	2.48			
	SC23117	17	1.03			
ED3N-2	SC23118	152	9.2			
	SC23119	41	2.48			
	SC23120	49	2.97			
ED3N-3	SC23121	49	2.97			
	SC23122	16	0.969			
	SC23123	23	1.39			
ED3N-4	SC23124	49	2.97		1,940 / 3,017	7,770 / 12,100
	SC23125	38	2.3			
	SC23126	41	2.48			

^ Mechanical evaporation rate is based on 20% / 30% evaporation efficiency per evaporator.
^^ The natural evaporation rate is based on the mean evaporation rate recorded between May 2007 to June 2012, refer to **Appendix C**.
^^^ Based on four active and identical evaporators as is the current mode of operation, at an operating performance of 225L/min.
^^^^Surface spray & ring main evaporation systems not included in calculation.

Table 6.7 – LOM derived odour emission rates for natural evaporation methods: As collected on 23 February 2023 ^^^^

Sample Location	TOU Sample Number	Odour Concentration (ou)	Calculated Liquid Odour Potential (ou/mL)	Current Surface Area (m^2)	Natural Evaporation rate (mm/month) ^^	Mean Odour Emission Rate ($ou.m^3/s$)
ED1 Stormwater/AMD	SC23130	16	0.969	400,000	92.67	13,700
	SC23131	16	0.969			
ED1 Coffer Dam	SC23132	16	0.969	62,072		2,120
	SC23133	16	0.969			
ED3N-1	SC23115	76	4.6	7,500		716
	SC23116	41	2.48			
	SC23117	17	1.03			
ED3N-2	SC23118	152	9.2	7,018		1,210
	SC23119	41	2.48			
	SC23120	49	2.97			
ED3N-3	SC23121	49	2.97	6,997		438
	SC23122	16	0.969			
	SC23123	23	1.39			
ED3N-4	SC23124	49	2.97	41,026		3,740
	SC23125	38	2.3			
	SC23126	41	2.48			
ED3S1	SC23134	16	0.969	81,254		2,780
ED3S2	SC23127	54	3.27	21		1,940
	SC23128	42	2.54			
	SC23129	32	1.94			
MBT: Leachate dam	SC23135	19	1.15	3,545		n/d
	SC23136	45	2.72			
MBT: V drain	SC23137	38	2.3	800		n/d
	SC23138	45	2.72			

^ Mechanical evaporation rate is based on 20% / 30% evaporation efficiency per evaporator.
^^ The natural evaporation rate is based on the mean evaporation rate recorded between May 2007 to June 2012, refer to **Appendix C**.
^^^ Based on four active and identical evaporators as is the current mode of operation, at an operating performance of 225L/min.
^^^^Surface spray & ring main evaporation systems not included in calculation.
n/d = not determined, refer to **Section 2.6.5.1**

6.1 COMMENTS ON RESULTS

The following sections comment on the results presented in **Table 6.1**, **Table 6.2**, **Table 6.3**, **Table 6.4**, **Table 6.5**, and **Table 6.7**.

6.1.1 The Void Samples

The following comments are made based on the Void samples collected in the 11th IOA:

- The sampling locations inside the Void have been nominally shown in **Figure 6.1**. The sample numbers presented in **Figure 6.1** correspond with those in the sampling location column in **Table 6.1**. The conditions prevailing in the Void at the time of the 11th IOA are presented in **Photo 6.1**;

- As presented in **Table 6.2**, the mean SOER results for the ATF (SC23111 – SC23114) in the 11th IOA is 1.25 ou.m^3/m^2.s, representing a slight decrease since the 10th IOA (2.20 ou.m^3/m^2.s). The odour character of the ATF samples collected in the 11th IOA was reported as 'garbage, vanilla, pineapple', representing a similar finding from previous IOAs, with an increase in ester formation. Based on previous IOA results for this source, this variation is considered to reflect normal variation from the ATF activity inside the Void; and

- The WCA samples (SC23102 – SC23110) were collected from the waste covered areas across the Void surface profile at strategic locations designed to provide a representative quantification of the general emissions from the Void at the time of sampling. This includes:

  - Intermediate cover and capped area;

  - Known problematic fugitive emission pathway at the north-eastern corner of the Void perimeter covered with biocover material (SC23104-SC23105);

  - Spatial and visual variability across the surface profile; and

  - The SOER results are low (less than 0.16 ou.m^3/m^2.s) and suggest fugitive emission release and cover conditions at the sampled locations were effective at the time.

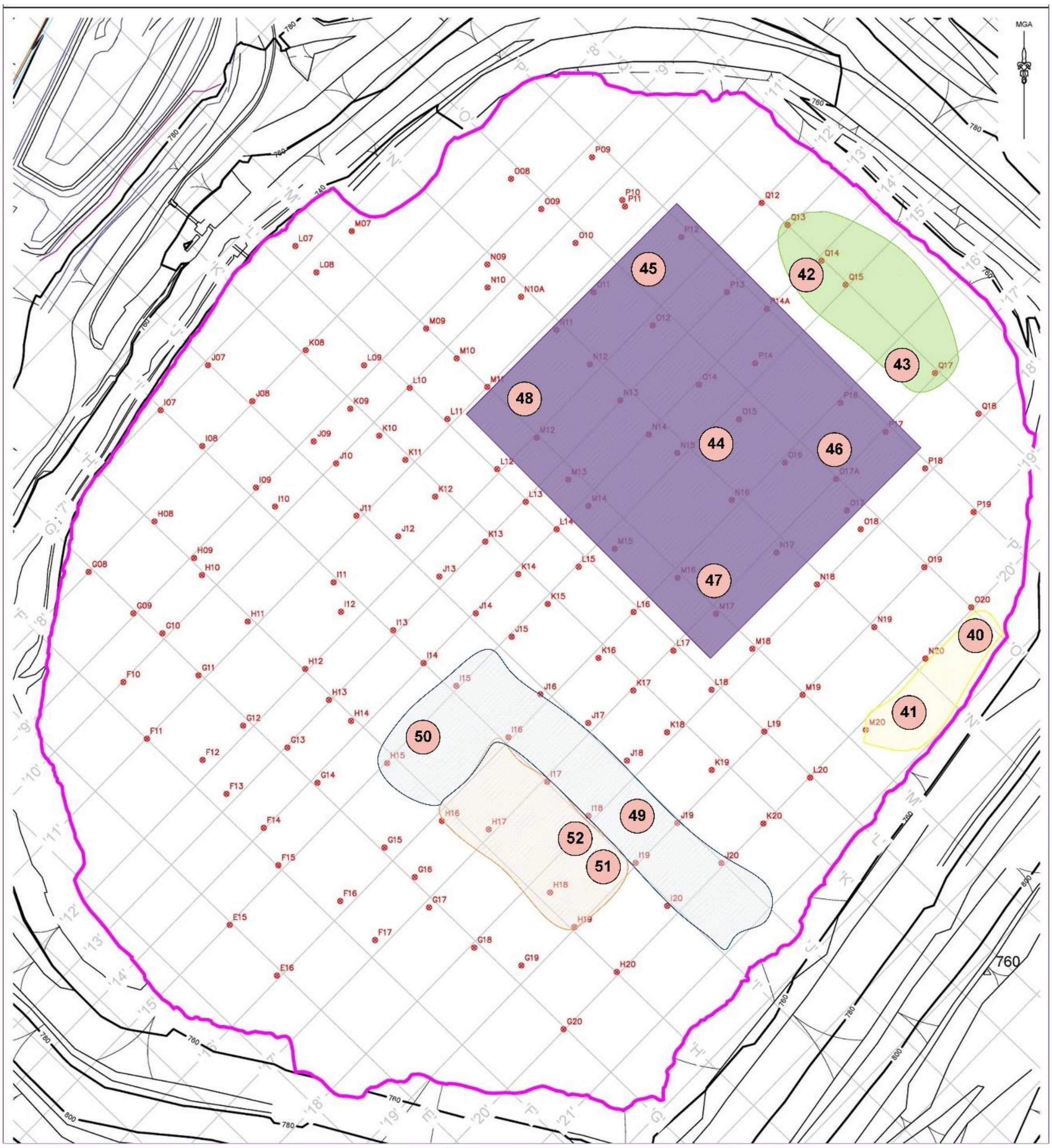


Image reproduced from the Woodlawn Bioreactor Landfill Monitoring Bore Locations (**Drawing 16700-245**) which was supplied by Veolia

Legend

- Sample location and number
- Active tipping face (ATF)
- Bio-Cover (BC)
- Daily cover (DC)
- Capping cover (CC)
- Intermediate cover (IC)

Figure 6.1 - Nominal sampling locations within the Void: 11th IOA

Photo 6.1 – Conditions prevailing in the Void during the 11th IOA on 23 February 2023

6.1.2 Pond Source Samples – ED3N Pond System

The following comments are made based on the ED3N Pond System samples collected in the 11th IOA:

- All samples from the ED3N system were collected from the bank of the dams. The nominal sampling locations are shown in **Figure 6.2**;
- All samples collected and tested from ED3N-1 and ED3N-3 (SC23078 - SC23079, SC23082 - SC23083) were found to be below the EA 2010 SOER model inputs;
- All samples collected and tested form ED3N-2 and ED3N-4 (SC23080 – SC23081, SC23084 – SC23085) were found to be above the EA 2020 SOER model inputs; and
- The SOER for ED3N-2 and ED3N-4 represents a higher than historical average when compared to results obtained in previous IOAs and exceeds the EA 2010 SOER model inputs.

6.1.3 Pond Source Samples – ED3S1 Pond System

The following comments are made based on the ED3S1 Pond System samples collected in the 11th IOA:

- No leachate is stored in ED3S1 Pond System;
- A gas and liquid sample were collected from this source for testing by LOM (refer to **Table 6.1** and **Table 6.7,** respectively);
- The measured SOER was below the EA 2010 SOER model inputs. It is noted that NSW EPA is concerned that the stormwater from the landfill void that is stored in ED3S1 may have come into contact with waste. Based on the previous IOA results and the 11th IOA (refer to **Table 6.2**), there was no evidence of a measurable impact (or change of liquor quality) to demonstrate this occurrence from an odour emissions perspective; and
- In previous IOAs, it has been consistently shown to be a negligible source at the Woodlawn Facility. However, this may change if this area is converted to a wet weather contingency dam for stormwater diversion during high rainfall periods (refer to **Section 2.5**).

6.1.4 Pond Source Samples – ED3S2 Pond System

The following comments are made based on the ED3S2 Pond System samples collected in the 11th IOA:

- The SOER input from the LMS May 2016 Report used a SOER of 0.159 ou.m^3/m^2.s for the modelling of ED3S2. The mean result derived from the 11th IOA is 0.661 ou.m^3/m^2.s (refer to **Table 6.2**). This result is above the modelled input value and has been further evaluated as part of the dispersion modelling results documented in **Section 8.5**).

6.1.5 Pond Source Samples – ED1 Stormwater/AMD System

The following comments are made based on the ED1 Stormwater/AMD system samples collected in the 11th IOA:

- No leachate is stored in ED1 Stormwater/AMD. However, NSW EPA is concerned that overflow received from ED3S1, which could contain stormwater from the landfill void that may have come into contact with waste, had entered the ED1 Stormwater Dam;
- The SOER result was very low and consistent with expectations for stormwater. The measured SOER was also below the EA 2010 SOER model inputs used for ED3S1 (this is the equivalent source and used due to the absence of specific EA 2010 SOER model inputs for this source). It is noted that NSW EPA is concerned that the stormwater from the Void that is stored in ED1 Stormwater/AMD may have come into contact with waste. Based on the 11th IOA (refer to **Table 6.2**), there was no evidence of a measurable impact (or change of liquor quality) to demonstrate this occurrence from an odour emissions perspective; and
- Two samples were collected from the bank of the dam at the nominated locations (at and near Sample ID 1806-11-028).

6.1.6 Pond Source Samples – ED1 Coffer Dam

The following comments are made based on the ED1 Coffer Dam samples collected in the 11th IOA:

- A mentioned in **Section 2.4.6**, given the current water level height, it was possible during the 11th IOA to gain safe access to ED1 coffer dam to enable odour sampling and testing via area source sampling; and
- The SOER results for ED1 Coffer Dam were very low and consistent with expectations for treated leachate.

6.1.7 Leachate Treatment Dam Samples

The following comments are made based on the LTD samples collected in the 11th IOA:

- Both the anoxic and anaerobic zones were sampled as part of the 11th IOA;
- The LTD was found to be operating under sub-optimal operating conditions from an odour emissions perspective at the time of the 11th IOA; and
- The mean SOER result derived in the 11th IOA for the LTD is 30.7 ou.m^3/m^2.s, representing a significant increase since the previous IOA (0.415 ou.m^3/m^2.s). This value is above the EA 2010 SOER value of 3.6 ou.m^3/m^2.s for the LTD and requires further investigation (refer to **Section 10.2.3.1**).

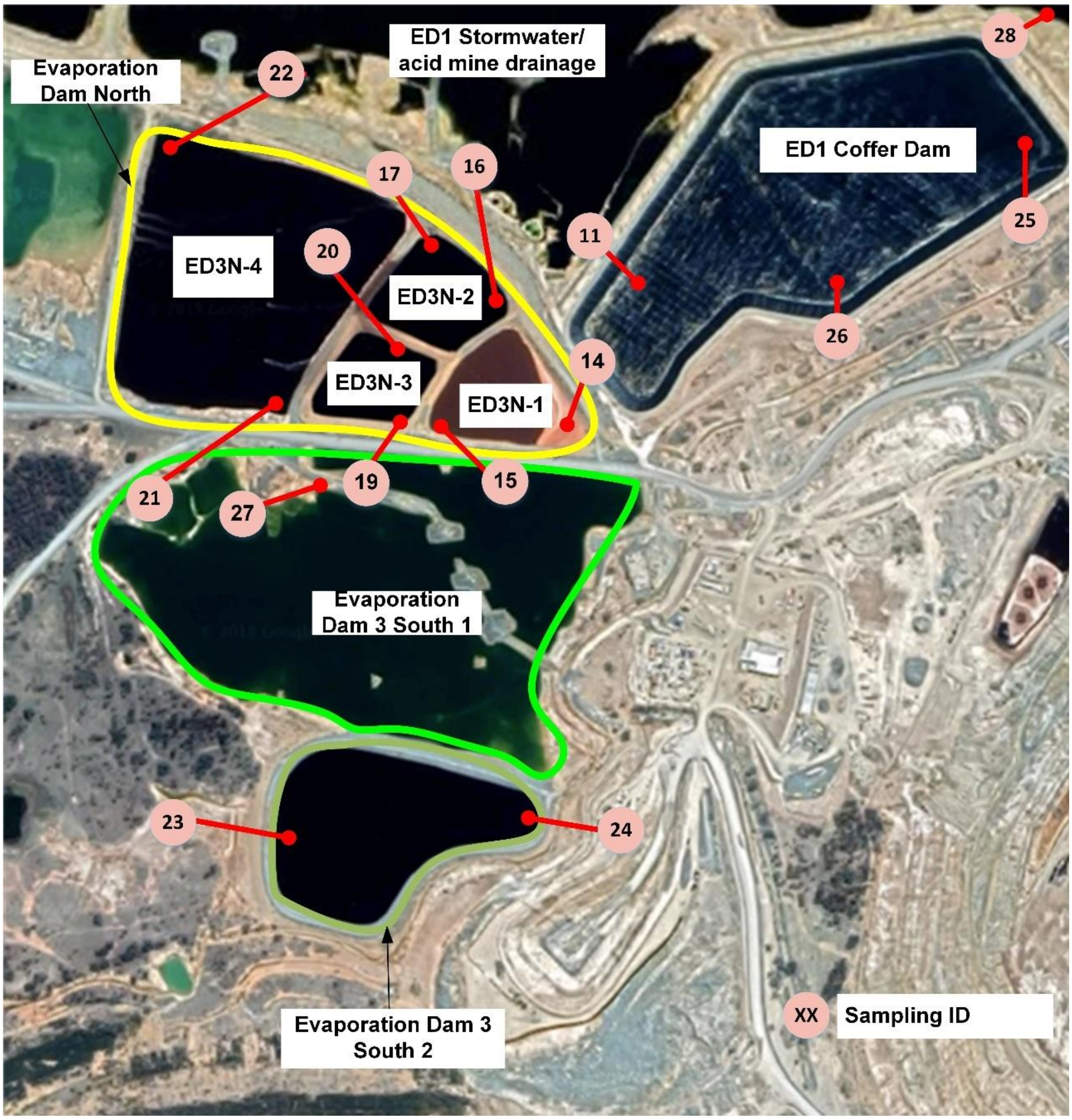


Figure 6.2 – Pond sources nominal sampling locations (1806-11-0XX): 11th IOA

6.1.8 Liquid Odour Measurement Samples

The following comments are made based on the liquid samples collected in the 11th IOA:

- The liquid odour measurement results represent the odour that would be released if the sample were evaporated, either by natural or mechanical means. For the 11th IOA, mechanical and natural evaporation has been used in the calculations. The natural evaporation rate shown is based on the mean rate at the Woodlawn Facility between May 2007 to June 2012;

- An extensive number of liquid samples were collected from ED3N-1, ED3N-2, ED3N-3, ED3N-4, ED3S1, ED3S2, ED1 Stormwater/AMD, ED1 Coffer Dam, and LTP in the 11th IOA. As such, the dataset obtained in the 11th IOA provides a good level of confidence in relation to the leachate quality and odour potential when evaporated;

- The natural evaporation OERs across ED3N, ED3S1, ED3S2, ED1 Stormwater/AMD, and ED1 Coffer Dam are within historical trends from previous IOAs;

- All collected liquid samples analysed via the LOM method were found to be low in odour, but 'ammoniacal, wastewater, musty, rotten, mouldy' odour characters were recorded for some samples, with others indicating only a 'musty' odour character. Despite this finding, a 'musty or muddy water' odour character is typically a reliable indicator of optimum pond/wastewater liquor health and reflects a minimal odour release potential under treated/optimal conditions, even at high OERs (i.e., the odour emission is of a treated quality/neutral odour profile/characteristic);

- The SOERs were elevated from ED3N-2 and ED3N-4 (refer to **Section 6.1.2**). As such, problematic odour emitted from ED3N-2 and ED3N-4 during the 11th IOA is suspected to be caused by other chemical and diffusion pathways that appear not to translate to an odorous release potential circumstance when mechanically or naturally evaporated (as opposed to diffusion/stripping from a wind flux over the surface, reflective of the area source sampling protocol – refer to **Section 4.2**). This likely reflects the complex chemistry of the stored liquor in ED3N-2 and ED3N-4. As such, the continued mechanical evaporation of treated leachate in ED3N, ED3S1, ED3S2, ED1 Stormwater/AMD, and ED1 Coffer Dam is considered to pose a minimal odour risk;

- Overall, the liquid sample results are consistent with previous IOAs and very unlikely to be problematical with respect to mechanical evaporation leading to off-site impacts. The implication of this result is discussed in **Section 9.2.1.8**; and

- A liquid sample from the LTP was collected from the balance tank, anoxic tank, and aerobic tank. All samples were found to have very low odour, indicating that optimal wastewater treatment conditions prevailed during the 11th IOA. Overall, the liquid samples from ED1 Coffer Dam indicate that the LTP was performing in an optimum condition at the time of the 11th IOA, despite being in the process-proving phase and receiving abnormally odorous influent from the LTD.

6.1.9 Landfill Gas Samples

The following comments are made based on the landfill gas samples collected in the 11th IOA:

- 11th IOA determined that it was not necessary to collect an inlet landfill gas sample to the Void based on the testing carried out during the May 2022 Emissions Testing Report and October 2022 Emissions Testing Report (refer to **Appendix C**).

6.1.10 MBT Facility

The following comments are made based on the MBT Facility samples collected in the 11th IOA:

Biofilter System

- The odour testing results for the Biofilter 1 System indicated a lower inlet odour emission rate compared to the 10th IOA (83,300 ou.m^3/s to 64,600 ou.m^3/s). This is likely reflective of the operating conditions prevailing at the time. The biofilter outlet results were below the desirable performance target of 1,000 ou or less, however inlet process character (garbage) was detected;

- The odour testing results for the Biofilter 2 System indicated a substantially higher inlet odour emission rate to the 10th IOA (25,600 ou.m^3/s to 129,000 ou.m^3/s). This is likely reflective of the operating conditions prevailing at the time. The Biofilter 2 System outlet results were above the desirable performance target of 1,000 ou or less. At the time of sampling, Biofilter 2 System bed moisture and inlet RH levels were low and further optimisation is required to improve performance;

- The effect of operating circumstances as found in the 11th IOA has meant that the biofilter outlet emissions are higher than the desirable target or the outlet character continues to consist of the inlet character; and

- The OERs are based on the measured inlet airflows to Biofilter System 1 and Biofilter System 2, i.e., 64,600 m^3/hr and 123,000 m^3/hr, respectively. These airflows are 20% and 30% below the design airflow limit of 81,200 m^3/hr and 175,500 m^3/hr for Biofilter System 1 and Biofilter System 2, respectively (refer to **Section 2.6.3**).

MBT Maturation Pad

- The samples from the MBT Maturation Pad were collected to represent the product profile of the stockpile material present at the time, as all stockpiles were mature; and

- The SOER range was between 0.00985 – 0.164 ou.m^3/m^2.s and with expectations for the quality and long-age of the fully matured compost product.

LAP

- The LAP was found to have an average SOER of 0.68 ou.m^3/m^2.s, with all samples reporting an ‘ammonia, rotten’ odour character. Despite the character the SOER is almost an order of magnitude improvement from the SOER of 5.6 ou.m^3/m^2.s measured during the 10th IOA; and

- The LOM samples from the Leachate Dam and V-drain indicate a low odour emissions potential when evaporated, which is consistent with the SOERs measured from the gas samples. This potential will only result in localised detection of the odour characters (ammonia, rotten). Furthermore, this finding is consistent with the relatively small surface areas, which means that these liquid sources only contribute slightly to the overall emissions profile of the local precinct. This is supported by the dispersion modelling results conducted in the 11th IOA (refer to **Section 8.5**).

7 FIELD AMBIENT ODOUR ASSESSMENT SURVEY

A series of FAOA surveys were conducted as part of the 11th IOA. It is understood that the completion of these FAOA surveys was required at specific times over the course of the 11th IOA, as requested by NSW EPA. Specifically, the FAOA surveys were required to be undertaken during the following time periods:

- Morning;
- Afternoon; and
- Evening.

Due to unfavourable wind conditions, the morning survey was unable to be completed. Therefore, a total of two (2) FAOA survey session were conducted during the 11th IOA.

The FAOA surveys are beneficial in assessing any potential fugitive emission release from the Bioreactor & MBT Facility operations and their impact off-site, particularly when conducted during these hours. The FAOA were conducted on 20 February 2023. All surveys were carried out by calibrated and experienced TOU field assessors. The following section summarises the methodology and results from the FAOA surveys conducted as part of the 11th IOA.

7.1 FAOA SURVEY SCHEDULE

The FAOA survey schedule undertaken for the 11th IOA is summarised in **Table 7.1**.

Table 7.1 – FAOA survey schedule as completed in the 11th IOA

FAOA Survey Session No.	Survey Date	Survey Time
1 of 2	20 February 2023	Afternoon, 1440 hrs – 1617 hrs
2 of 2	20 February 2023	Evening, 2020 hrs – 2137 hrs

7.1.1 FAOA Survey Operating Conditions

The operating conditions prevailing during each FAOA survey session conducted as part of the 11th IOA were as follows:

- Afternoon (on 20 February 2023):
  - Bioreactor: business as usual.
  - MBT Facility: business as usual.
- Evening (on 20 February 2023):
  - Bioreactor: business as usual.
  - MBT Facility: business as usual.

7.2 PREAMBLE

At present, no Australian Standard exists for FAOA surveys. Consequently, TOU utilises a method for assessing the ground-level impacts of odour emissions using a modified version of the German Standard VDI 3940 (1993) – '*Determination of Odorants in Ambient Air by Field Inspections'*. This standard prescribes the methods by which field technicians (or assessors) determine, define and document observed ground level odours and the manner in which the determination of these odours is defined in relation to odour character, the frequency of odours observed and the odour intensity of those individual observations as a quantitative scale of measure.

FAOA surveys are considered a valuable odour impact assessment tool as previous experience with ambient odour sampling and subsequent olfactometry testing suggests that accurate and useful ambient odour concentration data is difficult to obtain. This limitation also applies to the adoption of dispersion modelling where there are limitations associated with the practical quantification of all operational emission sources or accidental odour emission release events triggered by upset/atypical scenarios. This ultimately impacts the quality of input emissions data and practical confidence of the modelling predictions (this is of significance to the 11th IOA as documented in **Section 9.4**). Therefore, TOU has adopted a more practical approach based on field ambient odour surveillance measurement surveys. With this method, calibrated and experienced odour assessor/s traverse the general area and downwind surrounds of odour sources in a strategically mapped pattern, assessing the presence, character and intensity of any odours encountered and recording these observations along with wind speed and direction (when applicable). For the FAOA surveys conducted at the Woodlawn Facility, all accessible downwind areas were assessed. The assessed areas were based on the wind conditions prevailing at the time of the FAOA Survey.

7.3 FAOA SURVEY MEASUREMENTS METHODOLOGY

The FAOA Survey measurement methodology as adopted in the 11th IOA is consistent with the guidance provided in the NSW EPA document titled *Guide to conducting field odour surveys* dated June 2022 (the **NSW EPA Odour Guide**). To that end, the techniques employed in the FAOA surveys conducted during the 11th IOA were able to quantify and/or qualify the following:

- Odour intensity:
- Odour character;
- Frequency;
- Extent of odour plume; and
- Likely source of odours detected near and far-field from the Woodlawn Facility.

For the surveys undertaken at the Woodlawn Facility, each TOU assessor spent five minutes at each Measurement Location Point (**MLP**) in order to gauge the effects of any odour impact. Each measurement cycle comprised of thirty (30) individual 'grab' assessments of odour, one every ten seconds for a single measurement cycle of five minutes (representing a truncated measurement interval provided in the NSW EPA Odour Guide – this was undertaken in the interest of enhancing downwind spatial coverage given the limited time period and distance between each MLP). When plotted each grab measurement resulted in a single data point.

Overall, each survey utilised one or two assessors, with each assessor undertaking measurements over the assessment area at different MLPs over the duration of each survey session. The derived results of the surveys were then illustrated visually on odour impact maps.

At each MLP, wind velocity and direction was checked using a vane anemometer. In the event of a positive detection of odour at an MLP, the TOU assessor attempted to evaluate the odour intensity, odour character and likely source (whenever possible). In this way, the FAOA method enables the determination and extent of the impact of odour around the area of interest, rank their intensity and likely source.

7.3.1 Odour Intensity Categories

The ranking scale for the observed off-site odours detected beyond the facility boundary was quantified according to the *German Standard VDI 3940 'Determination of Odorants in Ambient Air by Field Inspections'*. The standard's ranking system is based on the following seven (7)-point intensity scale, as shown in **Table 7.2**.

Table 7.2 - VDI 3882 (Part 1) odour intensity categories

Odour Strength	Intensity Rank (code)	TOU Interpretation (meaning)
Not detectable	0	No odour detected
Very Weak	1	Odour is barely recognisable by someone specifically looking for the odour and is unlikely to be detected at other times
Weak	2	Odour is weak with character and able to be determined with some effort
Distinct	3	Odour is clearly evident and its character is easily identifiable
Strong	4	Odour is strong and readily detectable
Very Strong	5	Odour is very strong
Extremely Strong	6	Odour is extremely strong. This level of odour is more likely to be encountered at its source/site boundary rather than at downwind locations.

The MLP assigned an odour intensity score of '0' (not detectable) were still be recorded in order to outline the presence and extent of the odour present at the MLP. The 'distinct' level is that at which the odour character (e.g. bin juice, fermented garbage, putrid) is clearly definable.

7.3.2 Odour Intensity and Frequency Criterion

Although outside the scope of work for the 11th IOA, and referring to the Odour Intensity Categories listed and described in **Table 7.2** above, a particular odour intensity level can often be linked to a possible odour impact from an assessed facility. This criterion, whether it is Category 2 (Weak) or Category 3 (Distinct), will be dependent upon the sensitivity of the receptor areas, the nature/offensiveness of the odours present, and the frequency of exposure. Odour Intensity Category 1 (very weak) would rarely, if ever, correspond to adverse odour impacts.

As previously mentioned in **Section 7.3**, the FAOA surveys conducted downwind of the Woodlawn Facility resulted in two assessors generating thirty (30) sniffs per measurement cycle per MLP. From this, the data was benchmarked against a suitable frequency impact criterion of 10%, i.e. a positive detection of an odour is measured for more than or equal to 10% of the time (equivalent to three (3) sniffs over five (5) minutes) during the measurement cycle at an odour intensity of 1 or greater. This criterion was selected based on previous FAOA studies conducted by TOU and considered to be the event in which adverse odour impact is likely given the sensitivity of the receiving environment (i.e., the Tarago township).

7.3.3 FAOA Key Odour Descriptors

The odour sources at the Woodlawn Facility originate from the processes occurring in each key area, such as the Void, LMS, and MBT Facility. Based on TOU's extensive experience at the Woodlawn Facility, key odour descriptors were allocated and subsequently standardised to represent the quality of odours detected within the assessed area. The odour descriptors used in the surveys enabled the characterisation of the detected odour/s and determination of likely source by strategically undertaking the surveys upwind, downwind and closer to the Woodlawn Facility boundary, when required.

The definition for each odour character/descriptor used in the FAOA surveys are as follows:

- Odour character A – landfill gas, sulphurous;
- Odour character B – sweet garbage, municipal solid waste; and
- Odour character C – sour, vomit (butyric acid), garbage.

7.3.4 Survey Meteorological Conditions

Ideally, FAOA surveys should be carried out over a range of meteorological conditions, from near-calm to moderate to strong wind speeds, and under differing wind directions. The result of each FAOA survey would then determine the impact range within that assessment area for that survey, and the overall findings represent a broader picture of possible adverse odour impacts. For the FAOA Surveys conducted as part of the 11th

IOA, the focus was on the times of the day when calm to light winds is prevalent, i.e., early mornings and late evenings and cooler temperatures. These meteorological conditions are suspected to be the most problematic based on logged odour complaints.

The general prevailing local wind conditions at the time of conducting the FAOA surveys were broadly calm to moderate speeds with various wind directions encountered. The weather conditions were largely fine, with cloud cover on 20 February 2023.

7.3.5 Recording of Meteorological Conditions

The local meteorological conditions prevailing over the duration of the FAOA surveys were recorded using a Kestrel 4500 Pocket Weather Tracker Anemometer (refer to **Photo 7.1** for an illustrated setup). At each MLP assessed, the assessors would set up the anemometer apparatus enabling a grab measurement of wind speed and direction at an MLP. This was undertaken during every survey at each MLP.

Photo 7.1 - Illustrated setup of the Kestrel Anemometer apparatus in operation (**Source**: TOU)

7.3.6 Interpretation of Survey Findings

Each map plot result consists of several features. These are generally depicted on a pie chart and wind vane indicator on each map plot. The features include:

- A measurement location point (**MLP**): these are strategic points on the map that were designed to enable assessors to pursue upwind and downwind effects from the Woodlawn Facility;

- Location wind conditions: the local wind direction and speed at each MLP have been indicated by a yellow arrow. In the event a wind direction has not been indicated, the conditions at the time were calm (i.e., < 0.5 m/s) and wind direction was unable to be accurately determined. The recorded wind conditions at each

MLP may have varied at the time of the assessment from the prevailing wind conditions that existed in the general Tarago precinct recorded by local meteorological stations. Given the complex meteorological dynamics that can occur arising (such as local terrain, topography, katabatic channelling, and effects from natural and built environments) affecting wind direction and speed, the local wind conditions experienced at some MLP varied from the prevailing wind condition; and

- Odour descriptors: at each MLP where a measurement cycle is undertaken, key parameters are recorded where an odour is detected. The key descriptors shown on the maps include the intensity of odour (how strong the smell is) based on the VDI 3882 German Odour Intensity Scale. In addition, the odour character is also recorded based on an odour character inventory developed by TOU to describe the range of odours encountered throughout the course of the surveys.

7.4 FAOA SURVEY RESULTS

The FAOA survey results are presented on odour impact map plots, as follows:

- FAOA Survey Map Plot 1 – Session 1 (Afternoon): 20 February 2023 between 1440 hrs and 1617 hrs; and

- FAOA Survey Map Plot 2 – Session 2 (Evening): 20 February 2023 between 2020 hrs and 2137 hrs.

7.4.1 Commentary on FAOA Results

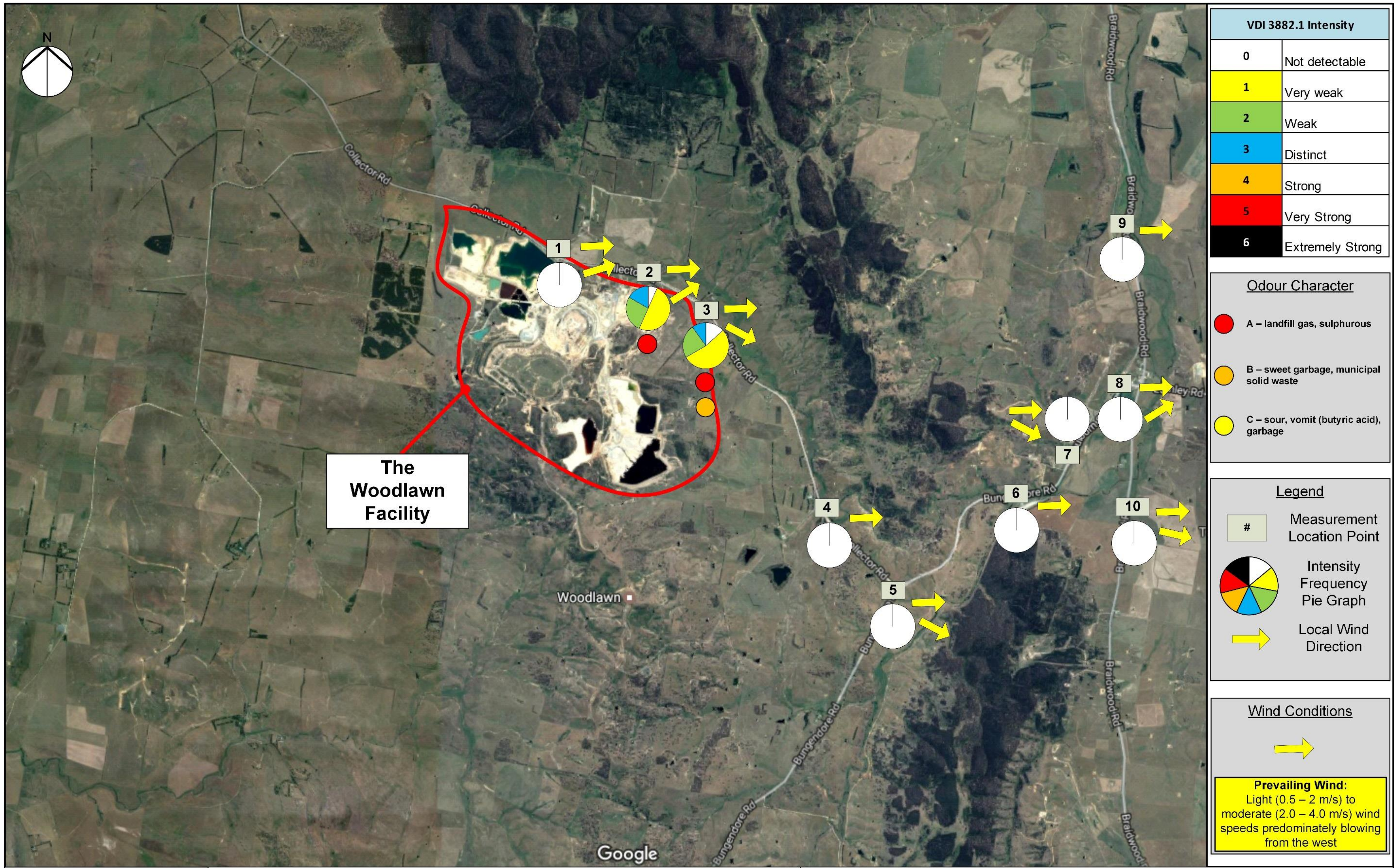
Based on the FAOA survey map plot results, the following comments are made:

- FAOA Survey Map Plot 1: Very weak (1) to Distinct (3) 'landfill gas, sulphurous', 'sweet garbage, municipal solid waste' and odours were detectable along Collector Road. The likely source was determined to be the Woodlawn Facility, specifically the Bioreactor operations based on the detected odour markers; and

- FAOA Survey Map Plot 2: Very weak (1) to distinct (3) 'landfill gas, sulphurous', 'sweet garbage, MSW' and 'sour, vomit (butyric acid), garbage' odours were intermittently detectable from a narrow plume crossing at Taylors Creek Road. The likely source was determined to be the Woodlawn Facility, likely from either the Bioreactor and/or MBT Facility operations based on the detected odour markers.

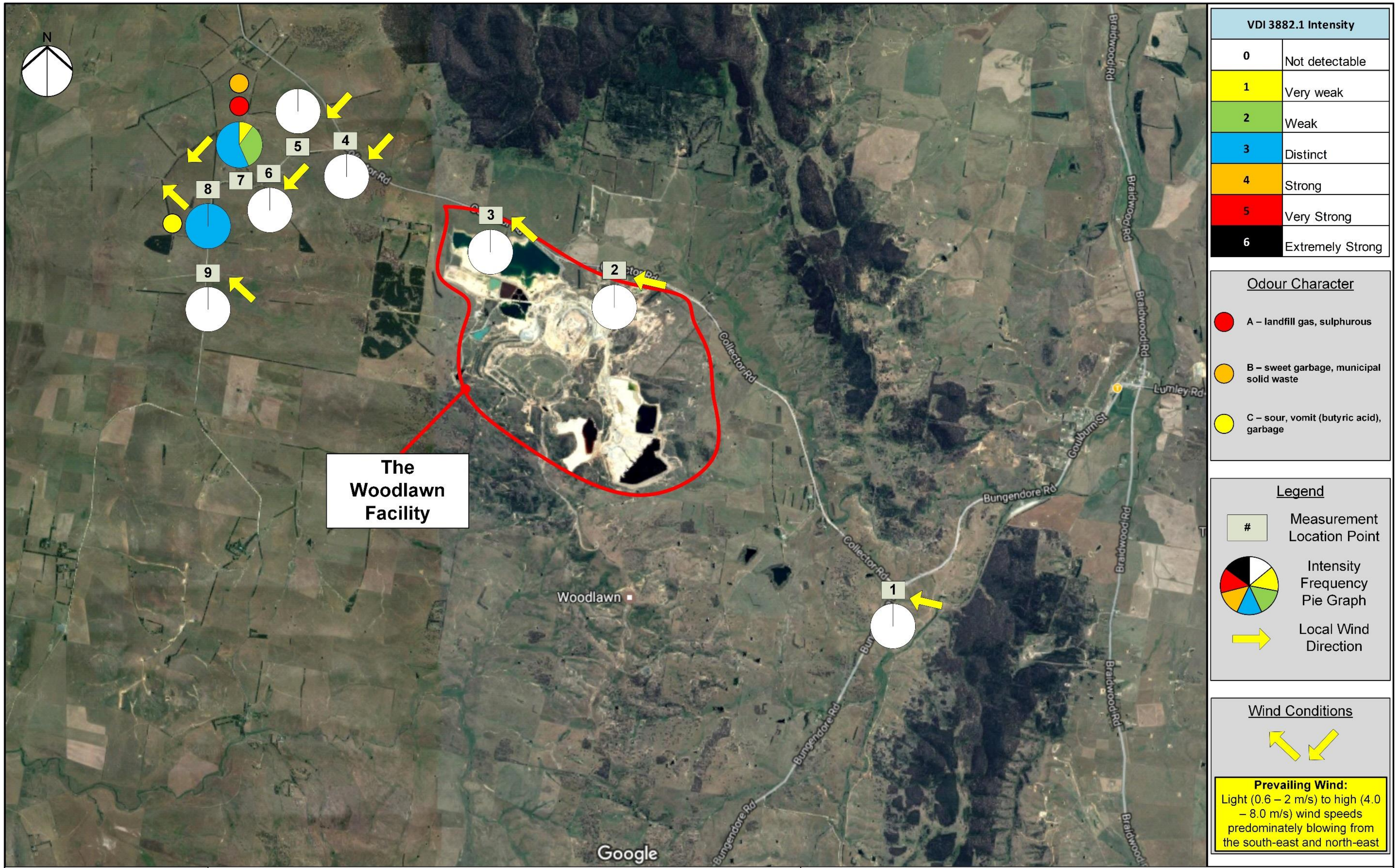
7.4.2 FAOA Survey Concluding Remarks

Overall, the FAOA surveys identified odour that can be traced back to the Woodlawn Facility at modest distances in the 11th IOA. The predominate odour types (Odour Character A, Odour Character B, and Odour Character C (i.e., 'landfill gas, sulphurous', 'sweet garbage, MSW', and 'sour, vomit (butyric acid), garbage', respectively) that were detectable during the FAOA surveys under the prevailing operations were likely emanating from the Void surface and detectable at Very Weak (1) and Distinct (3) odour intensities Based on the derived odour measurements and extensive experience gained by the 11th IOA team of the Woodlawn Facility (and at other landfill operations), this odour is likely related to fugitive gas emission pathways originating from the surface of the Void, which is judged to be the major contributor to the risk of odour emission release from the Void. This supports Veolia continued strategies as documented in the WIP 2020 and WIPS5 2022 (refer to **Section 10.2.4**) and previous audit recommendations promoting striving for operational excellence and continuous improvement in this area (particularly with respect to leachate and landfill gas extraction as well as stormwater diversion).



THE ODOUR UNIT	Veolia Woodlawn – Odour Audit #11 Field Ambient Odour Assessment Survey Session 1 of 2 – Afternoon Odour Impact Map	**Field Ambient Odour Assessment Survey** Session Date: 20/02/2023 Session Time: 1440 hrs – 1617 hrs Area: 1 Odour Impact Criterion: Intensity ≥ 1 Frequency ≥ 10% Drawn By: M. Gilbert Revision: 2 Drawn Date: 29/03/2023

FAOA Survey Map Plot 1 – Session 1 (Afternoon): 20 February 2023 between 1440 hrs and 1617 hrs



THE ODOUR UNIT	Veolia Woodlawn – Odour Audit #11 Field Ambient Odour Assessment Survey Session #2 of 2 – Evening Odour Impact Map	**Field Ambient Odour Assessment Survey** Session Date: 20/02/2023 Session Time: 2020 hrs – 2137 hrs Area: 1 Odour Impact Criterion: Intensity ≥ 1 Frequency ≥ 10% Drawn By: M. Gilbert Revision: 2 Drawn Date: 29/03/2023

FAOA Survey Map Plot 2 – Session 2 (Evening): 20 February 2023 between 2020 hrs and 2137 hrs

8 ODOUR MODELLING ANALYSIS

8.1 PREFACE

As part of the scope of work for the 11th IOA, TOU was requested to deliver a re-run of the Woodlawn Facility-specific odour dispersion model initially done in the EA 2010 with the current operational factors and odour audit emissions data. As mentioned in **Section 9.4**, the purpose of the re-run is to demonstrate compliance with the modelling-based, project-specific odour performance goal of 6 ou and *Condition 7 (F)* of the 11th IOA requirements.

8.1.1 Relevant Modelling Background Information

To enable the undertaking of the modelling re-run, TOU was supplied the original odour dispersion model used in the EA 2010 developed by the former Heggies Pty Ltd, now operating under SLR Consulting. TOU updated the original CALMET meteorology for its initial assessment of the addition of the ED3S dam to the leachate management system (refer to the LMS May 2016 Report). The preparation methodology has been reproduced in **Section 8.3**. The original configuration and odour emission rates can be found in *Section 5* of the EA 2010 titled *Odour and Dust Impact Assessment (Rev 5) Report* dated 2 August 2010 (the **Previous Model**).

8.1.2 Scope of Works

The scope of the 11th IOA required the update of the 10th IOA odour dispersion model with current operational factors and emissions data measured as part of the 11th IOA. This involved the modification and removal of odour sources from the 10th IOA odour dispersion model to best represent the present operations during the 11th IOA period. The following section details the methodology and findings of the odour modelling analysis as completed in the 11th IOA for the Woodlawn Facility.

8.2 ODOUR DISPERSION MODELLING METHODOLOGY

8.2.1 Odour Emissions Testing Results Summary

The results of the odour emissions testing carried out for the 11th IOA containing the source areas, SOERs and OERs are summarised in **Table 8.1.** The tabulated odour emission inventories for the EA and each of the annual odour audits, along with the individual sample results for the current and previous odour audits, can be provided upon request. The exclusion for the modelling exercise is as follows:

- The contribution of the spray evaporation system (as described in **Section 2.4.2.1**) and reported in **Table 6.6**. There is no evidence to suggest that mechanical spray evaporation is a problematical activity from an odour viewpoint, given the outcome of the LOM analysis undertaken in the 11th IOA (refer to **Section 6.1.8**).

Location^	Area (m^2)	SOER ($ou.m^3/m^2.s$)	OER ($ou.m^3/s$)	Comments
ED3N-1	7,500	0.146	1,095	Mean value of two (2) samples from the 11th IOA
ED3N-2 & 3	14,000	4.67	65,500	Mean value of four (4) samples from the 11th IOA
ED3N-4	41,000	11.3	464,000	Mean value of two (2) samples from the 11th IOA
ED3S1	81,300	0.0940	7,640	Previous IOA data used in lieu of the lower result obtained in the 11th IOA for conservatism (i.e., 0.0315 $ou.m^3/m^2.s$ – refer to **Table 6.1**)
ED3S2	21,300	0.661	14,100	Mean value of two (2) samples from 11th IOA
ED1 Coffer	62,100	0.0474	2,940	Mean value of two (2) samples from the 11th IOA
Active Tipping Face	2,000	1.25	2,500	Mean value of four (4) samples from the 11th IOA
Leachate Treatment Dam	4,030	30.7	124,000	Mean value of anoxic and aeration zone samples from the 11th IOA
Waste Covered Area	159,000	0.0688	10,960	75th percentile of 20 samples from previous IOA and the 11th IOA
MBT Maturation Area 1 MSW	1,280	0.0889	114	Mean value of two (2) samples from the 11th IOA
MBT Maturation Area 2 Unused	--	--	--	No stockpiles present.
MBT Maturation Area 3 Unused	--	--	--	No stockpiles present.
MBT Maturation Area 4 FOGO	469	0.371	174	Mean value of two (2) samples from the 11th IOA
MBT Maturation Area 5 Biocap	1,410	0.0258	36	Mean value of two (2) samples from the 11th IOA
MBT Maturation Area 6 FOGO	422	0.0141	6	Mean value of two (2) samples from the 11th IOA
MBT Leachate Aeration Pond	3,550	0.682	2,420	Mean value of four (4) samples from the 11th IOA
MBT Biofilter 1	--	--	8,060	Sum of measured OER from three (3) samples
MBT Biofilter 2	--	--	43,900	Sum of measured OER from four (4) samples

Table 8.1 – A summary of odour emissions data used in the modelling study

^ excludes ED1 Stormwater/AMD as this does not reflect an odour source nor is applicable to the EA 2010. This is supported by the results obtained in the 11th IOA that should that the off-site impact contribution is negligible (refer to **Section 6.1.5**.).

8.2.2 Odour Source and Emission Rate Configurations

The sources from the previous model used in the 10th IOA had their location and areas corrected (most by minor SOER adjustments), defunct sources were removed, and new sources were added to best represent the present operations reflected in the latest iteration of odour emissions testing for the 11th IOA. The result is illustrated in **Figure 8.1**. The dour sources from the MBT Facility and the LTP are shown in **Figure 8.2** and **Figure 8.3**, respectively. The 11th IOA model source areas and emission rates are provided in **Table 8.2**, respectively.

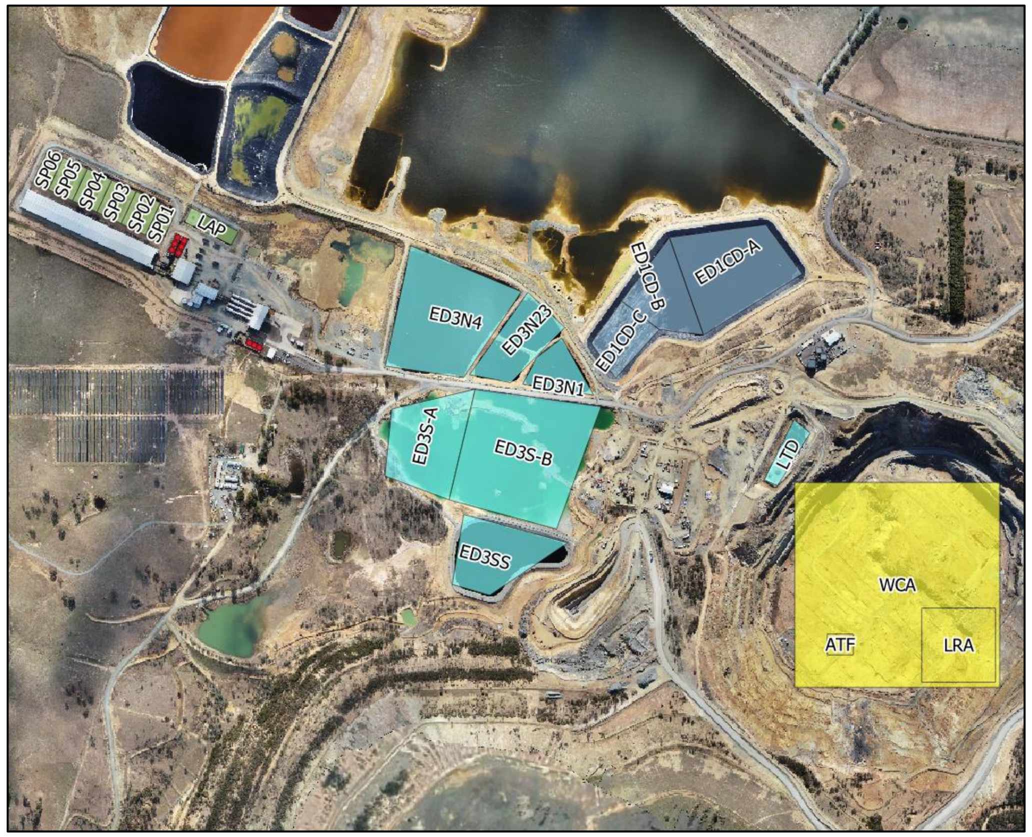


Figure 8.1 – Layout of modelled sources in the 11th IOA

Figure 8.2 – Layout of modelled MBT sources in the 11th IOA

Figure 8.3 – Layout of the modelled LTP sources in the 11th IOA

Table 8.2 – The 11th IOA model source areas and emission rates					
Source ID	**Description**	**Area (m^2)**	**SOER ($ou.m^3/m^2.s$)**	**OER ($ou.m^3/s$)**	**Comment**
Bioreactor and Leachate Evaporation System					
ATF	Active Tipping Face	2,000	1.25	2,500	None.
LRA	Leachate Recirculation Area (ceased)	--	--	--	Leachate recirculation ceased (WIP 2020).
WCA	Waste Covered Area (fugitives)	159,000	0.0688	11,000	None.
ED3N-1	Leachate Evaporation Dam 3 North 1	7,500	0.146	1,100	None.
ED3N-2 & 3	Leachate Evaporation Dam 3 North 2 & 3	14,000	4.67	65,500	None.
ED3N-4	Leachate Evaporation Dam 3 North 4	41,000	11.3	464,000	None.
ED3S	Leachate Evaporation Dam 3 South 1 (Sections A & B)	81,300	0.0940	7,640	Not measured during IOA. Last known measurement used.
ED3SS	Leachate Evaporation Dam 3 South 2	21,300	0.661	14,100	None.
LTD	Leachate Treatment Dam	4,030	30.7	124,000	None.
Sub-total OER				**689,000**	To three significant figures.
MBT Maturation Pad, Leachate and Biofilters					
LAP	Leachate Aeration Pond	3,550	0.682	2,420	None.
SP01	Area 1 MSW Maturation	1,280	0.0889	114	None.
SP02	Area 2 Unused	--	--	--	None.
SP03	Area 3 Unused	--	--	--	None.
SP04	Area 4 FOGO Unscreened	469	0.371	174	None.
SP05	Area 5 Biocap	1,410	0.0258	36	None.
SP06	Area 6 FOGO Screening and Storage	422	0.0141	6	None.
BF1	Biofilter 1 (Cells 1, 2 & 3)	--	--	8,060	None.
BF2	Biofilter 2 (Cells 1, 2, 3, 4, 5 & 6)	--	--	43,900	None.
SUB-TOTAL OER				**54,700**	To three significant figures.
Leachate Treatment Plant					
BT1	Balance Tank 1	227	8.3	1,880	77 h residence time (Note 1)
AX1	Anoxic Tank 1	28	1.9	53	163 h residence time (Note 1)
AX2	Anoxic Tank 2	28	1.37	38	182 h residence time (Note 1)
AE1	Aeration Tank 1	141	0.524	74	238 h residence time (Note 1)
AE2	Aeration Tank 2	141	0.106	15	332 h residence time (Note 1)
ED1CD	ED1 Coffer Dam (Sections A, B & C)	62,100	0.0474	2,940	Sources moved to LTP group.
SUB-TOTAL OER				**5,000**	To three (3) significant figures.
IOA #10 MODEL TOTAL OER				**749,000**	To three (3) significant figures.

Note 1 - SOER of LTP process units in series estimated by exponential decay of measured SOER from LTD to ED1 Coffer Dam (ED1CD) as a function of residence time based on flowrate of 282 m^3/d through the LTP as advised by Veolia.

8.3 ODOUR DISPERSION MODELLING METHODOLOGY

8.3.1 NSW EPA Comments on Woodlawn ARC EIS Modelling Issues

As part of the consultation with DPIE and NSW EPA, it was requested that the 11th IOA note the NSW EPA comments on the modelling issues raised in its submission on the Woodlawn Advanced Energy Recovery Centre (**Woodlawn ARC**) Project Environmental Impact Statement. The most relevant to the 11th IOA were requests for information from the following sections of the NSW EPA submission:

> *"Odour Emissions Inventory*
>
> - *A sensitivity analysis to better understand potential for impacts associated with variable odour emission scenarios and significant odour sources excluded from the assessment.*
>
> - *An update to the odour emissions inventory to include all future odour sources associated with the project including, but not limited to, the proposed leachate evaporation pond located adjacent to the proposed APCr encapsulation cell and potential odours from the storage of waste containers on the hardstand marshalling area."*

TOU note the limitations of and challenges in quantifying odour emissions specifically from the landfill gas fugitive emission pathways from the Void, and variable emissions particularly from the long-term evolution of operational management and environmental conditions (for example, unusually wet weather experienced in February/March 2022). As such, FAOA surveys are routinely utilised to assess potential impacts from unquantifiable fugitive emission pathways and sensitivity of the 11th IOA modelling predictions. Consideration is also given to the circumstances at the time of odour emissions testing on how representative it is of normal/intended operational management conditions.

The intention of the modelling in the 11th IOA is to provide an assessment of comparative scenarios for the measurements of the existing operation against its previous measured state and the original EA 2010 targets. The purpose is not intended to provide an assessment of criterion outcomes typically used for new and modified development applications. Rather, for the 11th IOA, the criterion is used to provide a reference point for comparison. In saying this, TOU support NSW EPA's advice that it does not consider modelling an appropriate means of assessing compliance with *Section 129* of the Protection of the Environment Operations Act for existing facilities on whether the emission of odour is offensive or is being prevented or minimised using best management practices and best available technology.

The other requests for information relevant to the 11th IOA were from the following sections of the NSW EPA submission:

"Meteorology

- *Further evaluation of CALMET model performance including consideration of other evaluation methods (i.e., statistical methods).*

- *Provision of CALMET generated wind fields that capture temporal/seasonal variations in meteorological data and provide confidence that drainage flow, under low wind speed conditions, is being accurately captured by the model.*

- *Demonstration that plume mixing after inversion breakup is being simulated in the model.*

- *An evaluation is required on the vertical component of meteorological modelling data. Available balloon soundings data at weather stations should be considered in the evaluation. This is to include demonstration that the number of vertical levels used in CALPUFF is sufficient to capture plume dispersion given the project includes a tall thermal buoyant source.*

- *A copy of the relevant sections of the referenced Independent Environmental Audit undertaken by Ramboll in 2021.*

- *Information and/or records describing the steps taken to ensure the quality of the EP AWS data.*

- *Details of all input, output and meteorological files used in the dispersion modelling supplied in a Microsoft Windows-compatible format."*

TOU notes the challenges in accurately simulating the local meteorology due to complex geophysical environment surrounding Woodlawn and the lack of suitable surface stations in the vicinity. To facilitate a like-for-like comparison of the 11th IOA predictions with previous modelling predictions, TOU directly used the CALMET meteorological and dispersion model configuration from the EA 2010 for the baseline scenario.

In 2016, TOU updated the original CALMET meteorology for the assessment of the ED3S dam (refer to the LMS May 2016 Report). In doing so, TOU re-ran the EA 2010 model with the updated meteorology and other adjustments to align with approved methods to ensure that like-for-like comparisons of audit predictions with the baseline EA 2010 modelling predictions were maintained under the updated meteorology. TOU acknowledges that it had access to the Woodlawn 'EP AWS' on-site surface station data, however, was not confident enough to include it as metadata and quality records could not be produced at the time. TOU agree with NSW EPA that comparison of observation data from the on-site station with CALMET and The Air Pollution Model (**TAPM**) simulations is not particularly robust and would return almost perfect correlation at the location where observation data had been assimilated.

With respect to representation of vertical layer meteorology, this will not affect the predictions in the 11th IOA as it will almost certainly not influence ground or near-ground level and near-ambient temperature emission sources.

For drainage flow, under low wind speed conditions, interpretation of wind-fields should be treated with caution as what may seem intuitive and aesthetically pleasing on face value, may not be the accurate ground-truth and could risk the model becoming oversensitive to terrain effects from less significant local features and overlooking larger scale effects from more significant regional features.

In the absence of local coverage for quality-assured surface station observation data, TOU supports the use of optimum model settings that are contained and explained within the CALPUFF modelling system guidance document prepared for NSW EPA – refer to **Section 8.3.2** for details.

8.3.2 NSW Odour Criteria and Dispersion Model Guidelines

Regulatory authority guidelines for odorous impacts of gaseous process emissions are not designed to satisfy a 'zero odour impact criteria', but rather to minimise the nuisance effect to acceptable levels of these emissions to a large range of odour-sensitive receptors within the local community.

The odour impact assessment for this project has been carried out in accordance with the methods outlined in the documents:

- NSW EPA Approved Methods;
- NSW EPA Technical Framework; and
- Barclay & Scire, 2011. Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the '*Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'*.

The documents specify that the odour modelling for Level 3 impact assessments, upon which this study has been conducted, be based on the use of:

- The 99.0th percentile dispersion model predictions;
- 1-hour averaging times with built-in peak-to-mean ratios to adjust the averaging time to a 1-second nose-response-time;
- Odour emission rates multiplied by the peak-to-mean ratios as outlined in **Table 8.3**;
- The far-field distance is typically defined as greater than ten (10) times the largest source dimension, either height or width; and
- The appropriate odour impact assessment criterion (**IAC**), based on the population of the affected community near the development.

Table 8.3 – NSW EPA peak-to-mean factors			
Source type	**Pasquill-Gifford stability class**	**Near-field P/M60***	**Far-field P/M60***
Area	A, B, C, D	2.5	2.3
	E, F	2.3	1.9
Line	A-F	6	6
Surface wake-free point	A, B, C	12	4
	D, E, F	25	7
Tall wake-free point	A, B, C	17	3
	D, E, F	35	6
Wake-affected point	A-F	2.3	2.3
Volume	A-F	2.3	2.3

* Ratio of peak 1-second average concentrations to mean 1-hour average concentrations

Source: Environment Protection Authority, 2005 – Table 6.1

The IAC for complex mixtures of odours is designed to include receptors with a range of sensitivities. Therefore, a statistical approach is used to determine the acceptable ground-level concentration of odour at the nearest sensitive receptor. This criterion is determined by the following equation:

$$IAC = \frac{\log_{10}(p) - 4.5}{-0.6}$$

Equation 8.1

where,

IAC = Impact Assessment Criteria (ou)
***p* =** population

Source: NSW EPA titled Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales dated 2022 – *Equation 7.1*

Based on **Equation 8.1**, **Table 8.4** outlines the odour performance criteria for six different affected population density categories. It states that higher odour concentrations are permitted in lower population density applications.

Table 8.4 – Odour IAC under various population densities	
Population of affected community	**Odour performance criterion (ou)**
Urban Area (≥ ~2000)	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤ ~2)	7.0

Source: NSW EPA titled Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales dated 2022 – *Table 18*

The original odour impact assessment contained in the EA 2010 had adopted the IAC of **6 ou** "*given the low number of sensitive receptor locations in the vicinity of the Woodlawn site*". TOU has maintained consistency with this approach as conditions have not significantly changed.

8.3.3 Odour Dispersion Model Selection

The odour dispersion modelling assessment was carried out using the CALPUFF System (Version 7.2.1 Level: 150618). CALPUFF is a puff dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport. CALMET is a meteorological model that produces three-dimensional gridded wind and temperature fields to be fed into CALPUFF. The primary output from CALPUFF is hourly pollutant concentrations evaluated at gridded and/or discrete receptor locations. CALPOST/CALRANK processes the hourly pollutant concentration output to produce tables at each receptor and contour plots across the modelling domain. For further technical information about the CALPUFF modelling system, refer to the document *CALPUFF Modeling System Version 6 User Instructions*.

The CALPUFF system can account for a variety of effects such as non-steady-state meteorological conditions, complex terrain, varying land uses, plume fumigation and low wind speed dispersion. CALPUFF is considered an appropriate dispersion model for impact assessment by NSW EPA in their document - *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales* in one or more of the following applications:

- complex terrain, non-steady-state conditions;
- buoyant line plumes;
- coastal effects such as fumigation;
- high frequency of stable calm night-time conditions;
- high frequency of calm conditions; and
- inversion break-up fumigation conditions.

In the case of this odour modelling study in the 11th IOA, CALPUFF was required to handle the complexity of surrounding terrain features. Under calm and very light winds, non-steady-state conditions such as accumulation of odour and/or downslope movement with drainage airflow would almost certainly occur.

For the odour modelling study in the 11th IOA, the air contaminant was odour and ground-level concentrations in odour units (**ou**) have been projected.

8.3.4 Geophysical and Meteorological Configuration

A CALMET hybrid three-dimensional meteorological data file for Woodlawn was produced that incorporated of gridded numerical meteorological data supplemented by surface observation data, topography, and land use over the domain area.

8.3.5 Terrain Configuration

Terrain elevations were sourced from 1 Second Shuttle Radar Topography Mission (**SRTM**) Derived Smoothed Digital Elevation Model (**DEM-S**). The SRTM data was treated with several processes, including but not limited to removal of stripes, void filling, tree offset removal and adaptive smoothing. The DEM-S was used as input into TERREL processor to produce 20 km by 20 km grid at 0.15 km resolution. A map of the terrain is illustrated in **Figure 8.4.**

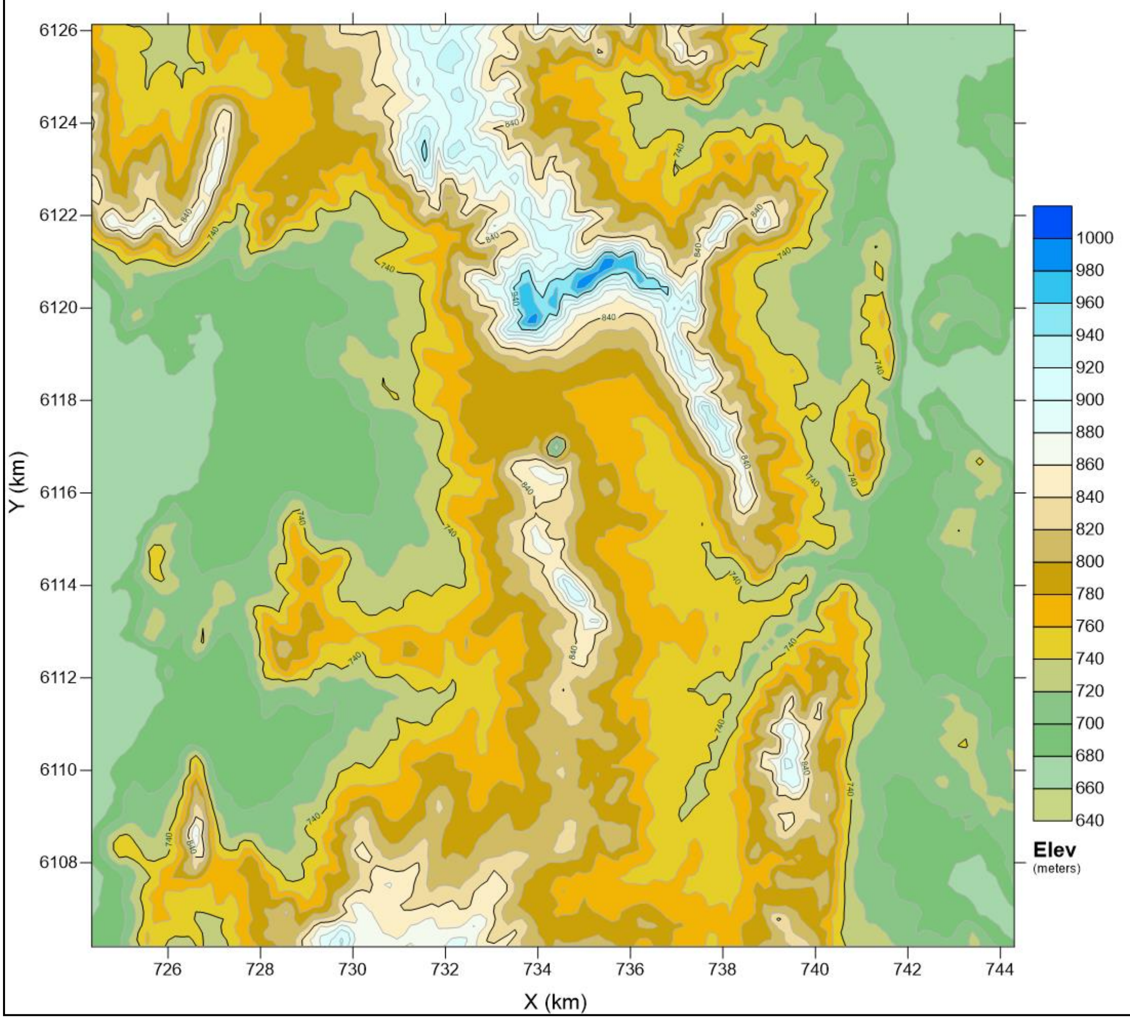


Figure 8.4 - Terrain map of Woodlawn and its surrounds

8.3.6 Land Use Configuration

Land use was sourced from the United States Geological Survey (**USGS**) Global Land Cover Characteristics Data Base for the Australia-Pacific region. The data was used as input into CTGPROC processor to produce a 20 km by 20 km grid at 0.15 km resolution. A map of the land use is illustrated in **Figure 8.5**.

8.3.7 Geophysical Configuration

The geophysical data file was created using the MAKEGEO processor. Land use data from CTGPROC and terrain data from TERREL were used as input to produce a 20 km by 20 km geophysical grid at 0.15 km resolution.

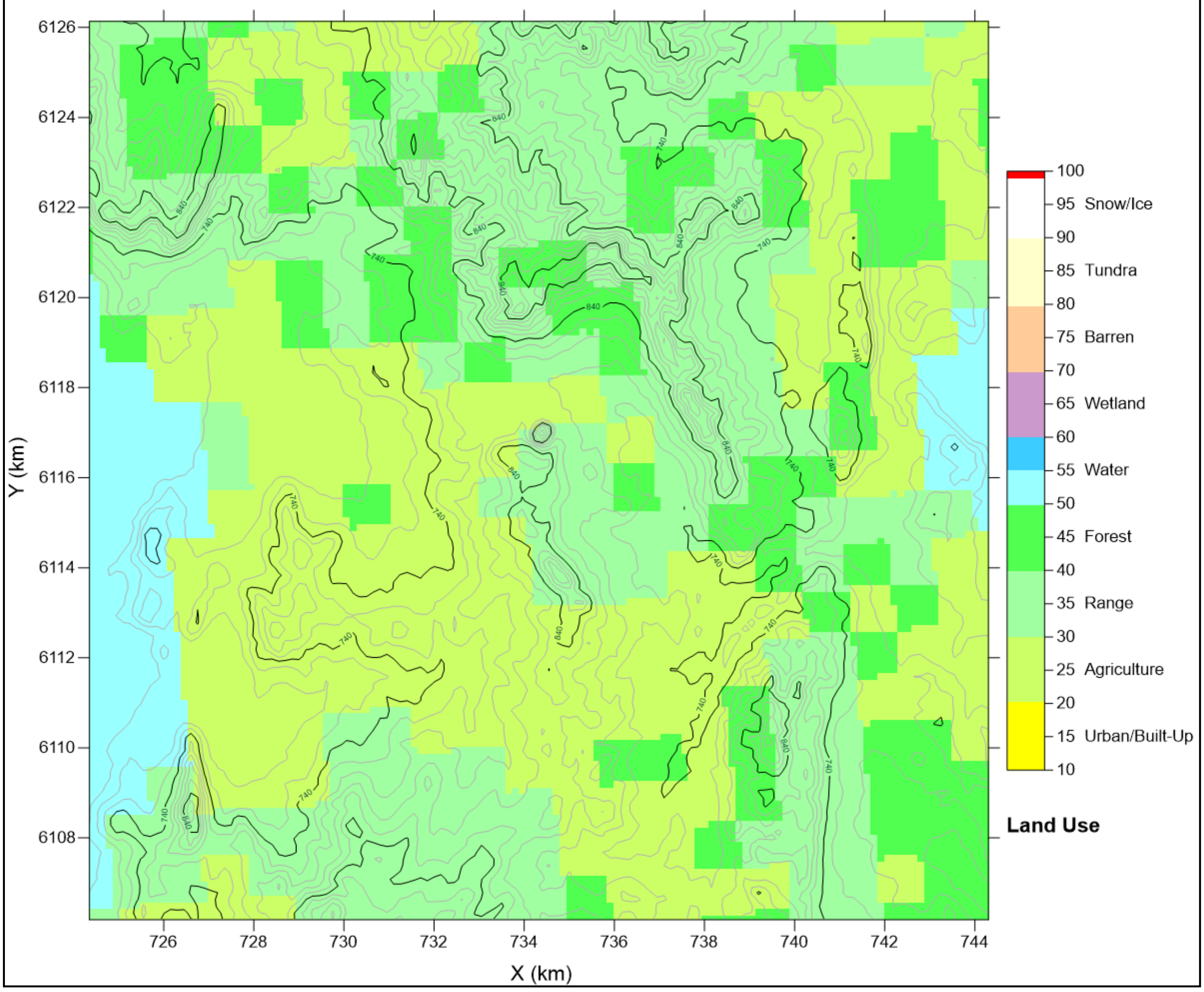


Figure 8.5 – Land use map of Woodlawn and its surrounds

8.3.8 Meteorological configuration

8.3.8.1 Input data

One-hour average observed meteorological surface data for a representative year (2015) was sourced from Goulburn Airport which is maintained by the Bureau of Meteorology (**BOM**). The BOM data was formatted into a generic format and was processed with SMERGE to produce a surface meteorological data file.

Numerical meteorological data was produced as a 3D data tile from TAPM (v4.0.5) and processed it with CALTAPM (v7.0.0) into a suitable format. TAPM was run using multiple nested grids, at least three nests, and 35 vertical levels centred over the

Woodlawn site. TAPM innermost nest was 33 km by 33 km at 1 km resolution. The nested grid resolutions were close to a ratio of three (3) as possible.

8.3.8.2 CALMET Meteorological Model Configuration

CALMET was run using the hybrid option that uses geophysical data, surface station data from Bundaberg Airport and upper-air data from the TAPM 3D data tile. The data was used to initialise the diagnostic functions of the CALMET module to produce a full 3D meteorology data for input into CALPUFF. **Table 8.5** shows the key variable fields selected.

8.3.8.3 Meteorological Data Analysis

Observed 2015 BOM surface data was compared with longer-term climate (2011 – 2015) from Goulburn Airport to gauge how representative and suitable the year is for air quality dispersion modelling. For reference, meteorological data were also extracted from the CALMET model for the location directly near the Woodlawn site office. The annual windroses for Goulburn Airport show very good agreement, with west-to-northwest winds dominating (**Figure 8.6**)**.**

The Woodlawn windroses (**Figure 8.7**) show bias to lighter winds and greater frequency of east-to-south-easterly winds, perhaps due to influences from the nearby valley and ridgelines. A more conservative bias is expected relative to the observations at Goulburn Airport.

Both monthly average (**Figure 8.8**) and diurnal temperature (**Figure 8.9**) profiles for the long term and 2015 are in very good agreement. Diurnal mixing heights and stability class frequencies over the Woodlawn site are shown in **Figure 8.10** and **Figure 8.11**, respectively.

Table 8.5 – CALMET key variable fields

Grid Configuration (WGS-84 UTM Zone 55S)												
134						**NX Cells**						
134						**NY Cells**						
0.15						**Cell Size (km)**						
724.277			6106.107			**SW Corner (km)**						
11						**Vertical Layers**						
ZFACE (m)	0	20	40	80	160	320	640	1000	1500	2000	2500	3000
LAYER	1	2	3	4	5	6	7	8	9	10	11	
MID-PT (m)	10	30	60	120	240	480	820	1250	1750	2250	2750	

Critical Wind Field Settings

Value	Found	Typical	Values
TERRAD	4	None	Terrain scale (km) for terrain effects
IEXTRP	-4	4,-4	Similarity extrap. of wind (-4 ignore upper stn sfc)
ICALM	0	0	Do Not extrapolate calm winds
RMAX1	6	None	MAX radius of influence over land in layer 1 (km)
RMAX2	8	None	MAX radius of influence over land aloft (km)
R1	3	None	Distance (km) where OBS wt = IGF wt in layer 1
R2	4	None	Distance (km) where OBS wt = IGF wt aloft

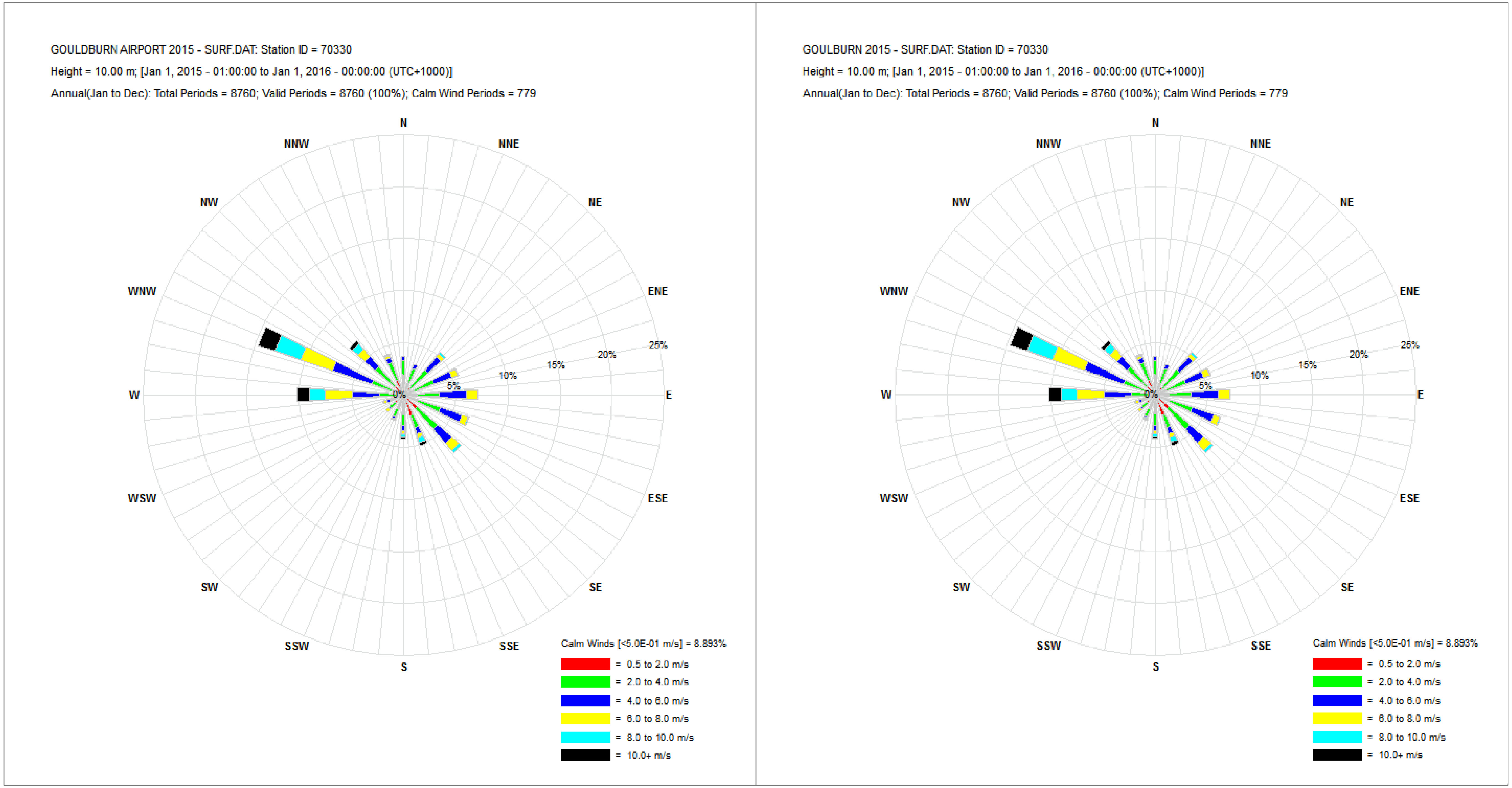


Figure 8.6 – Annual windroses for Goulburn Airport 5 years and 2015 only

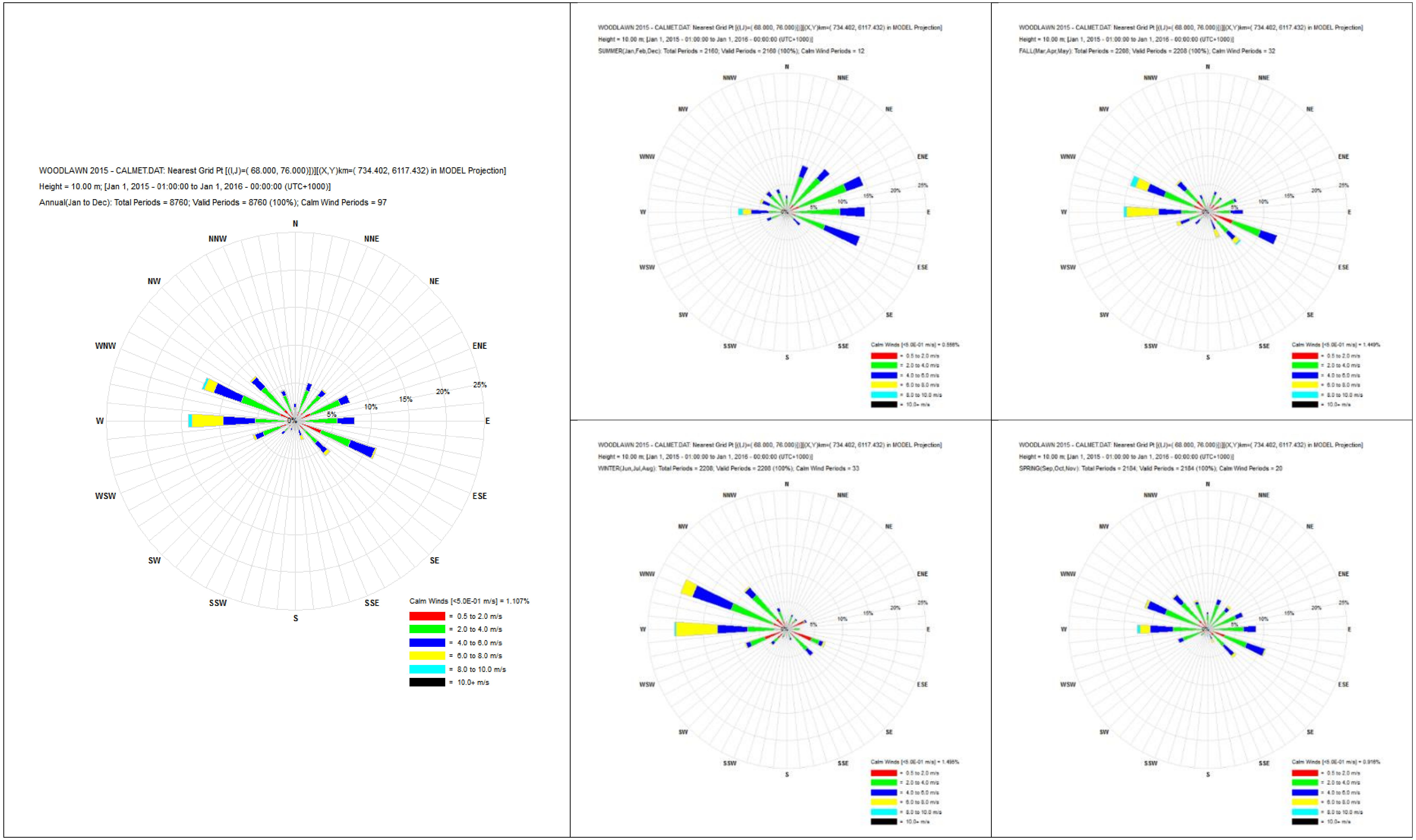


Figure 8.7 – Annual and seasonal windroses for Woodlawn 2015 (modelled)

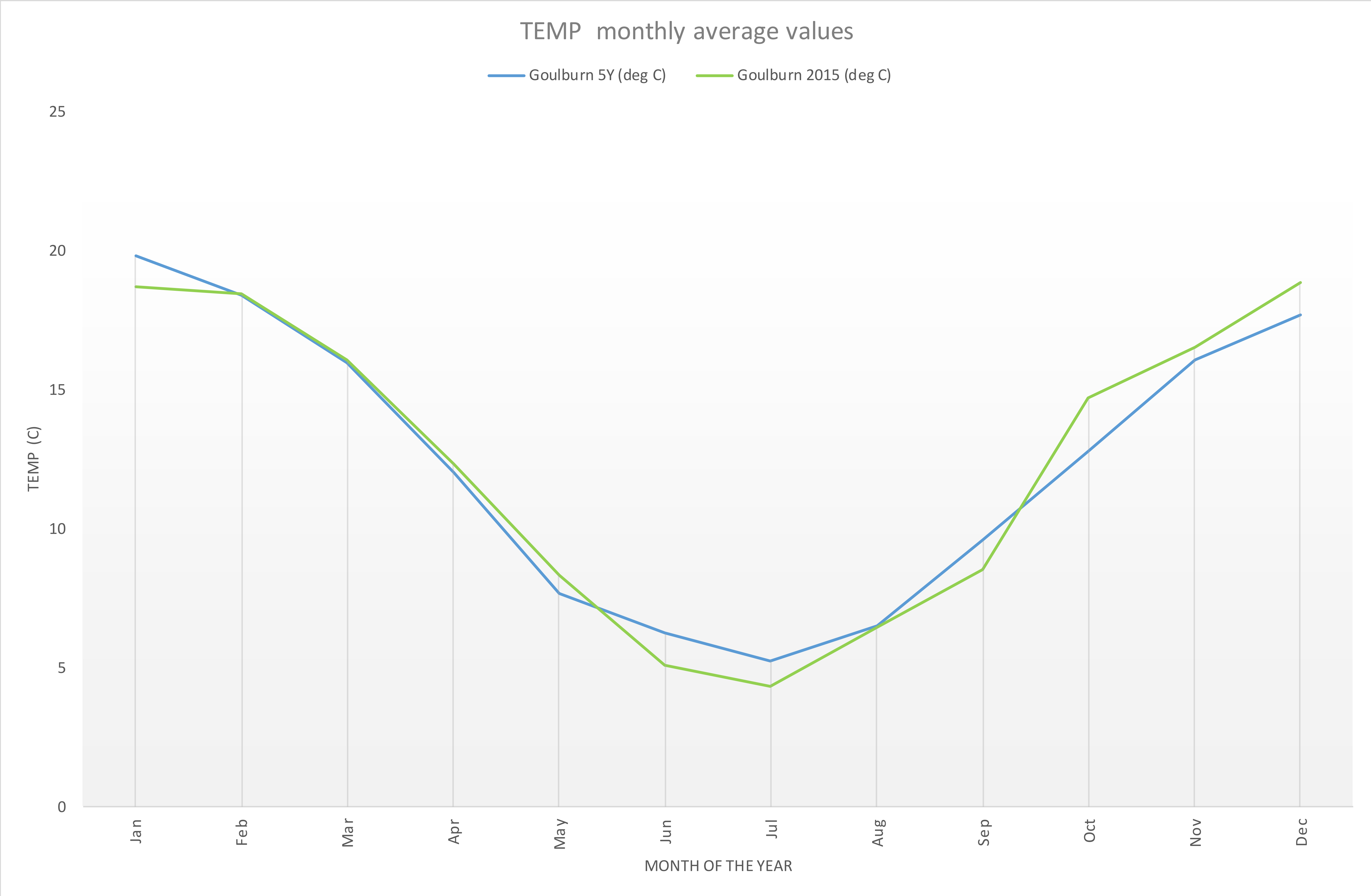


Figure 8.8 – Monthly average temperatures for Goulburn Airport 5 years and 2015 only

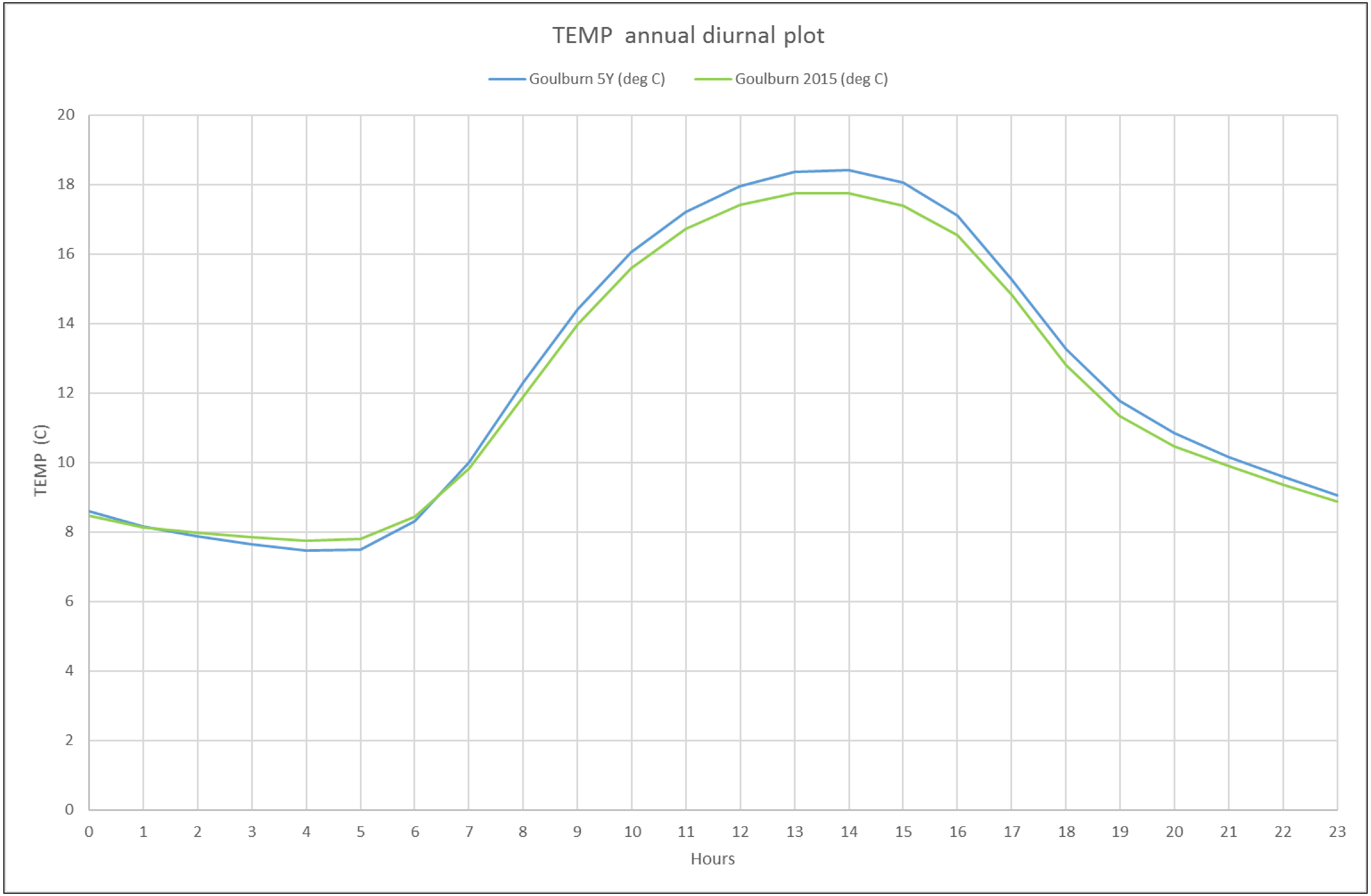


Figure 8.9 – Annual diurnal temperature for Goulburn Airport 5 years and 2015 only

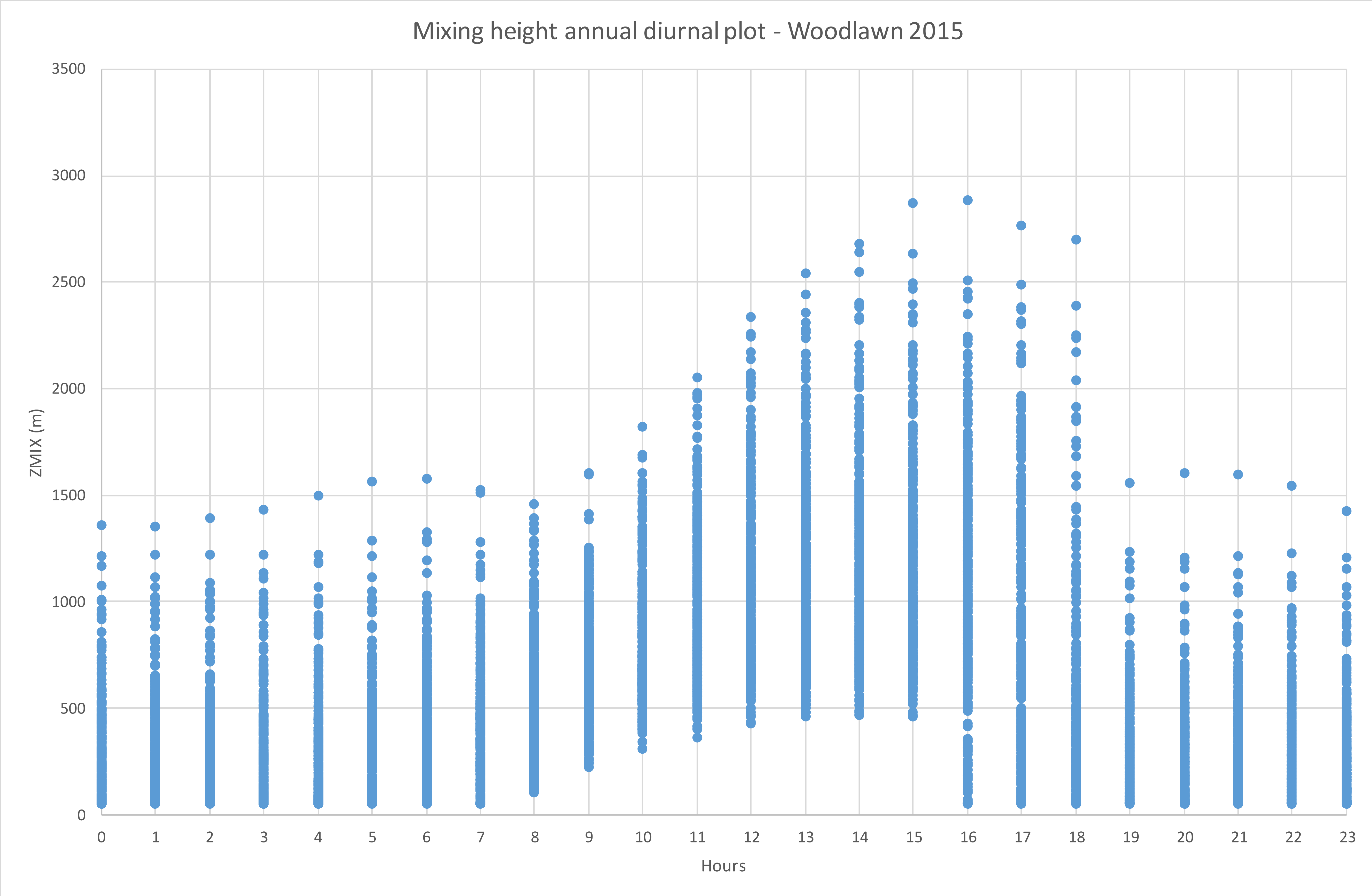


Figure 8.10 – Annual X-Y scatter plot diurnal mixing height for Woodlawn 2015 (modelled)

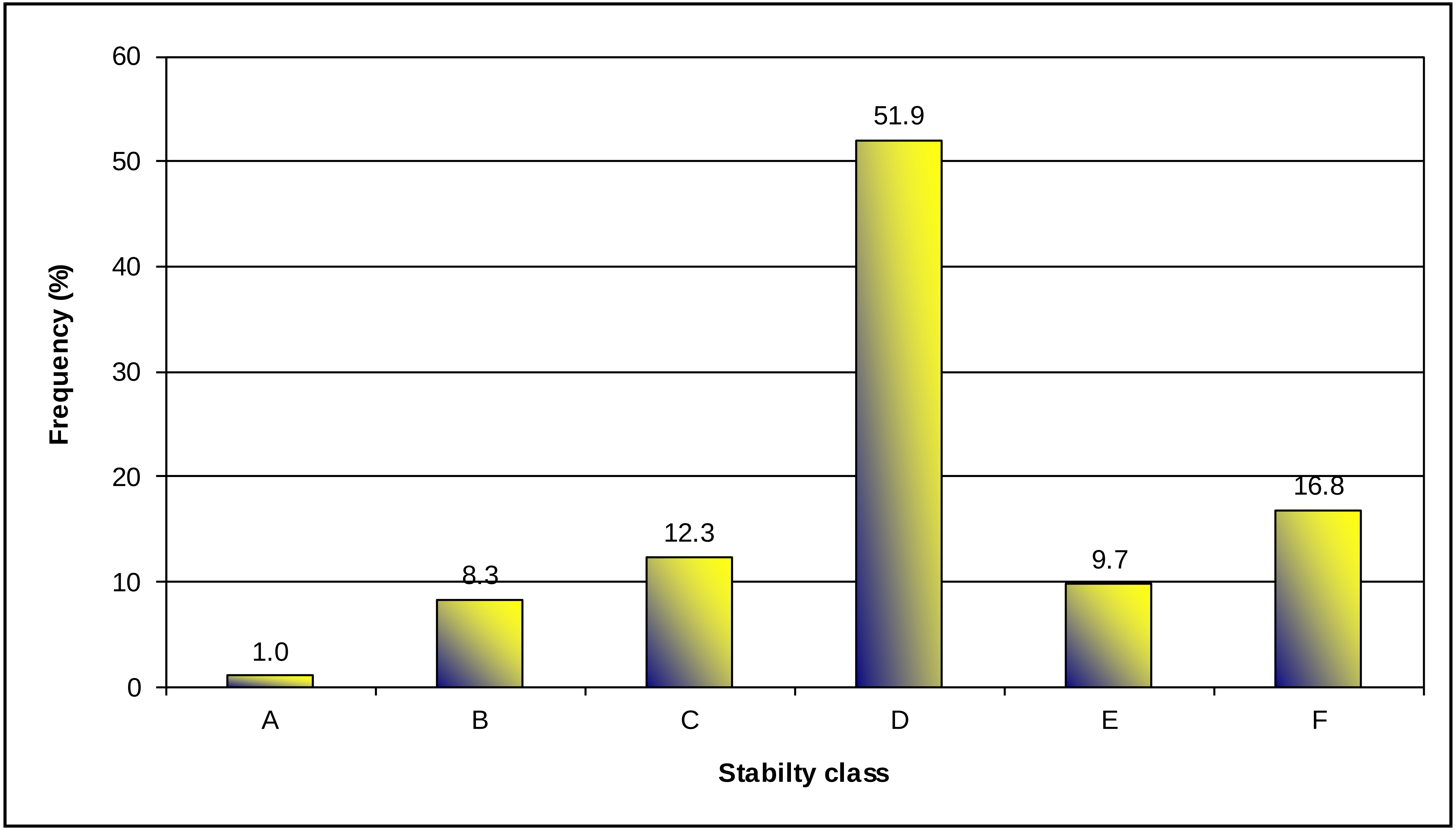


Figure 8.11 – Annual stability class frequency for Woodlawn 2015 (modelled)

8.3.9 CALPUFF Dispersion Model Configuration

8.3.9.1 Computational domain

The computational domain was set to the same parameters as the meteorological domain.

8.3.10 Receptor Configuration

Three groups of arbitrary discrete receptors were configured over the modelling domain. A receptor grid was created with a fine resolution inner nest of 9.6 km by 9.6 km by 0.15 km spacing; and an outer nest of 19.35 km by 19.35 km by 0.45 km spacing. A sensitive receptor was placed over the location of the main dwelling at the Torokina property to the southwest of the Woodlawn Facility operations. The discrete receptors over properties to the north and east of the Woodlawn Facility have been removed from the updated model as they are project-related residences and not considered relevant to the 11th IOA.

8.3.11 Source Configuration and Emission Rates

Full odour source and emission rate configurations are available upon request.

8.3.12 CALPUFF Model Options

CALPUFF default model options were set except for the following as recommended in *Table A*-4 contained and explained within *Barclay and Scire (2011)*:

- Dispersion coefficients (MDISP) = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (2);
- Probability Density Function used for dispersion under convective conditions (MPDF) = Yes (1); and
- Minimum turbulence velocities sigma v for each stability class over land and water (SVMIN) = 0.2 m/s for A, B, C, D, E, F (0.200, 0.200, … , 0.200).

8.4 ODOUR EMISSIONS SCENARIO

The odour emissions scenario used for the modelling was for what was observed during the 11th IOA, except for the Waste Covered Area that used a dataset from the previous 10th IOA and the 11th IOA. This scenario represents TOU's best estimate of total odour emissions from normal operations. This scenario does not consider abnormal conditions or upset events (refer to **Section 7.2** for further commentary and context).

8.5 ODOUR DISPERSION MODELLING RESULTS

The odour dispersion modelling results are visually shown as contour plots that illustrate the contour plot of the ground level odour IAC of 6.0 ou (99%, P/M60) for the following source groups:

- **Figure 8.12** - Predicted odour impact from all odour sources of Woodlawn operations;
- **Figure 8.13** - Predicted odour impact from Bioreactor/Leachate and MBT source groups;

- **Figure 8.14** - Predicted odour impact from Leachate, LTP + ED1CD, and Void source groups; and
- **Figure 8.15** - Predicted odour impact from the MBT Pad + MBT LAP and MBT Biofilter source groups.

The predicted odour concentration at the Torokina property is provided in **Table 8.6** below, which indicates that the ground level odour concentration has increased significantly since the previous model (the previous result was 0.4 ou).

Table 8.6 – Sensitive receptor location and predicted odour impact result: 11th IOA

Receptor	UTM East (km)	UTM North (km)	Elevation (m)	Ground level odour concentration (ou)
Torokina	731.336	6114.923	717	2.5

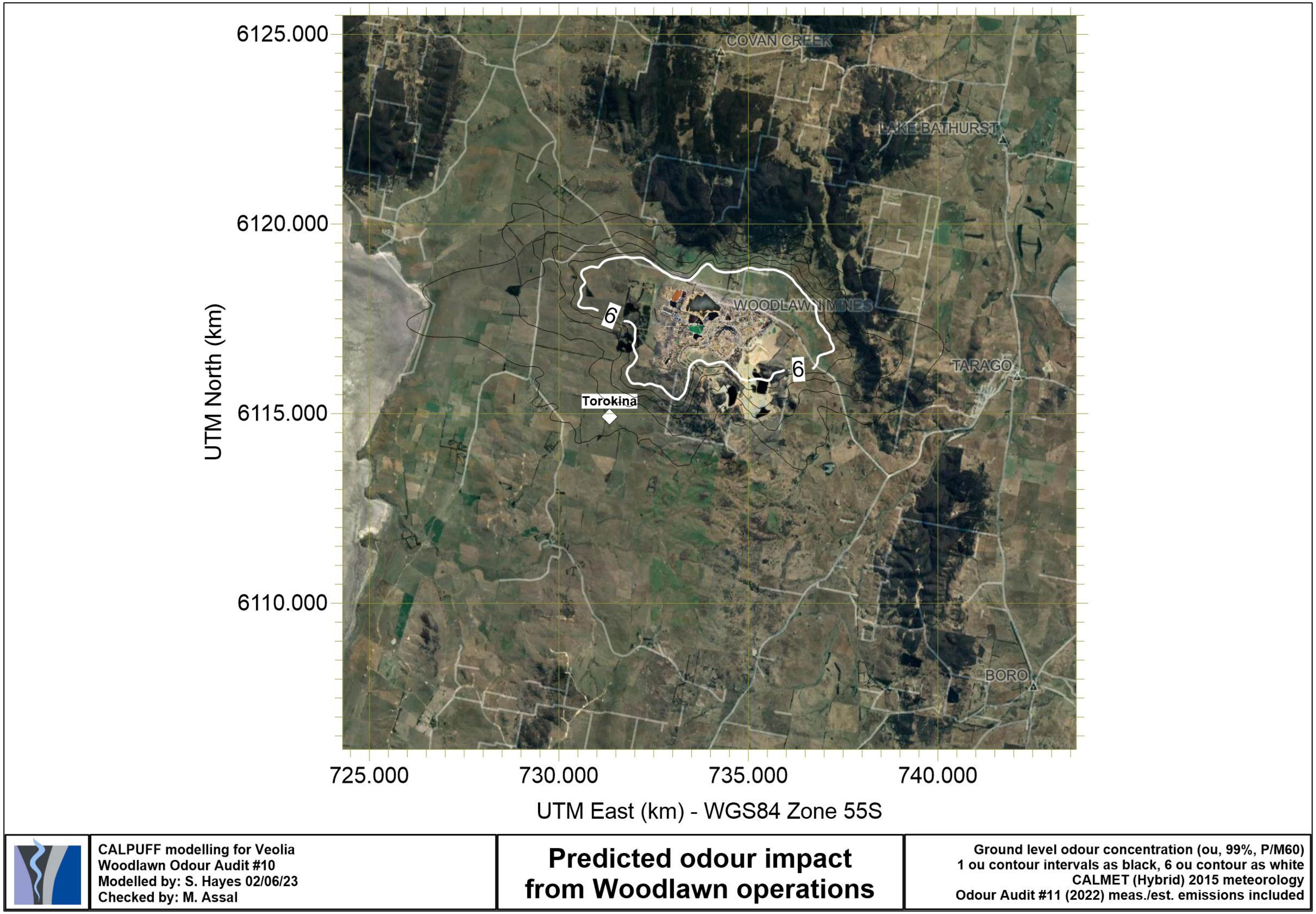


Figure 8.12 - Predicted odour impact from all odour sources of Woodlawn operations

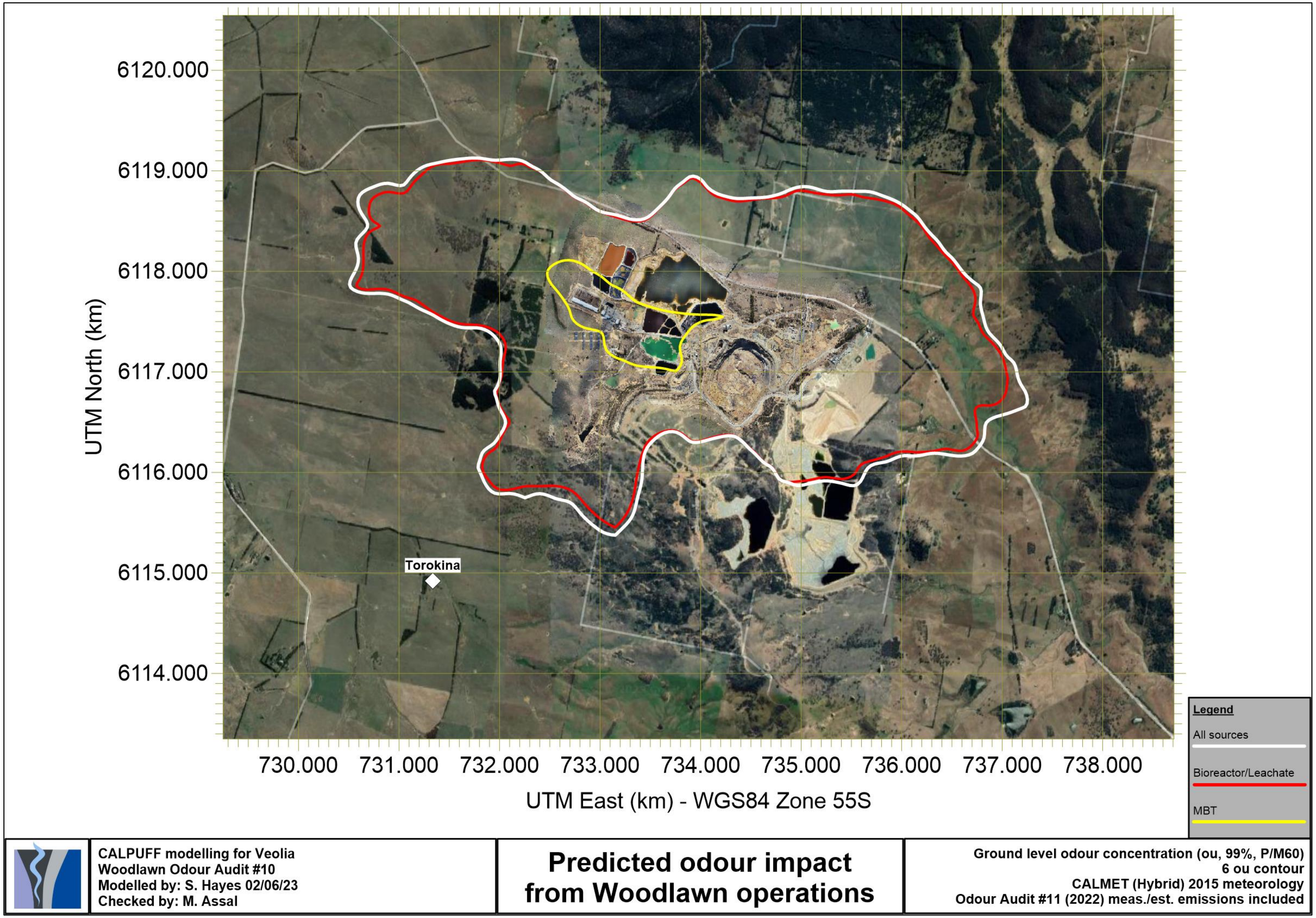
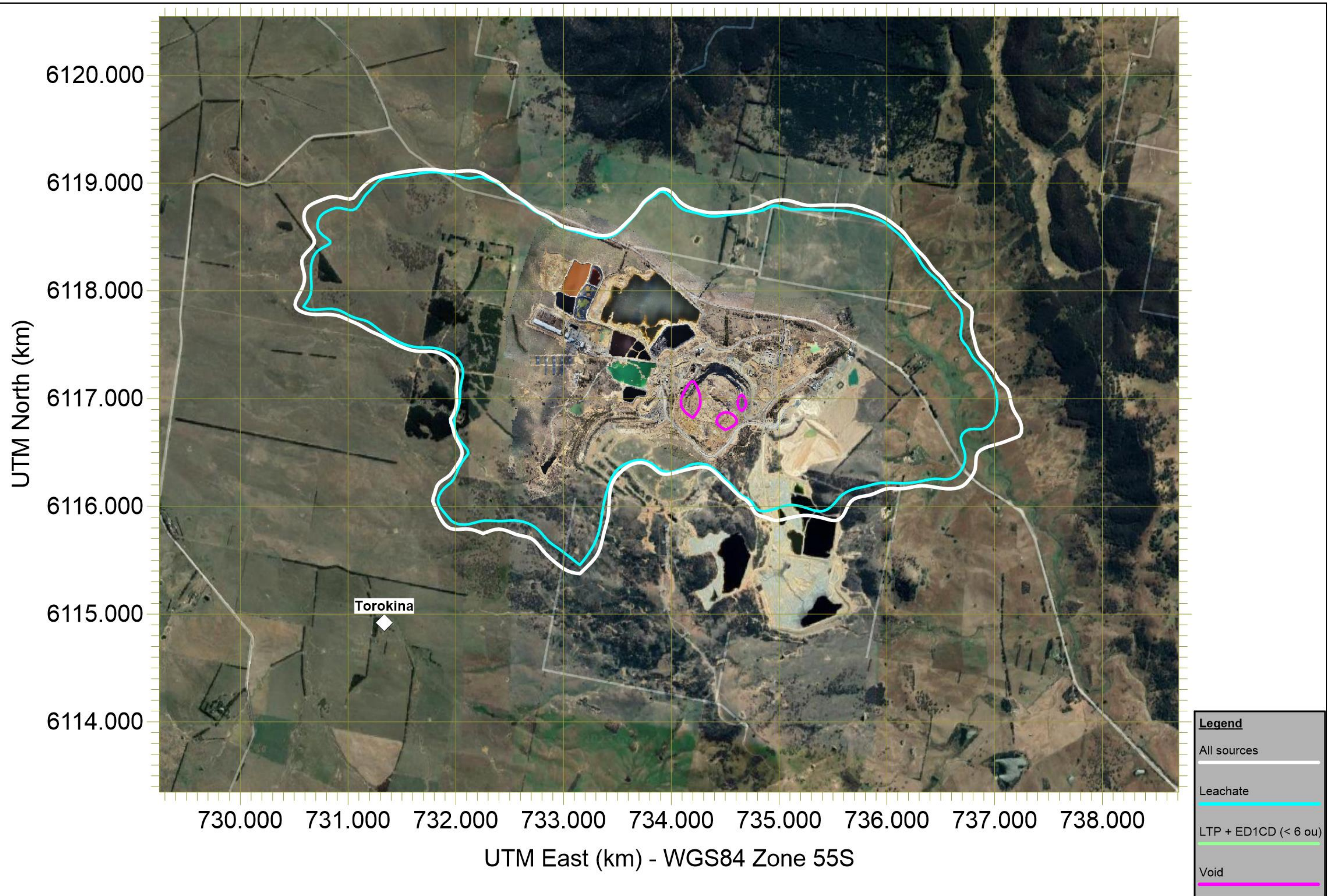
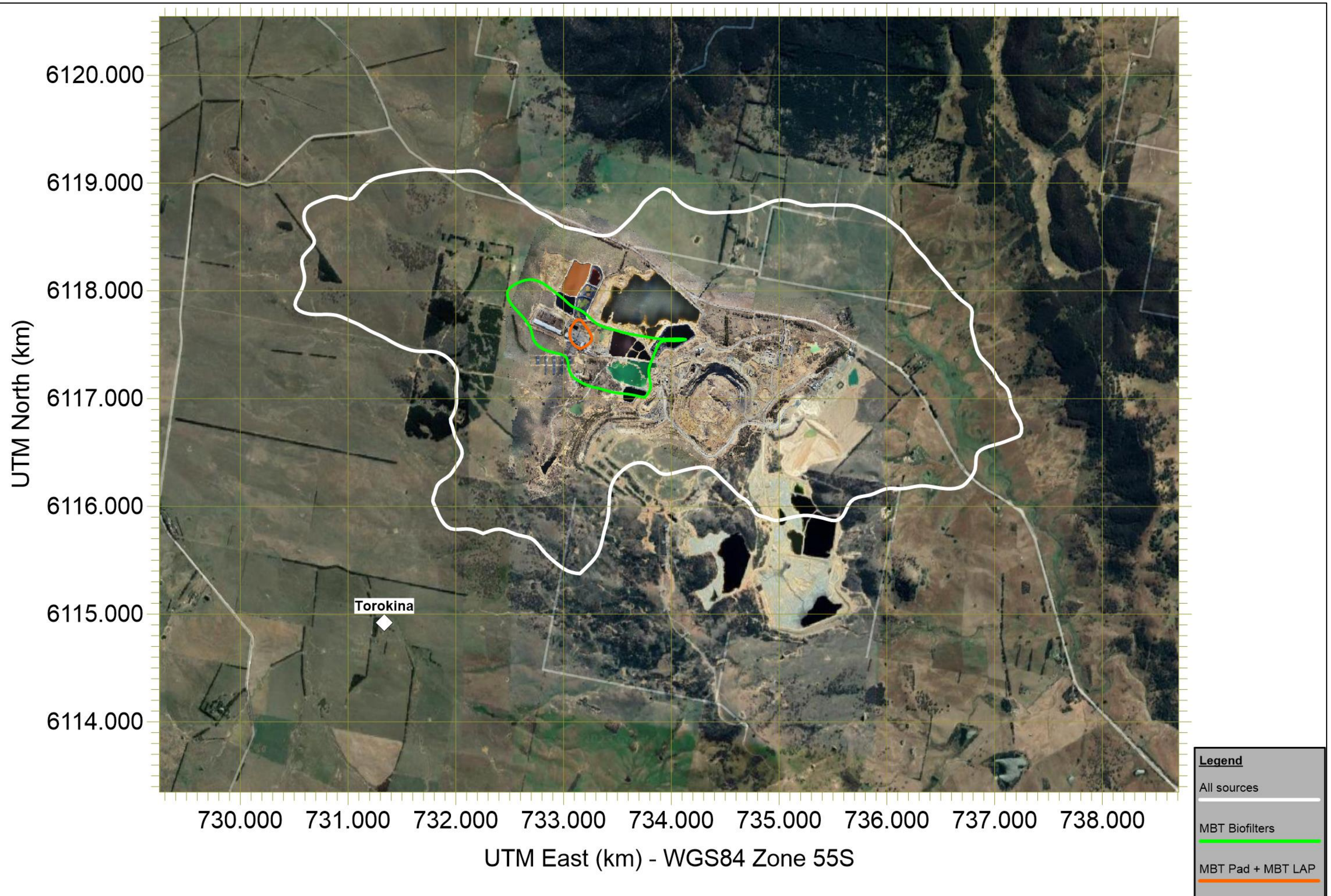


Figure 8.13 - Predicted odour impact from Bioreactor/Leachate and MBT source groups



CALPUFF modelling for Veolia Woodlawn Odour Audit #10 Modelled by: S. Hayes 02/06/23 Checked by: M. Assal	**Predicted odour impact from Woodlawn operations**	Ground level odour concentration (ou, 99%, P/M60) 6 ou contour CALMET (Hybrid) 2015 meteorology Odour Audit #11 (2022) meas./est. emissions included

Figure 8.14 - Predicted odour impact from Leachate, LTP + ED1CD, and Void source groups



CALPUFF modelling for Veolia Woodlawn Odour Audit #10 Modelled by: S. Hayes 02/06/23 Checked by: M. Assal	**Predicted odour impact from Woodlawn operations**	Ground level odour concentration (ou, 99%, P/M60) 6 ou contour CALMET (Hybrid) 2015 meteorology Odour Audit #11 (2022) meas./est. emissions included

Figure 8.15 - Predicted odour impact from the MBT Pad + MBT LAP and MBT Biofilter source groups

8.6 MODELLING STUDY FINDINGS

An odour dispersion modelling analysis of the Woodlawn Facility in February 2023 was completed as part of the 11th IOA. This involved the modification of the previous IOA model to best represent the present operations during the 11th IOA period, i.e., calendar year 2022.

The odour emissions scenario used for the modelling was observed during the 11th IOA. This scenario represents TOU's best estimate of total odour emissions from normal operational conditions for the Woodlawn Bioreactor. This scenario does not consider abnormal conditions or upset events.

Overall, the predicted cumulative impact has increased substantially since the 10th IOA. It has also been found that the leachate sources contribute to almost all the odour profile of the Woodlawn Facility, attributable to the elevated OERs and source type characteristics (large pond surface areas). Despite this, the modelling has found that the ground level concentration at the nearest sensitive receptor (i.e., the Torokina property dwelling) is predicted to be below the NSW EPA odour IAC of 6.0 ou (99%, P/M60). As mentioned in previous audits, this appears to be incongruent with the professional experience and expert understanding by TOU of the Woodlawn Facility operations, field observations during the 11th IOA, and findings of the FAOA Survey – this exemplifies the inherent uncertainty in using dispersion modelling to assess odour impact, particularly for complex operations and the geographic location of the Woodlawn Facility.

The 11th IOA considers compliance with the odour assessment criterion to be one tool that provides an indication of acceptable odour impacts. The benchmark is if the emission of odour is offensive or is being prevented or minimised using best management practices and best available technology, with modelling used to evaluate different design or event scenarios comparatively. Therefore, the 11th IOA considers that dispersion modelling may not be an appropriate tool to assess odour compliance or otherwise for the purpose of the defined objectives set in the 11th IOA. This finding is supported by previous IOAs and further discussed in **Section 8.6.1**.

8.6.1 Modelling Study Concluding Remarks

The modelling outcome outlined in the 11th IOA has indicated a significant increase in impact compared with the previous IOA findings. This is caused by the substantial increase in SOER from the leachate sources, including the LTD, ED3N-2 and ED3N-4 SOER and corresponding OER results exceeding the ranges used in the EA 2010 (refer to **Table 9.4**). Concerningly, it does not consider the unquantifiable impact as associated with fugitive gas emission pathways from the Void (assessed via the undertaking of the FAOA survey monitoring program conducted in the 11th IOA). This is despite Veolia actively undertaking measures to minimise odour emissions from the Woodlawn Facility, including participation in a community consultation process, highlighting the importance of community feedback that could uncover potential unintended issues from adjustments to treatment processes and odour mitigation controls. The 11th IOA recommends that the root-cause of the increase in odour emissions from the leachate sources is investigated and corrective action taken as soon as practicable (refer to **Section 10.2.3.1** for details).

9 AUDIT DISCUSSION

9.1 PREVIOUS AUDIT RECOMMENDATIONS

Section 9.1.1 and **Section 9.1.2** outline the mandatory and non-mandatory recommendations documented in the previous IOA, respectively, and Veolia's response to those recommendations since that time (a copy of the complete response can be found here). The colour legend used to identify the status of these recommendations within the 11th IOA period is as follows:

Colour Code	Colour Code Description
Orange	Not yet completed
Green	Complete
Blue	On-going
Grey	Not yet completed/Complete/On-going

As outlined in the colour code description, it is important to note that some of these recommendations are, and will continue to remain, an integral part of the on-going process operations and plans at the Woodlawn Facility. The WIP 2020 is a comprehensive and technically focused document aimed at educating management, operators, and relevant stakeholders on the operational philosophy, continuous improvement, and infrastructure development plans for the BWMS. These on-going process operations and plans are part of the WIP 2020 and WPIS5 2022, including, but not limited to:

- Planned infrastructure instalments within each waste lift;
- Landfill gas collection system including:
    - The design philosophy for the system of wells beneath the waste profile in the Void;
    - Well extensions; and
    - Horizontal infrastructure and condensate management.
- Continuous monitoring of leachate and gas extraction;
- Remediation actions in the event of equipment failure and process upset in the Void. It also documents the contingency measures implemented to ensure the sustained operation of the Void in the event of equipment failure and process upset;
- The implementation of operational management programs, including:
    - Leachate management;

- Pumps and pumping solutions; and
- The expansion of wells in the Void to optimise and improve landfill gas extraction and minimise leachate generation.

- Specific management techniques for:
  - H_2S emission release to air;
  - Covering of waste;
  - The design, location, and implementation of the biofiltration cover material along the perimeter of the Void, where required;
  - The intensification of the management of stormwater events to minimise the generation of leachate, as outlined in the 10th IOA;
  - The management of leachate eruptions and power failures; and
  - The application of biocover material to manage fugitive gas emission pathways from the surface of the Void.
- Treated leachate and water reduction measures, as outlined in the Leachate & Water Management Strategy; and
- Details on current issues and long-term plan for the Woodlawn Facility.

The above on-going process operations (and others) are comprehensively documented in previous WIP 2020 and WIPS5 2022. The 11th IOA notes that all management plans at the Woodlawn Facility are 'live' documents that are constantly updated as the volume of waste into the Void increases over time.

Veolia made the full document of the WIP 2020 and WIPS5 2022 available for review in the 11th IOA. As previously mentioned in **Section 1.3**, the relevant components of the WIP 2020 and WIPS5 2022 are incorporated into the 11th IOA report, where required, as they are commercial-in-confidence documents.

9.1.1 Mandatory Recommendations

The mandatory recommendations from the previous 10th IOA are summarised in **Table 9.1** and include the follow-up response to those recommendations as of the 11th IOA. It is important to note that several of the recommendations represent on-going continuous improvement, upgrade, modification, and optimisation works to the operations at the Woodlawn Facility.

9.1.2 Non-Mandatory Recommendations

The non-mandatory recommendations from the previous 10th IOA are summarised in **Table 9.2** and include the follow-up response to those recommendations as of the 11th IOA. Similar to that stated in **Section 9.1.1**, it is important to note that several of the recommendations represent on-going continuous improvement, upgrade, modification, and optimisation works to the operations at the Woodlawn Facility.

Table 9.1 - The 10th IOA Mandatory Recommendations and Veolia's Response: 11th IOA

No.	The 10th IOA Mandatory Recommendations	Follow-up Response to Recommendation
1	*<u>Odour Management Plan</u>* *The preparation of a site-specific odour management plan for the Bioreactor and MBT operations that documents the following features as a minimum:* ▪ *Accepted waste streams and description of process operations;* ▪ *Standard operating procedures (SOP) that are employed in each key process area to anticipate the formation of emissions and minimise their potential impact on the local airshed (e.g., failure of pump equipment and/or high rainfall events);* ▪ *An outline of how the production and migration of emissions is minimised at the Woodlawn Facility, including design (where applicable) and operating practices;* ▪ *The monitoring and control protocols required to assist in the management of emissions;* ▪ *Critical odour emissions risk and control points;* ▪ *An outline of the key staff and responsibilities with respect to odour management; and* ▪ *An outline of the reporting requirements with respect to emissions present* *Put simply, the sole purpose of the Odour Management Plan is to eliminate, prevent or minimise the potential release of adverse levels of air pollutants and odour at the Woodlawn Facility through a documented hierarchy of controls, in the form of, but not limited to, engineered, administration and/or management practices. The Odour Management Plan target will seek to find a practical balance between maintaining the quality of process operations designed to yield continuous improvement and operational excellence and the ability to control emissions to air. The Odour Management Plan will develop the link and/or consolidate existing management plans and strategies with respect to odour from the Bioreactor and MBT Facility operations, as required.*	Status = **On-going** It is understood that a final draft version of the Odour Management Plan was submitted to the NSW EPA and DPIE for review during the preparation of 11th IOA report. However, further amendments in accordance with the IOA recommendations will be incorporated prior to finalising and submitting to the NSW EPA and DPIE for approval. The Odour Management Plan (incorporated as part of the AQGGMP) was submitted to TOU in July 2023 and will be reviewed as part of the next IOA in 2024 (as this timing falls outside of the 11th IOA reporting period).
2	*<u>Odour Mitigation from the Void</u>* Veolia should continue to manage fugitive landfill gas pathways from the surface using the existing toolkit such as biocover material. This continuation is apparent in the WIP 2020, which outlines a comprehensive plan that is being implemented to increase gas capture. As such, the Audit endorses this strategy as the primary measure to reduce odour emissions from the Void and recommends that Veolia continues the implementation of the gas systems detailed in the WIP 2020, including: ▪ *The augmentation of additional pipework and booster/flare/engine to the current capacity at the Woodlawn Facility. In principle, the addition of the power station engines will increase landfill gas usage capacity, further facilitate the optimisation and minimisation of fugitive landfill gas release from the Void surface;* ▪ *the planned infrastructure instalments within each waste lift;* ▪ *the continuous improvement of leachate extraction, treatment performance, capacity, and efficiency. This is supported by the implementation of the long-term leachate solution in the form of the LTP, which remains in the process-proving and optimisation phase of operation;*	Status = **On-going/Complete/Not yet completed**. Refer to **Appendix C** for the detailed response.

Table 9.1 (continued) – The 10th IOA Mandatory Recommendations and Veolia's Response: 11th IOA

No.	The 10th IOA Mandatory Recommendations	Follow-up Response to Recommendation
2	▪ *the continuous improvement in the waste tipping profile, covering and expansion and optimisation of the landfill gas infrastructure;* ▪ *the continuous monitoring of leachate and gas extraction;* ▪ *remediation actions in the event of equipment failure and process upset in the Void;* ▪ *continuous awareness of condensate management;* ▪ *the implementation of operational management programs, including:* ○ *Leachate management;* ○ *Pumps and pumping solutions; and* ○ *The expansion of wells in the Void for improved/minimisation of leachate recirculation and landfill gas extraction.* ▪ *application of biocover material to manage fugitive landfill gas emissions, as outlined in the WIP 2020.*	
3	*Management of High Rainfall Events* *The Audit continues to support the development of a strategy and engineering design that focuses on reducing leachate generation by diverting and extracting stormwater. This is a more effective and achievable goal compared with increasing leachate extraction rates through the LMS, especially during high rainfall or frequency storm events. As outlined in the Leachate Assessment, a leachate management strategy comprising high flow extraction of stormwater/slightly impacted stormwater, flexible leachate extraction rates, and maximising extractions during summer months for evaporation dams will be beneficial for managing leachate levels in the Bioreactor.*	Status = **Complete** Veolia implemented a leachate management strategy comprising high flow extraction of stormwater/slightly impacted stormwater, flexible leachate extraction rates, and maximising extractions during summer months for evaporation dams. This is documented in the Leachate & Water Management Audit and Leachate & Water Management Strategy.

Table 9.1 (continued) – The 10th IOA Mandatory Recommendations and Veolia's Response: 11th IOA

No.	The 10th IOA Mandatory Recommendations	Follow-up Response to Recommendation
4	<u>*Leachate Management System*</u> *Veolia should continue to adequately maintain, manage, monitor the upgraded LMS to ensure it is operating in an optimum state and meeting the leachate quality monitoring targets as outlined in the Leachate Treatment Operation Manual and recommended by Veolia Water. Moreover, the performance goals outlined in the WIP 2020 should continue to be pursed and materialised. In combination with the recommendation in Section 10.2.2.2 , the performance targets for the LMS should include:* ▪ *Maximising and optimising leachate extraction from the Bioreactor to meet the design treatment capacity and capability of the existing infrastructure;* ▪ *Minimising leachate generation by:* ○ *Continuation of the existing stormwater diversion program at the Woodlawn Facility;* ○ *For high rainfall events, develop acceptable limits for which contaminated but highly diluted stormwater can be rapidly diverted to stormwater storage, minimising leachate generation and pooling in the Void surface. The stormwater event should be designed with consideration of recent and atypical rainfall events brought about by La Niña and climatical impacts and contingency; and* ○ *Develop and establish a simple and reliable monitoring and performance metric protocol that enables the capability of diverting diluted contaminated stormwater to one of the evaporation dams (i.e., ED3S1, ED3S2, or ED3N) or alternative contingency pond storage dedicated for contaminated stormwater. This will present an opportunity to further mitigate the potential adverse impacts on the landfill gas capture infrastructure and ultimately provide an improved odour outcome under such circumstances.*	Status = **On-going/Not yet completed** Veolia will continue to pursue and materialise the performance goals outlined in the WIP 2020/WPIS5 2022 and minimise leachate generation by: ▪ Maintaining the existing stormwater diversion program; ▪ Establishing acceptable limits for the rapid diversion of contaminated but highly diluted stormwater to stormwater storage during high rainfall events and submitting to the NSW EPA for approval; and ▪ Due consideration of the findings and proposed recommendations/measures of the Leachate & Water Management Audit and Leachate & Water Management Strategy.
5	<u>*Active Tipping Face*</u> *Veolia should continue to develop strategies for minimising the exposed ATF surface area. It should also proceed and continue with the details in the WIP 2020. The Audit notes that changes to the tipping profile to maximise stormwater capture and removal (refer to Section 10.2.3) have increased the footprint of the ATF. The target of leachate minimisation through stormwater diversion and management will have a larger material impact on odour compared to the minimisation of the active tipping area, given its impact on fugitive gas emission release and landfill gas capture. The Audit notes that Veolia notes that it is progressively moving to a tent shape from the current pyramid design (consistent with the outcomes of the Leachate Assessment). Following the completion of the tent profile, consideration will be given to an east-to-west slope to allow stormwater removal.*	Status = **On-going** Veolia will continue to actively develop and refine strategies for the minimisation of the exposed ATF surface area, including details in the WIP 2020/WPIS5 2022. Following the completion of the gable profile, consideration will be given to an east-to-west slope to allow stormwater removal.
6	<u>*Refine Investigation of Odour Issues in the Community*</u> *Given the significant increase in odour complaints documented in the Audit, the Audit recommends that Veolia continues with its community engagement and liaison process. This is understood to include continued community engagement through various groups (i.e., Tarago and District Progress Association Inc (TADPAI), Tarago Times publications & Community Liaison Committee, Open days). Furthermore, in view of the limited efficacy of ambient H_2S monitoring with existing sensory technology (as outlined in Section 9.2.1.3), the Audit recommends calibration and training of Veolia staff in the undertaking of field ambient*	Status = **On-going/Not yet completed** Veolia will continue to progress with its community engagement and liaison process by way of: ▪ Quarterly community liaison committee (**CLC**) meetings; ▪ Monthly Tarago Times articles; ▪ Quarterly Newsletter; and

Table 9.1 (continued) – The 10th IOA Mandatory Recommendations and Veolia's Response: 11th IOA

No.	The 10th IOA Mandatory Recommendations	Follow-up Response to Recommendation
6	*odour assessment surveillance surveys to provide an additional tool in the TARP (refer to Section 9.2.1.2.1.2 for details) in lieu of the odour diary program (refer to Section 10.2.5.1). Veolia should also continue to log and monitor odour complaints in the current odour complaints register.*	▪ Veolia website updates. Veolia environmental staff will complete calibration and training at a NATA-accredited odour laboratory to qualify for the undertaking of FAOA surveillance surveys. It is noted that the calibration and training were completed in July/August 2023 and will be reviewed as part of the next IOA in 2024 (as it falls outside of the 11th IOA reporting period).
7	*Status of Odour Diaries* *It is understood that the reinstatement of the odour diary program occurred in February 2021. The Audit has reviewed the retrieved data from the collected diaries and it is not considered a suitable community feedback tool in its current form to provide valuable data. As such, the odour diagram program should be discontinued unless participating community members are professional trained on its use and data entry protocols.*	Status = **Not yet completed** Veolia will identify any community members professionally trained to implement and use the odour diary program. If no members are professionally trained to use the diary, remove the odour diary from future use. This will be reviewed as part of the next IOA.
8	*Ambient Landfill Gas Composition Laboratory Analysis* *Given the findings of the FAOA survey are incongruent with the dispersion modelling (predominately due to the unquantifiable nature of fugitive emission pathways within the Void surface), a landfill gas composition analysis should be completed to provide technical feedback on the gas analytes present of the landfill gas released to the ambient environment from uncontrolled gas emission release points from the surface of the Void at the Woodlawn Facility. The objective of the landfill gas composition analysis will be to identify the gas analytes present, with a focus on characterising those gas compounds that are known to be odorous, including but not limited to sulphur gases and volatile organic compounds. This data may facilitate in refining the ambient monitoring goals/targets, as the Audit does not consider, on the merit of technical evidence and operational experience, that the predominate or major issue in the community is solely attributable to H2S from fugitive landfill gas emissions from the Void. This view is consistent with the sentiment extracted from the ambient data obtained in the H2S Study as well as that completed by the odour monitoring program completed by the NSW EPA.*	Status = **On-going/not yet completed** Veolia has engaged a suitably qualified expert for the undertaking of this analysis and will utilise the gas composition data to refine its ambient monitoring objectives and targets. It is noted that this is scheduled for completion by the end of December 2023 and will be reviewed as part of the next IOA in 2024.
9	*NSW EPA H_2S Monitoring Program Data Interpretation* *To extract further meaning and facilitate sound data interpretation, the H_2S data collected as part of the NSW EPA monitoring program will need to be contextualised with prevailing wind conditions, date and time of detection between different locations, and correlated with landfill gas extraction and leachate extraction rates to facilitate in the interpretation of this data. Furthermore, consideration to other potential sources of H_2S that may cause interferences from the local environment needs to be considered to improve confidence in the data and evaluate if H_2S as a tracer gas for odour emissions from the Woodlawn Facility can be relied upon as a sole parameter. This will be completed as part of a separate study to the Audit and before the next IOA*	Status = **Completed/Ongoing** Veolia has established the deployment of H_2S monitors across three (3) key locations (a single location at the Woodlawn Facility and two (2) locations in the Tarago community. The H_2S data is contextualised with meteorological data and can be found online. This deployment is further discussed in **Section 9.2.1.5**.

No.	The 10th IOA Mandatory Recommendations	Follow-up Response to Recommendation
Table 9.1 (continued) – The 10th IOA Mandatory Recommendations and Veolia's Response: 11th IOA		
10	*Odour Mitigation from the MBT Facility* *The Audit recommends a heightened awareness of the operability and maintenance of the biofilter-based odour control system at the MBT Facility, which should be consistent with the Biofilter Manual to ensure optimal and sustained odour removal performance. It is recommended that the MBT Facility improve its overall management of biofilter bed moisture to ensure optimum odour removal performance. This can be achieved by an intensification of the surface drip irrigation system and/or optimisation of the current spray humidification system. Based on the physical and odour measurement data obtained during the Audit, the requirement for a biofilter refurbishment should be considered within the next 12 months or earlier. A biofilter condition and performance assessment can be completed to support the case for a refurbishment if required.* *The LAP should also be improved for further optimise leachate quality within the LAP system at the MBT Facility.*	Status = **Complete/On-going** The biofilters servicing Odour Control System 1 and Odour Control System 2 underwent a complete refurbishment between November 2022 and March 2023. This reflects the first refurbishment in the life cycle of the biofilters at the MBT Facility (as documented in **Section 2.6.3.1** of the 11th IOA). Veolia is still in the process of optimising the spray humidification system servicing the biofilters and LAP treatment process performance at the MBT Facility. The MBT OEMP was submitted to TOU in July 2023 and will be reviewed as part of the next IOA in 2024 (as this timing falls outside of the 11th IOA reporting period).

Table 9.2 - The 10th IOA Non-mandatory recommendations and Veolia's Response		
No.	**The 2020 IOA Non-Mandatory Recommendations**	**Follow-up Response to Recommendation**
1	*<u>IMF and Waste Transport Activities</u>* *Based on TOU observations, the Audit suggests that Veolia continue to review the following aspects relating to the use of the IMF and waste transport activities to further improve its odour performance as a minor and transient source of odour, namely:* ▪ *The washing practice associated with the sealed containers; and* ▪ *The maintenance of the sealed containers.*	Status = **Complete** Continue to monitor the operation of the container and truck wheel washing practices on site and maintain the integrity of the container fleet on an automated maintenance schedule.

9.2 DISCUSSION OF AUDIT OUTCOMES

The following discussion examines the outcomes of the 11th IOA against each of the conditions of consent as outlined in **Section 1.3**.

9.2.1 Condition 7 (B & D)

Condition 7 (B & D) of the 11th IOA requirements stipulate that the following will be carried out in the IOA:

- *Audit the effectiveness of the odour controls on-site in regard to protecting receivers against offensive odour; and*
- *Review the relevant odour sections of the Air Quality and Greenhouse Gas Management Plan for the project and assess the effectiveness of odour control.*

As mentioned in the previous IOAs and complemented by the on-site experience obtained during the 11th IOA and discussions with Veolia personnel, there continues to be a range of current and on-going odour controls implemented at the Woodlawn Facility designed to mitigate off-site impacts arising from its waste management operations. These revolve around:

1. Leachate management method including leachate recirculation and optimisation of excess leachate (refer to **Section 9.2.1.1**);
2. Short-to-medium term leachate and water management strategy (refer to **Section 9.2.1.2**);
3. Improvement of landfill gas extraction from the Bioreactor (refer to **Section 9.2.1.3**);
4. Landfill gas extraction and fugitive emissions from the Void (refer to **Section 9.2.1.4**);
5. The ambient H_2S community monitoring (refer to **Section 9.2.1.5**);
6. The effectiveness and utility of the AQGGMP (refer to **Section 9.2.1.6**);
7. Landfill gas combustion exhaust quality (refer to **Section 9.2.1.7**);
8. Improve evaporation capability (refer to **Section 9.2.1.8**);
9. The continued implementation of cover/capping material, particularly in known high-risk areas such as the Void perimeter where shrinkage effects are pronounced and cracks in surface cover (refer to **Section 9.2.1.9**);
10. Minimisation of active tipping face (refer to **Section 9.2.1.10**);
11. Water cart to control dust (refer to **Section 9.2.1.11**);

12. The effectiveness of the truck wash bay (refer to **Section 9.2.1.12**);

13. The effectiveness of public initiatives (refer to **Section 9.2.1.13**);

14. Transportation of waste in sealed containers until unloading at the Bioreactor (refer to **Section 9.2.1.14**);

15. The minimisation of leachate generation during stormwater events through improved surface catchment management (refer to **Section 9.2.1.15**);

16. The effectiveness of the current odour control infrastructure at the MBT Facility (refer to **Section 9.2.1.16**); and

17. Quality of compost product stored in the Maturation Storage Pad Area (refer to **Section 9.2.1.17**).

As outlined in **Table 9.1**, the final draft version of the AQGGMP was submitted to the NSW EPA and DPIE for review during the preparation of 11th IOA report. However, further amendments in accordance with the IOA recommendations will be incorporated prior to finalising and submitting to the NSW EPA and DPIE for approval. Given that the AQGGMP was submitted to TOU in July 2023, it will be reviewed as part of the next IOA in 2024 (as this timing falls outside of the 11th IOA reporting period). This also applies to the MBT OEMP.

9.2.1.1 Leachate Management Method

9.2.1.1.1 Operational Status of Leachate Recirculation

To increase the landfill gas capture through the covered waste surfaces, leachate generated within the Bioreactor is removed when it exceeds the field capacity or interferes with gas extraction infrastructure. Any excess leachate that is extracted from the Void flows directly to the LTD or LTP for primary leachate treatment (refer to **Section 2.4** for further details).

The leachate recirculation method currently practised within the Void continues to be via direct injection techniques when required (refer to **Section 2.3.2**). As explained in previous IOAs, this has the effect of minimising the potential exposure of leachate partitioning from the liquid phase to the gas phase, through aerosol generation and/or evaporation pathways, and subsequently leading to the generation of odorous emissions. The 2012 IOA indicated that Veolia's adoption of this recirculation technique is more effective at minimising odours than previously utilised techniques (such as spray sprinklers). The previous 2013 IOA concurred with this finding and remains valid.

As previously mentioned in **Section 2.3.2** and based on the WIP 2020, the use of leachate recirculation is no longer needed to maintain effective steady-state operations within the waste mass of the bioreactor. It is only used or required during exceptional circumstances. As such, there is only one reinjection infrastructure being kept as a contingency leachate management method when the leachate transfer system experiences any failure or requires maintenance. Subject to the waste lift status and Void profile, the nominated reinjection point location is connected to the ring main and is normally in the closed position. In the circumstance of leachate transfer system failure or any downtime due to maintenance schedule, e.g., pump failure or pipe damage, the valve between the reinjection point and the ring main will be opened to allow the extracted leachate to be re-injected to the waste. The reinjection will be stopped once the leachate transfer system is back to normal operation.

9.2.1.1.2 Leachate Reinjection Contingency

As part of operational contingency, it is noted in the WIPS5 2022 that another reinjection point will be setup to supplement the main reinjection point. This will use the whole subsurface rock trench as the leachate storage reservoir. This reinjection trench will only be used when the leachate transfer system fails and will serve to keep the bund area dry and avoid equipment damage. During this operational scenario, repair actions will be conducted as soon as possible. This supplementary reinjection point is intended to only be used for no more than a day to enable repair/remedial works to be completed.

9.2.1.1.3 Optimisation and Continuous Treatment of Excess Leachate from the Void

<u>The LTD</u>

The 11th IOA understands that there is no longer a need to store untreated leachate in the evaporation dams following the upgrade improvements made to the LTD system since April 2013 (refer to previous 2013 IOA for details) and the growing waste volumes in the Bioreactor. Moreover, since the 2014 IOA, Veolia has further modified the leachate treatment process by dividing the LTD into two treatment zones, namely (in order of process flow):

- an anoxic zone; and
- an aerobic zone.

The splitting into these zones appears to suggest that the Woodlawn Facility has converted the LTD into an activated sludge treatment process, which is aimed at optimising chemical oxygen demand (**COD**) reduction and/or nitrification/denitrification processes. This modification reflects Veolia's ongoing efforts to optimise the treatment process. However, from an odour emissions viewpoint, it is hypothesised that as part of optimisation efforts and trials to enhance leachate treatment, this may have led to unintended consequences resulting in the elevated odour emission results measured for the LTD, ED3N-2 and ED3N-4 in the 11th IOA. Veolia is addressing this matter and, therefore, is documented as a mandatory recommendation in the 11th IOA (refer to **Section 10.2.3.1**).

<u>The LTP</u>

As documented in previous IOAs, the Woodlawn Facility has constructed and commissioned an MBR-based facility (i.e., the LTP) as the long-term leachate management strategy. As indicated in the WIP 2020, the LTP is in the process proving stage, which includes, but is not limited to, biomass growth, biological process tuning, and process optimisation. The LTP is based on a modified activated sludge biological process to treat the main parameters found in the raw leachate extracted from Bioreactor to a higher quality effluent. The LTD and LTP are currently operated simultaneously at the Woodlawn Facility, providing an improved capability in leachate management and treatment capacities from the Void.

Based on the above analysis, no further action is required by Veolia on this matter. If, however, there are future operational issues with the LMS, Veolia should take the precautionary measures of notifying the NSW EPA (and any other relevant stakeholders) until the issue is rectified.

9.2.1.2 Short-to-Medium Term Leachate and Water Management Strategy

As outlined in the Leachate & Water Management Strategy, there are existing and proposed measures that are aimed at reducing the overall water and leachate inventories at the Woodlawn Facility. In broad terms, these measures include:

- The current leachate pump network is currently setup in the Void, as shown in **Figure 2.8**;
- The current measures as outlined in **Section 2.4** and illustrated in **Figure 2.9**;
- Proposed measures, including but not limited to:
    - Increased LTP capacity, as this will allow for further treatment of the treated leachate (LTD treatment) contained in ED3N and ED3SS, allowing ED3N and ED3SS to be dewatered at a faster rate; and
    - Intensifying mechanical evaporation techniques to increase evaporative losses of treated leachate from coffer dams. This could include the deployment of additional surface aerators and thermal evaporators.

It is understood that the proposed measures are based on existing site operations and infrastructure and require minimal modifications to the project approval or EPL conditions. The 11th IOA endorses these volume reduction strategies as they are consistent with minimal risk of changing the current odour emission profile at the Woodlawn Facility (as outlined by the results documented in **Section 6.1.8**). This will need to be reviewed annually, as part of each IOA.

9.2.1.3 Improvement of Landfill Gas Extraction from the Bioreactor

The landfill gas extraction at the Woodlawn Facility is an on-going operational process. The WIP 2020/WPIS5 2022 indicates that there is a comprehensive plan by Veolia to increase gas capture by undertaking the following key items:

1. The continuous expansion of the new capture system to promote gas collection;
2. Management of leachate via minimising surface water flow, leachate recirculation, improvement in landfill gas infrastructure design and condensate management, and improvement in continuous treatment capacity and efficiency (achieved via the installation of the LTP); and

3. Provisions within the landfill gas management system to adequately combust excess levels of extracted landfill gas. At the time of the 11th IOA, there are total of three (3) landfill gas flare systems operating at the Woodlawn Facility.

Further information regarding the design and operation of the landfill gas extraction system has been previously documented in extensive detail in the 1st IOA. As such, it has not been documented as part of the 11th IOA.

9.2.1.4 Landfill Gas Extraction and Fugitive Emissions

As outlined in the previous IOAs, it remains difficult to calculate a representative odour emission rate from the Void, given the dynamic virtue of the surface layout. Therefore, as per the previous IOA, an alternative approach has been taken where improvement in landfill gas capture efficiency is used as an indicator of reduced potential for fugitive gas emissions from the Void surface in combination with leachate extraction and stormwater ingress to the Void.

As required, the 11th IOA has obtained landfill gas production data, which includes landfill gas flowing to the cogeneration engines and the flare systems. **Table 9.3** summarises the average monthly landfill gas extraction results over the period between March 2022 and January 2023 and compares this result to that obtained in the 10th IOA. As can be derived from the results in **Table 9.3**, the monthly averaged landfill gas extraction over the period between March 2022 and January 2023 was approximately 3,558,530 m^3 (gas to generators plus flared). In comparison to the gas extraction result obtained from the previous period in the 10th IOA (i.e., 3,056,765 m^3), this represents a 16% increase in total gas extraction volume per month (equivalent to 501,765 m^3 per month on average). This reflects the continued efforts by the Woodlawn Facility to optimise and increase the leachate gas capture capability and capacity from the Bioreactor operations, reflecting an effective engineered control for managing odour emissions from the Void surface discussed in **Section 9.2.1.3**.

Table 9.3 – Monthly landfill gas extraction between the 2020 IOA & the 11th IOA

Summary table	Values
10th IOA landfill gas extraction (m^3/month)	3,056,765
11th IOA landfill gas extraction (m^3/month)	3,558,530
Improvement performance	+16%^

^ does not include average rates in February/March 2023, as this was not contained in the data package supplied to the 11th IOA.

The landfill gas trend between March 2022 and January 2023 is illustrated in **Figure 9.1**.

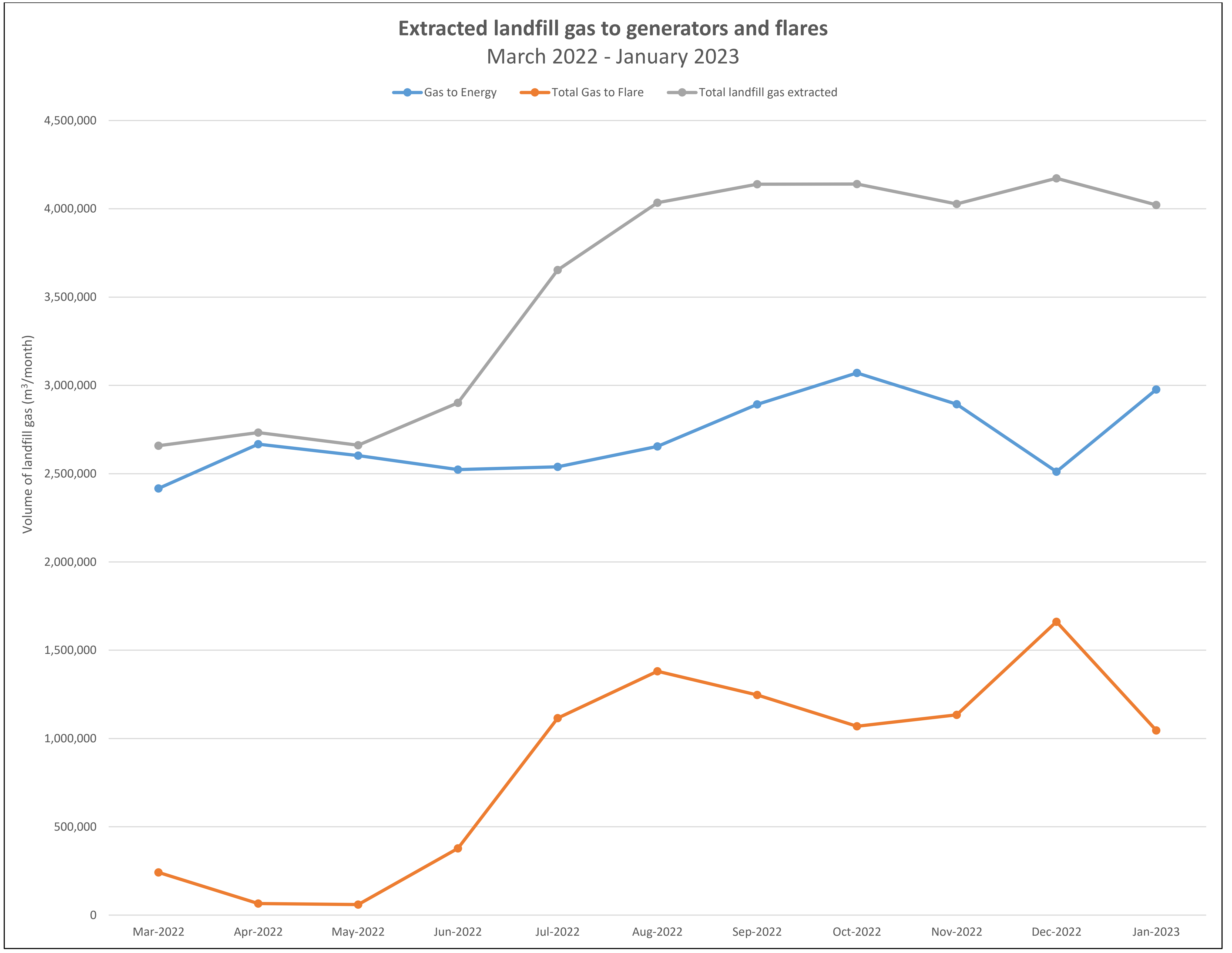


Figure 9.1 – Extracted landfill gas trend to generators and flares between March 2022 and January 2023

9.2.1.4.1.1 Fugitive Landfill Gas Emissions

As noted in the 10th IOA, it is understood that gas capture is measured against a calculated emissions model issued by the *Australian Government – Clean Energy Regulator*. This aspect is outside the scope of the 11th IOA and therefore not discussed further. Nevertheless, as demonstrated in previous IOAs, it remains clear that fugitive landfill gas emissions emitted from the Void surface can have a very high odour emission potential if gas capture efficiency declines. Therefore, the 11th IOA continues to endorse Veolia's plan to actively improve gas extraction capability from the Bioreactor and the items addressed in the WIP 2020**/**WPIS5 2022 to achieve this, including but not limited to:

- Gas field balancing, where individual gas extraction wells in the gas extraction network are monitored routinely for gas composition and pressure. This monitoring aims to achieve the following operational objectives:

- Active development of odour management response techniques to address fugitive emissions from problematic or identified areas from the Void surface. Veolia to trial the adoption of carbon filtration for the management of landfill gas emissions from these areas to mitigate the impact of fugitive gas emission release from the Void surface;

- Condensate management and monitoring of leachate extraction and treatment, as this improves gas extraction capacities (refer to the leachate extraction pump network and KOPs shown in **Figure 2.8**);

- Adjust wells to optimise landfill gas extraction;

- Determine if any wells are damaged or malfunctioning;

- Biofilter cover or ADC material on high-risk areas prone to fugitive emissions, particularly around the Void perimeter (refer to **Section 9.2.1.9** for further details) and cracks in the surface cover of the Void. This is shown to be effective, as outlined **Table 6.1**);

- Optimise tipping strategy, as this ultimately affects the efficiency of landfill gas and leachate. This is evident from the implementation of the completion of the gable profile and leachate management action plan;

- The connection of more wells/trenches. This is evident from the extensive monitoring location shown in **Figure 9.2** and the leachate extraction infrastructure (refer to **Figure 2.8**); and

- The implementation of a long-term leachate solution. Based on the leachate management improvement plan by Veolia, the following are being investigated:

  - Improve capture of uncontrolled runoff derived from rock benches/slopes by assessing current sub-catchment areas, identifying gaps, and installing infrastructure to continue to improve stormwater collection;

- Research and investigate potential changes to the waste surface profile for the next waste lift;

- The trial of different waste surface catchment management techniques;

- The transfer of contaminated stormwater from the Void directly to ED3S-2. The implication of this on landfill gas extraction is clear in **Figure 9.1**, which showed a modest increase in total landfill gas extracted from July 2022. This was noted by Veolia where it was documented that the landfill gas capture increased from 3,700 m^3/hr in November 2021 to 4,800 m^3/hr in July 2022, while leachate extraction remained above 3 L/s;

- Research into techniques and methods that allow for the most accurate comparison between well leachate levels, waste mass leachate levels and leachate extraction requirements for use in the development of a monitoring programme that will identify:

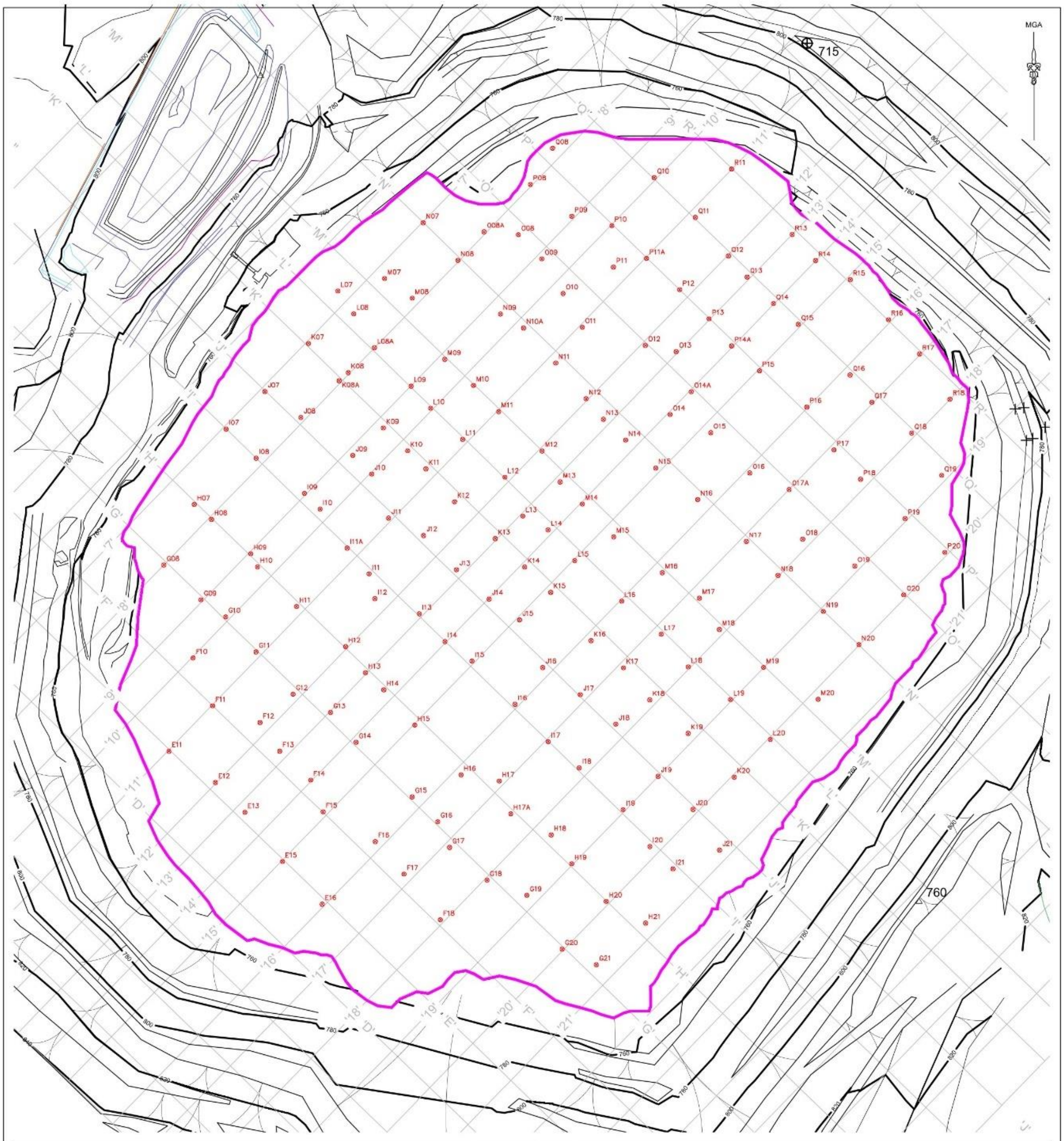
  - Location and number of representative wells;

  - Target areas for leachate extraction;

  - Any changes in leachate levels due to rainfall within the quarter; and

  - Leachate extraction target based on depth and potential infrastructure impacts as opposed to a sole focus on total volume of leachate removed.

- Veolia will continue to remove leachate at a rate of at above 3 L/s from the waste to LTP until identified otherwise by the implemented monitoring programme. As of the 11th IOA reporting period, a new ultrafiltration skid at the LTP had been commissioned to ensure that this throughput is maintained.



BORE HEIGHTS AS OF 14 DECEMBER 2022

*BRACKETS INDICATE LEVEL NOT UPDATED

BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL	BORE	RL
E11	747·71	F10	748·52	G08	745·67	H07	746·81	I07	746·95	J07	747·86	K07	746·59	L07	747·04	M07	746·93	N07	745·93	O08	746·39	P08	746·72	Q08	747·59	R11	758·34
E12	748·05	F11	748·90	G09	748·00	H08	747·09	I08	747·39	J08	748·61	K08	747·68	L08	746·70	M08	746·01	N08	747·19	O08A	746·44	P09	754·77	Q10	756·33	R13	759·70
E13	747·37	F12	749·51	G10	749·39	H09	748·19	I09	749·00	J09	748·35	K08A	746·39	L08A	746·48	M09	755·17	N09	755·14	O09	755·26	P10	755·39	Q11	756·78	R14	759·27
E15	747·21	F13	747·69	G11	750·18	H10	749·39	I10	750·06	J10	748·81	K09	748·12	L09	753·10	M10	756·13	N10A	756·48	O10	756·98	P11	756·88	Q12	758·55	R15	758·61
E16	745·73	F14	748·42	G12	750·14	H11	750·53	I11	751·15	J11	749·54	K10	748·87	L10	754·95	M11	757·23	N11	758·12	O11	758·09	P11A	757·85	Q13	759·03	R16	757·70
		F15	748·57	G13	749·47	H12	750·36	I11A	749·80	J12	755·27	K11	756·94	L11	759·26	M12	759·27	N12	758·16	O12	758·37	P12	759·53	Q14	757·88	R17	756·24
		F16	746·79	G14	748·60	H13	750·57	I12	750·81	J13	759·97	(K12)	(749·85)	L12	759·05	M13	759·01	N13	758·80	O13	758·52	P13	759·55	Q15	758·22	R18	755·32
		F17	745·77	G15	747·84	H14	749·61	(I13)	(750·69)	J14	760·14	K13	759·99	L13	759·36	M14	759·61	N14	759·01	O14	760·11	P14A	758·91	Q16	756·42		
		F18	743·90	G16	747·20	H15	748·66	I14	750·81	(J15)	(750·42)	(K14)	(751·06)	L14	760·50	(M15)	(759·26)	N15	758·72	O14A	758·78	P15	758·09	Q17	756·68		
				G17	746·61	H16	748·82	I15	749·57	(J16)	(750·34)	K15	759·63	(L15)	(751·03)	(M16)	(758·22)	N16	757·60	O15	758·59	P16	756·56	Q18	755·48		
				G18	745·19	H17	747·58	I16	749·06	J17	749·84	K16	759·04	L16	758·47	M17	757·06	N17	756·13	O16	757·23	P17	755·92	Q19	754·27		
				G19	744·76	H17A	746·89	I17	749·48	J18	748·53	K17	758·05	L17	757·06	M18	756·75	N18	754·58	O17A	756·18	P18	755·44				
				G20	744·26	H18	746·42	I18	747·54	J19	747·16	(K18)	(748·46)	L18	756·06	M19	755·26	N19	753·70	O18	755·69	P19	755·21				
				G21	744·75	H19	745·84	I19	746·46	J20	746·72	K19	755·66	L19	755·65	M20	753·54	N20	752·30	O19	753·55	P20	753·71				
						H20	745·23	I20	745·62	J21	745·76	K20	753·23	L20	753·91					O20	753·03						
						H21	745·16	I21	745·36																		

ISSUE	AMENDMENT	DATE
A	INITIAL ISSUE	22/12/2022

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A2 SHEET

VEOLIA ENVIRONMENTAL SERVICES

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VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
LANDFILL MONITORING
BORE LOCATIONS

DATE: 22/12/2022
SURVEYED: JB
DRAWN: MK
CHECKED: JK
ISSUE A
DRAWING No. 16700-260

DATUM AHD | CONTOUR INTERVAL 20m

Figure 9.2 – Landfill monitoring bore hole locations as of the 11th IOA

9.2.1.4.1.2 Monthly Surface Gas Monitoring Protocol

Since April 2021, the 11th IOA understands that monthly surface gas monitoring is conducted on the Void surface by Veolia. The 11th IOA also understands that the monthly surface gas monitoring protocol is as documented in the 10th IOA, as follows:

- The target gas compounds using the selected gas monitoring instruments include CH_4 and H_2S. These two gas analytes are considered reliable indicators of fugitive gas emission release from the surface of the Woodlawn Bioreactor;

- The monitoring protocol is consistent with the guidance provided in Section 5.2 - Landfill gas surface emissions monitoring of the *New South Wales Environment Protection Authority Environmental Guidelines*: *Solid waste landfills - Second Edition* dated 2016 (the **Landfill Guideline**);

- The monthly landfill gas monitoring (as per the EPL for the Bioreactor) is conducted by an external contractor and includes the following:

    - CH_4 via Gazomat Inspectra Laser Portable Gas Leak Detector (or equivalent), which is calibrated using CH_4 span gas for a range between 10 ppm and 1,000,000 ppm with an uncertainty factor of ± 2%. The Inspectra Laser measures the concentration of total volatile organic compounds (recorded as methane equivalent) in air calibrated with a response factor of 1 for CH_4; and

    - H_2S via an MX6 iBrid Portable Multi-Gas Monitor or (equivalent), which is calibrated using a reference gas of H_2S at a known concentration of 25 ppm.

- Veolia continues to adopt the use of in-house monitoring via the following instruments:

    - CH_4 via a TDL-500 Laser Methane Gas Analyser that uses laser spectroscopy for the detection and measurement of CH_4 gas. The measurement range is 0 - 10,000 ppm. For surface gas monitoring from the Woodlawn Bioreactor, this measurement range is considered adequate, given that the typical accuracy for CH_4 detection threshold is 1 ppm (as indicated on the manufacturer's specification sheet). Given the instrument specification, it is considered suitable for surface gas monitoring of CH_4 where a detection threshold of 500 ppm or higher is required; and

    - H_2S via a GfG G450 Gas Monitor. The measurement range is 0.1 - 10 ppm. The lower and upper measurement range for this instrument is considered suitable for surface gas monitoring of H_2S from the Woodlawn Bioreactor. A lower detection limit of 0.1 ppm (100 parts per billion, **ppb**) is considered appropriate given that the measurement will be conducted on the surface of the Woodlawn Bioreactor (i.e., the source gas emission release point). If off-site ambient measurements of H_2S is required, a lower detection limit of 3 ppb is recommended (reflecting the lowest detection limit for the continuous monitoring of H_2S currently available on the market).

- If CH_4 is detected above 500 ppm and/or H_2S is detected above 1 ppm, the TARP is activated. These thresholds are considered appropriate for the given surface gas monitoring requirements.

As identified in the 10th IOA, the surface monitoring data does not account for downwind impacts at far distances from the Woodlawn Facility. This continues to support that the odour types may not necessarily be sourced from waste material in the methanogenesis phase (i.e., aged waste in the upper layers) but rather in other stages of the anaerobic digestion process that are associated with volatile organic compounds, esters, volatile fatty acids, and other reduced sulphur compounds. Notwithstanding this qualification, the existing monitoring protocol is suitable for facilitating significant landfill gas leaks and maintaining a safe working environment within the Void. As such, the monthly surface gas monitoring protocol is considered appropriate.

9.2.1.4.1.3 Monthly Surface Gas Monitoring – Impact Factors

The monthly surface gas monitoring results can be impacted by a range of operational and meteorological factors that could influence the variability in measurement of CH_4 and H_2S at key locations. In the instance where the monthly surface gas results recorded a threshold exceedance of CH_4 or H_2S at a given location, the likely factors that could lead to this include, but are not limited to:

- The condition and performance of the landfill gas infrastructure and leachate extraction pumps;
- Influence of wet weather events and stormwater ingress on the Void surface;
- The formation of fugitive emission release pathways from the Void surface due to shrinkage or consolidation effects (refer to **Section 2.3.1**); and/or
- An unintended consequence stemming from:
  - The operational complexity and strongly interconnected infrastructure that is constantly evolving; and
  - The dynamic layout of the Void does vary temporally, spatially, and operationally. The WIP 2020, WIPS5 2022, and AQGGMP have considered this unique aspect of the Void operations through the inclusion of proactive and reactive measures (refer to **Section 9.2.1.4.1.1**).

It is important to note that the monthly surface gas monitoring program is an important management tool to not only monitor surface landfill gas release but also to enable the detection of fugitive gas emission pathways as a basis to activate or trigger remedial and/or rectification actions. This will allow the appropriate Veolia personnel to take prompt action by application of biocover and/or capping material at the identified area of concern.

Put simply, the reasoning for threshold exceedances during the monthly surface gas monitoring is multifaceted, and there can be interrelated factors that lead to the formation and subsequent exceedance of CH_4 on localised occasions. This is supported by the established understanding that the Void surface is not a static environment and is subject to be impacted by dynamic factors, including the installation of landfill gas and leachate extraction infrastructure, waste lifts, quality and condition of the capping or covering material at the time, landfill gas extraction rates, stored leachate within the waste mass, and potential migration impacts of stormwater into the waste mass under wet weather conditions. Notably, the effect and impact of stormwater on landfill gas emission (and therefore Void surface emissions) was clearly observable in July 2022 following the transfer of contaminated stormwater from the Void directly to ED3S-2 (refer to commentary in **Section 9.2.1.3** and **Figure 9.1**).

9.2.1.5 Ambient H_2S Community Monitoring

The 11th IOA identified that the current ambient air quality community monitoring surveillance system had been deployed and designed to provide real-time feedback on the presence of H_2S and meteorological conditions. The environmental data is collated and organised in a cloud-based environmental management system (eagle.io) and presented in a form that is easy to access and interpret. All logged H_2S and meteorological data can be retrieved online. At the time of the 11th IOA, the monitoring locations included:

- The Woodlawn Facility (Point 9);
- The Tarago Recreation Area (Point 71); and
- The Tarago Showground (Point 72).

The online services were commissioned after the 11th IOA reporting period. As such, all data from the integrated platform will be reviewed as part of the next IOA in 2024. Based on a review of the cloud-based portal as part of the 11th IOA, Veolia has adopted an effective data analytics solution to communicate a multifaceted monitoring program to the community and relevant stakeholders. Therefore, the current ambient H2S community monitoring program protocol is appropriate for the specified intention (refer to **Section 9.2.1.5.1** for further information).

9.2.1.5.1 Commentary on Ambient H_2S Community Monitoring

As outlined in the 10th IOA, the H_2S monitoring being completed in the community can facilitate in refining the ambient monitoring goals/targets. However, it does not consider, on the merit of technical evidence and operational experience, that the predominate or major issue in the community is solely attributable to H_2S from fugitive landfill gas emissions from the Void. This is because there are many human-made and natural sources of H_2S (such as vehicle transport, decaying vegetative matter, septic tanks, sewage, and aged garbage). Therefore, a positive detection and concentration reading from the currently deployed Acrulog units does not necessarily mean that the Bioreactor operations are the only source. To establish this connection, Veolia would require additional data, contextualisation, and the investigation and guidance of experts to establish such a connection. Therefore, the feedback provided by the Acrulog units should be regarded as a tool to create an enhanced level of community awareness of H_2S levels in the local area. Notwithstanding this, the current real-time H_2S and meteorological monitoring surveillance system is an excellent source of data that is well-collated and presented for the benefit of the community and relevant stakeholders.

To supplement the ambient air quality community monitoring surveillance system, the following additional strategies should be considered to refine the ambient monitoring goals/targets:

- Trial the expansion of the community ambient gas specification analysis monitoring program to non-conventional gas analytes (volatile fatty acids, esters) to identify their presence in the local air shed of interest. This would need to include sampling at a downwind location on the Void perimeter and two downwind locations off-site (e.g., Collector Road and Tarago). It should be noted that some of the gaseous compounds will not be NATA accredited and their quantification in air will be limited to specific gas analytes. The intent will be to attempt to identify unique marker/s that is/are traceable to emissions from the Void surface; and

- Conduct continuous CH_4 monitoring at strategic locations to identify if this can be used as a marker for landfill gas migration from the Woodlawn Bioreactor into the local air shed of Tarago (this will be done in tandem with the current H_2S monitoring). This may involve a short-to-mid-term (weeks to months) monitoring window to account for weather conditions, with monitoring locations at the perimeter of the Void and Tarago.

It should be noted that there is no guarantee that any of the gaseous compounds within any laboratory analysis that may be conducted will be detectable above the lower detection limits. Even if there is a positive odour event (or complaint) during the monitoring, there is also no guarantee that the odour-causing compounds can be quantified in the laboratory as the lived experience and olfactory senses are very sensitive to specific odorous compounds at levels that are often present below the lower detection limit of most instrumentation. This is exasperated by the distance between the source and receptor, such as that between the Woodlawn Facility and Tarago. As such, this is best addressed by FAOA surveillance surveys (as outlined in **Section 7.2**).

9.2.1.6 Air Quality and Greenhouse Gas Management

As outlined in **Table 9.1**, the final draft version of the Odour Management Plan was submitted to the NSW EPA and DPIE for review during the preparation of the 11th IOA report. However, further amendments in accordance with the IOA recommendations will be incorporated prior to finalising and submitting to the NSW EPA and DPIE for approval. The Odour Management Plan (incorporated as part of the AQGGMP) was submitted to TOU in July 2023 and will be reviewed as part of the next IOA in 2024 (as this timing falls outside of the 11th IOA reporting period).

9.2.1.7 Landfill Gas Combustion Exhaust Quality

According to the May 2022 Emissions Testing Report and October 2022 Emissions Testing Report (refer to **Appendix C**), all combusted gas emissions analysed on NSW EPA Point 8 - Generator No. 2 Exhaust Stack complied with the EPL Limits for NO_x, SO_3/H_2SO_4 and H_2S. The engine load at the time was reported to be 954 kilowatts (**kW**). The total hydrocarbon destruction efficiency was found to be greater than 98%, indicating efficient combustion of the landfill gas supply to the generators.

Given the outcomes reported in the May 2022 Emissions Testing Report and October 2022 Emissions Testing Report and provided the landfill gas engines continue to operate under optimal conditions, and there is no significant deterioration in combustion performance and operating temperature, the landfill gas engine exhaust stacks are not considered to be significant odour emission sources at the Woodlawn Facility. These results are consistent with the judgements made in the previous IOAs in that the engine stacks are a minor source of odour (given the operating combustion temperatures) and highly unlikely to result in adverse odour impact beyond the Woodlawn Facility boundary. This finding continues to remain valid in the 11th IOA.

9.2.1.8 Improve Evaporation Capability

As outlined in the Leachate & Water Management Strategy, there are existing and proposed measures that are aimed at reducing the overall water and leachate inventories at the Woodlawn Facility. The proposed measures seek to supplement the current measures and include (as outlined in **Section 9.2.1.2**):

- Increased LTP capacity, as this will allow for further treatment of the treated leachate (LTD treatment) contained in ED3N and ED3SS, allowing ED3N and ED3SS to be dewatered at a faster rate; and

- Intensifying mechanical evaporation techniques to increase evaporative losses of treated leachate (refer to **Section 2.4.1**). This could include deployment of additional surface aerators and thermal evaporators.

These proposed measures will continue to be proactively developed and implemeted as part of improving the evaporation capability. It is noted that this circumstance may potentially be assisted by the predicted impact of the emerging El Niño forecast in Australia, which is expected to yield warmer and drier weather patterns (valid at the time of writing). This will be a favourable outcome for the Woodlawn Facility and its desire to accelerate the evaporative losses of its treated leachate and water inventory.

9.2.1.8.1 Evaporation of Treated Leachate/Water and Odour Potential

The natural evaporation OERs across ED3N, ED3S1, ED3S2, ED1 Stormwater/AMD, and ED1 Coffer Dam are within historical trends from previous IOAs (refer to **Table 6.7**). All collected liquid samples analysed via the LOM method were found to be low in odour, but ‘ammoniacal, wastewater, musty, rotten, mouldy’ odour characters were recorded for some samples, with others indicating only a ‘musty’ odour character. Despite this finding, a ‘musty or muddy water’ odour character is typically a reliable indicator of optimum pond/wastewater liquor health and reflects a minimal odour release potential under treated/optimal conditions, even at high OERs (i.e., the odour emission is of a treated quality/neutral odour profile/characteristic). As such, the continued mechanical and natural evaporation of treated leachate/water in ED3N, ED3S1, ED3S2, and ED1 Stormwater/AMD is considered to pose a minimal odour risk.

It is noted that NSW EPA is concerned that the stormwater from the Void that is stored in ED3S-1 and ED1 Stormwater/AMD may have come into contact with waste. Based on the 11th IOA (refer to **Table 6.2**), there was no evidence of a measurable impact (or change of liquor quality) to demonstrate this occurrence from an odour emissions perspective.

9.2.1.8.1.1 Monitoring of Evaporation

A robust monitoring record was supplied to the 11th IOA surrounding the monitoring of mechanical evaporation on ED3N and ED3S. The records indicate whether a mechanical evaporation module for a given pond source was operational at a given date and time. On this basis, the existing SCADA system servicing the monitoring of evaporation is considered effective at managing and monitoring volume reduction levels at a given pond source.

9.2.1.8.1.2 Commentary on ED3N-2 and ED3N-4 Odour Emissions

The SOERs from ED3N-2 and ED3N-4 (refer to **Section 6.1.2**). As such, problematic odour emitted from ED3N-2 and ED3N-4 during the 11th IOA is suspected to be caused by other chemical and diffusion pathways that appear not to translate to an odorous release potential circumstance when mechanically or naturally evaporated (as opposed to diffusion/stripping from a wind flux over the surface, reflective of the area source sampling protocol – refer to **Section 4.2**). This likely reflects the complex chemistry of the stored liquor in ED3N-2 and ED3N-4. As such, the continued mechanical evaporation of treated leachate in ED3N-2 and ED3N-4 is considered to pose a minimal odour risk via the current mechanisms of evaporation.

9.2.1.8.1.3 Commentary on LTP Odour Emissions

A liquid sample from the LTP was collected from the balance tank, anoxic tank, and aerobic tank. All samples were found to have very low odour, indicating that optimal wastewater treatment conditions prevailed during the 11th IOA. This was supported by the liquid samples from ED1 Coffer Dam that supported the view that the LTP was performing in an optimum condition at the time of the 11th IOA, despite being in the process-proving phase and receiving abnormally odorous influent from the LTD. As such, the continued mechanical of treated leachate in ED1 Coffer Dam is considered to pose a minimal odour risk.

9.2.1.8.2 Status of Evaporation Capability from an Odour Viewpoint

The results derived using the LOM testing are summarised in **Table 6.6** and **Table 6.7**. As noted in **Section 6.1.8**, all collected liquid samples analysed via the LOM method were found to be low in odour, but 'ammoniacal, wastewater, musty, rotten, mouldy' odour characters were recorded for some samples, with others indicating only a 'musty' odour character. Despite this finding, a 'musty or muddy water' odour character is typically a reliable indicator of optimum pond/wastewater liquor health and reflects a minimal odour release potential under treated/optimal conditions, even at high OERs (i.e., the odour emission is of a treated quality/neutral odour profile/characteristic).

Overall, the liquid sample results are consistent with previous IOAs and very unlikely to be problematical with respect to mechanical evaporation leading to off-site impacts.

9.2.1.9 Effectiveness of Waste Covered Areas

At the time of the 11th IOA, the waste covered areas across the Void surface profile were characterised by the following features:

- Intermediate cover and capped area;
- Known problematic fugitive emission pathway at the north-eastern corner of the Void perimeter was covered with biocover material; and
- Spatial and visual variability across the surface profile.

As outlined in **Section 6.1.1**, the SOER results from the waste covered areas were less than 0.16 ou.m^3/m^2.s, suggesting fugitive emission release and cover conditions at the sampled locations were effective at the time.

9.2.1.10 Minimisation of Active Tipping Face Area

As identified in the previous IOAs, the ATF can vary depending on the tonnage input and how the waste is managed. Since the 2015 IOA, the exposed active tipping face was revised to reflect more realistic conditions that are prevalent in the Void. In addition, minimising the ATF continues to be one of the key performance indicators at the Woodlawn Facility for the following reasons (as outlined in previous IOAs):

1. Reduces the surface area of potential odour source;
2. Minimises temporary decommissioning of gas extraction infrastructure;
3. Minimises fuel usage, particularly in dozer and compactor; and
4. To meet NSW EPA benchmark techniques.

Photo 9.1, Photo 9.2 and **Photo 9.3** provide a visual indication of the ATF area size and activities occurring at the time of the 11th IOA field visit. The original value adopted in the EA 2010 for the ATF was 40,000 m^2. This value was later revised to between 4,000 m^2 and 6,000 m^2 in the 2013 IOA to reflect realistic and previous operating conditions occurring at the time. As of the 11th IOA, the current ATF area is now approximately between 1,000 m^2 and 2,000 m^2, reflecting Veolia's continued efforts at minimising the ATF in the Void.

As presented in **Table 6.2**, the mean SOER results for the ATF (SC23111 – SC23114) in the 11th IOA is 1.25 ou.m^3/m^2.s, representing a slight decrease since the 10th IOA (2.20 ou.m^3/m^2.s). The odour character of the ATF samples collected in the 11th IOA was reported as 'garbage, vanilla, pineapple', representing a similar finding from previous IOAs, with an increase in ester formation. Based on previous IOA results for this source, this variation is considered to reflect normal variation from the ATF activity inside the Void. This is lower than the SOER value used in the EA 2010 modelling of 7.6 ou.m^3/m^2.s. Based on these results and the outcome of the modelling study (refer to **Section 8.5**), there is a very low risk that the ATF will result in downwind odour impact on the nearest sensitive receptor. Notwithstanding this, it should be noted that:

- Fugitive landfill gas emissions are still judged to be the major contributor to odour emissions from the Void, as previously highlighted in **Section 9.2.1.4**; and

- Veolia has optimised operational practices such as the active tipping surface area is being kept to a minimum. This practice has a significant effect on the rate of emission from this source. That is, any reduction in the exposed waste surface area will result in a proportional decrease in emissions from the ATF, and vice versa.

Overall, the 11th IOA finds that current practices at the Woodlawn Facility relating to the ATF are conducive to the minimisation of odour from this source.

Photo 9.1 - A distant view of the ATF area size as found on 23 February 2023

Photo 9.2 - A close-up view of the ATF area size as found on 23 February 2023

Photo 9.3 - A close-up view of the ATF mobile tipping platform as found on 23 February 2023

9.2.1.11 Effectiveness of the Water Cart to Control Dust

The use of the water cart is an ongoing operational activity, which is effective at minimising dust generation. This was visually evident during the fieldwork component of the 11th IOA. The 11th IOA observed that the operating practice of using a water cart to control dust continues to be an on-going practice at the Woodlawn Facility. On the above basis, no further action is required by Veolia for this component of the Woodlawn Facility's operations.

9.2.1.12 Effectiveness of the Truck Wash Bay

The use of the truck wash bay at the Woodlawn Facility was observed to be consistently used by trucks upon exiting the Void. The consistent use of the truck wash bay is good practice for minimising potential odour emissions off-site that may be related to truck vehicle movement. Since the previous IOA, the truck wash bay has been optimised as follows:

- Wheel wash is continuously used to clean the trucks coming out of the Void, and the performance of the wheel wash monitored during operation; and
- Several spray nozzles have been modified, and the spray angle changed to achieve better coverage (especially the tail of the truck) and washing performance, as shown in **Photo 9.4.** This optimisation will minimise transient levels of odour that may be detectable and associated with truck movement in the community.

Overall, the truck wash bay and its adoption at the Woodlawn Facility is identified in the 11th IOA to be effective at managing odour from this activity.

Photo 9.4 – Truck wash bay nozzle optimisation (**Source:** 8th IOA)

9.2.1.13 Effectiveness of Public Initiatives

Veolia reported a couple of initiatives on its public website, namely of:

- Oxygen production and organics reduction measurements after installation of portable aeration unit on an identified storage dam; and

- A trial of two (2) portable carbon filter units that can be used on the waste surface to draw in air and treat odour from problematic areas.

At the time of the 11th IOA, these measures were still in active progress and could not be evaluated. It will be followed up as part of the next IOA in 2024. However, the 11th IOA provides the following commentary surrounding these two (2) initiatives:

- It is known that maintaining good levels of dissolved oxygen in a pond system is a key contributor to minimising odour emissions. The presence of excess oxygen ensures that aerobic biochemical oxidation is maintained, resulting in a typically 'musty, earthy, stagnant water odour). This is evident in the treated leachate quality results obtained in the 11th IOA. As such, this initiative is endorsed if it leads to enhanced oxygen production for pond sources, where targeted odour mitigation is required and treated leachate quality is maintained in pond sources at the Woodlawn Facility. As such, a trial of its utility in the Void operations is endorsed by the 11th IOA; and

- The adoption of a carbon filter is a conventional odour abatement technology that is effective, with good design, operation, and maintenance. Carbon filter involves passing air through a column of activated carbon medium, resulting in the adsorption of air containments by adsorption and/or physical-chemical reactions (depending on the type of carbon selected). It is typically used as a polishing treatment stage, as primary treatment in low volumetric airflows (such as landfill gas applications) or as a backup/ redundancy treatment. It is excellent for the removal of a range of odorous compounds and air contaminants, uses a non-hazardous filter medium, is easy to replace, and has fairly low to moderate capital and operating costs. However, in landfill applications, the carbon filter medium can be rapidly exhausted, particularly with saturated and/or heavily contaminated airstreams, requiring frequent monitoring and replacement to maintain effective performance. As such, a trial of its utility in the Void operations is endorsed by the 11th IOA.

9.2.1.14 Transportation of Waste in Sealed Containers

The IMF was inspected as part of the 11th IOA, and a brief downwind olfactometry assessment was conducted to determine any presence of waste-based odour. The inspection found no evidence of any waste-based odour that could be emitted off-site from the IMF. On this basis, the 11th IOA determines that there is still no need to sample the IMF as it is very unlikely to generate problematic odour emissions. This is provided that the waste containers used in the process remain adequately maintained and fully sealed during waste transportation.

The 11th IOA notes that it is a requirement that all waste containers are to be designed, constructed, and maintained to prevent the emission of odour and be watertight to prevent the leakage of leachate from waste containers during transport and handling activities. As such, current practices should be continued and monitored. It is also noted that the maintenance of the sealed containers is on an automated schedule. The IMF as found during the 11th IOA on 22 February 2023, is shown in **Photo 9.5** and **Photo 9.6**.

Based on TOU observations, the 11th IOA suggests that Veolia continue to review the following aspects relating to the transportation of waste in sealed containers to facilitate the minimisation of odour from this area/activity:

- The washing practice associated with the sealed containers; and
- The maintenance of the sealed containers.

Overall, similar to the previous IOAs, the 11th IOA has found that the current measures used for waste transport operations are effective at mitigating any odour emissions.

Photo 9.5 - The IMF facing south-west as observed during the 11th IOA inspection visit on 22 February 2023

Photo 9.6 - The IMF facing north-east as observed during the 11th IOA inspection visit on 22 February 2023

9.2.1.15 Minimisation of Leachate Generation During Stormwater Events

As indicated in **Section 2.5.2,** the WIP 2020, the surface water in the Void is managed in sub-catchments, as shown in **Figure 2.14** and **Figure 2.16**. Each sub-catchment has either natural or engineered drainage and flow control infrastructure, such as concrete dish drains, clay berms, pumps, and pipes, to manage surface water. These sub-catchment areas are intended to minimise the amount of surface water flow from the Bioreactor walls onto the waste. This aims to minimise the potential generation of excess leachate from surface water flows. Overall, the minimisation of leachate generation during stormwater events is an on-going activity, with the following facets intended to enhance stormwater diversion:

- Improve capture of uncontrolled run-off derived from rock benches/slopes by assessing current sub-catchment areas, identifying gaps, and installing infrastructure to continue to improve stormwater collection. During the 11th IOA reporting period, Veolia was trialling methods to test the effectiveness of different modifications to the perimeter system to enable greater capture and management of runoff from rock benches and slopes by assessing current sub catchment areas, identifying gaps, and installing infrastructure. This trial is illustrated in **Figure 9.4**;

- As outlined in the Evaporator Manual, ED3S2 can be pumped to three (3) locations in the bench around the eastern wall of the Void by a high-head pump via a central pipe. The spray units are in series and connected to the central pipe. There are multiple spray nozzles fitted to a manifold in each location. The spraying of stormwater into the bench and around the wall of Void has the potential to increase the evaporation rate should this approach be approved and validated. Currently, it is under trial and further investigation by Veolia. The trial layout for ED3S1 and the spray system in the eastern wall of the Void is shown in **Figure 9.3**;

- Research and investigate potential changes to the waste surface profile for the next waste lift;
- The trial of different waste surface catchment management techniques;
- The transfer of contaminated stormwater from the Void directly to ED3S-2 (if required and with permission);
- Research into techniques and methods that allow for the most accurate comparison between well leachate levels, waste mass leachate levels and leachate extraction requirements for use in the development of a monitoring programme that will identify:
    - Location and number of representative wells;
    - Target areas for leachate extraction;
    - Any changes in leachate levels due to rainfall within the quarter; and
    - Leachate extraction target based on depth and potential infrastructure impacts as opposed to a sole focus on the total volume of leachate removed.

As explained in **Section 9.2.1.4.1.1**, the minimisation/diversion of stormwater from the Void surface is beneficial for landfill gas capture efficiency and mitigation of fugitive landfill gas emissions. Therefore, this should continue to be one of the performance metrics for the operation of the Void.

Figure 9.3 – ED3S1 spray system locations in the eastern wall of the Void

9.2.1.15.1 Management of High Rainfall Events

As previously mentioned in **Section 2.5.2.2**, any stormwater into the Void, especially the portion that directly falls on the waste surface of the Void and the run-off from the upper benches, is one major source of excess leachate generation. As documented in the WIP 2020, it is indicated that leachate generation is very sensitive to high rainfall events due to the large, influencing catchment area and partial stormwater interception.

The large volumes of rainwater fall onto the waste surface during high rainfall events. Currently, stormwater is not 100% intercepted from the surface of the waste before becoming contaminated. Following high rainfall events, the leachate extraction system prioritises the extraction of surface water over leachate collected from the sub-surface (i.e., below the surface of the Void and within the Bioreactor). As the leachate extraction rate is limited to up to 4 L/s at both the LTP and LTD, these rainfall events result in further accumulation of leachate in the Bioreactor. This can reduce the efficacy of the landfill gas capture infrastructure and management of fugitive landfill gas emissions from the Void (as highlighted in **Section 9.2.1.4.1.1**). For this reason, the Leachate & Water Management Strategy sought to identify and establish a possible monitoring and performance metric protocol to divert diluted contaminated stormwater to one of the evaporation dams (i.e., ED3S and ED3N). The adoption of such a strategy provides an opportunity to mitigate the adverse impacts associated with high rainfall events on the landfill gas capture infrastructure and provide an improved odour outcome for the Woodlawn Facility under such circumstances. Therefore, given the importance of the management of high rainfall events in the Void, the WIP 2020 indicates that continuous improvement of the stormwater management system is actively being undertaken as part of operational excellence and optimisation. This will remain integral to managing the Void and will be addressed as part of the annual IOAs. This view is consistent with that expressed in the 10th IOA that highlighted the amount of leachate extraction is dependent on the collection of clean stormwater to minimise recharge through the landfill waste which generates leachate.

Overall, the awareness and recognition of the impact of stormwater on the Void operations will continue to be examined as part of the IOA, given its integral impact on landfill gas capture and its dependency on the extraction and treatment capacity of the LTD and LAP, which can have the ability to significantly influence the severity of fugitive odour emission release from the Void.

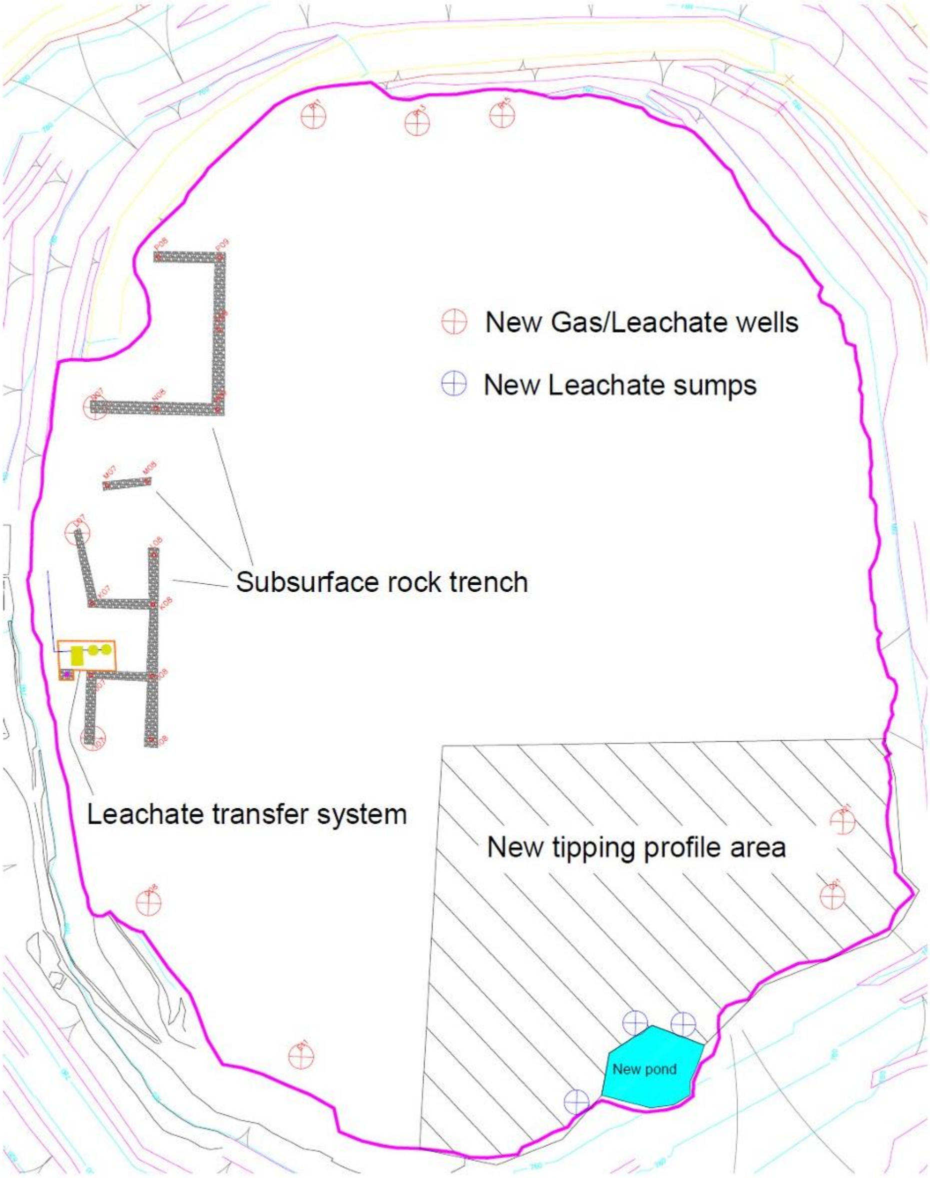

Figure 9.4 – Stormwater infrastructure improvements within the Void: 11th IOA

9.2.1.16 Effectiveness of Odour Controls at the MBT Facility

The MBT Facility consists of an extensive odour collection and control system to manage odour emissions throughout the composting process cycle. It was found that the biofilter performance was effective in substantially reducing odour prior to atmospheric discharge. However, it is known that biofiltration of this modern design can achieve further reduction if optimised. As such, the 11th IOA notes that Veolia should operate and maintain the biofilter-based odour control system according to the Biofilter Manual as part of best practice. As such, the 11th IOA completed the following measurement of key performance metrics (per previous IOAs):

- Biofilter airflow;
- Inlet humidity levels and performance of the inlet air humidification system;
- Biofilter outlet performance (refer to **Section 6.1.10**); and
- Biofilter back-pressure.

These parameters are continuously monitored via a SCADA system at the MBT Facility. A snippet of the SCADA system for Odour Control System 2 and Odour Control System 2 is shown in **Figure 9.5** and **Figure 9.6**, respectively. The outcomes from the physical performance of the 11th IOA are documented in **Section 9.2.1.16**, with the odour removal performance results summarised in **Section 6.1.10**.

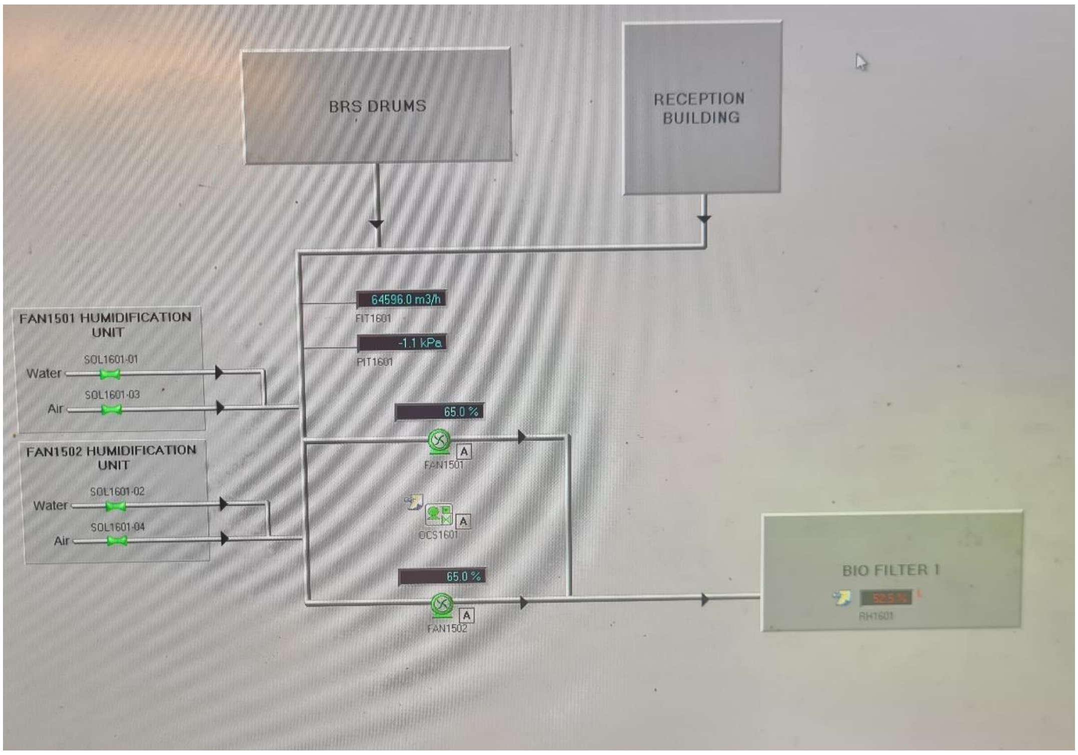

Figure 9.5 – Odour Control System 1 – Snippet of SCADA system: 23 February 2023

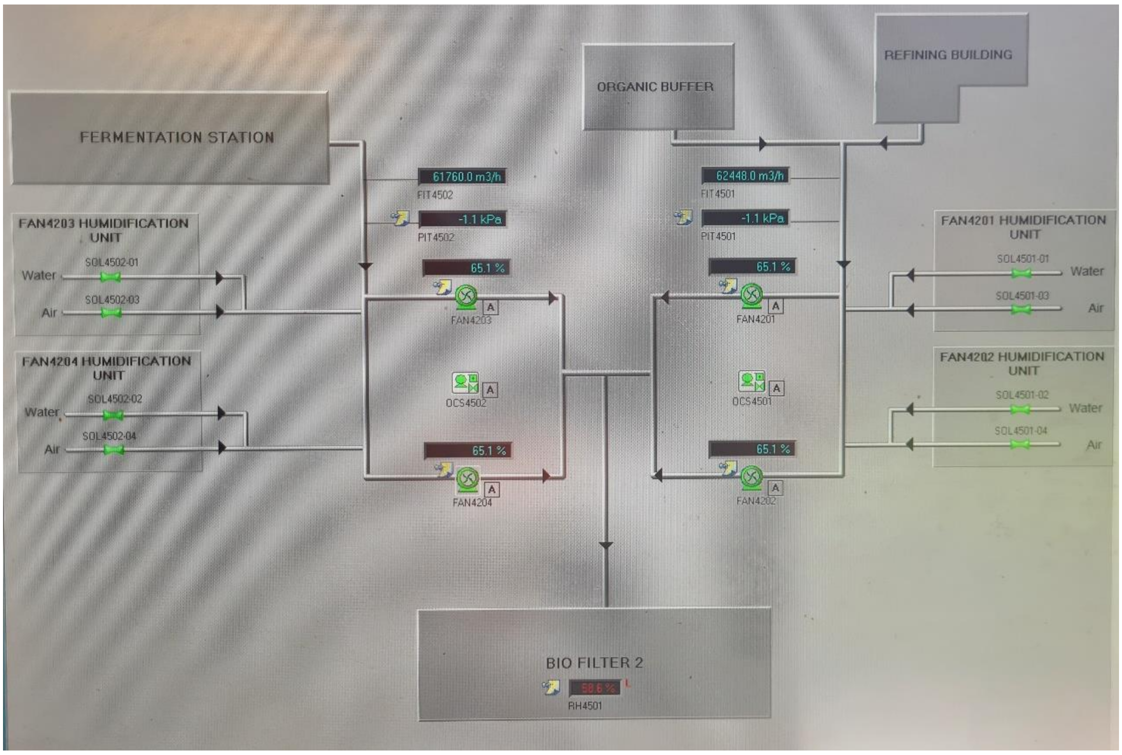

Figure 9.6 – Odour Control System 2 - Snippet of SCADA system: 23 February 2023

9.2.1.16.1 Biofilter Physical Performance

The physical performance of the biofilter system at the MBT Facility was assessed during the 11th IOA.

The measurement results obtained in the 11th IOA are as follows:

<u>Odour Control System 1 - Biofilter 1:</u>

Inlet airflow:	64,600 m^3/hr, actual
Inlet Temperature:	26.9 / 21.2 °C / °C
Inlet RH:	60%
Moisture Content:	13.34 g H_2O per kg of dry air
Biofilter Back-Pressure:	< +10 Pa

Comments: The inlet airflow and temperature for Biofilter 1 is within the design loading of 81,200 m^3/hr and less than or equal to 40°C (based on the Biofilter Manual). However, the RH level was significantly below the required performance target of 85% or higher. It is understood that Veolia is still in the process of optimising the spray humidification system servicing the biofilters. The biofilter medium condition was reflective of a refurbished biofilter system (refer to **Section 2.6.3.1**) and is consistent with the measured low biofilter backpressure.

__Odour Control System 2 - Biofilter 2__

Inlet airflow:	123,000 m^3/hr, actual
Inlet Temperature (Dry/Wet Bulb):	23.8 / 21.0 $^oC/^oC$
Inlet RH:	78%
Inlet Moisture Content:	14.47 g H_2O per kg of dry air
Biofilter Back-Pressure:	+172 Pa

Comments: The inlet airflow and temperature for Biofilter 2 are within the design loading of 175,500 m^3/hr and less than or equal to 40^{o}C (based on the Biofilter Manual). However, the RH level was significantly below the required performance target of 85% or higher. This low moisture condition can lead to bed dryness and sub-optimal odour removal performance. It is understood that Veolia is still in the process of optimising the spray humidification system servicing the biofilters. The biofilter medium condition was reflective of a refurbished biofilter system (refer to **Section 2.6.3.1**) and is consistent with the measured low biofilter backpressure.

9.2.1.16.2 Overall Effectiveness of Odour Control System at the MBT Facility

Notwithstanding the above physical measurements and given the outcomes of the odour modelling study (refer to **Section 8.5**), the effectiveness of the odour controls at the MBT Facility will continue to be reviewed as part of the IOA to ensure operational excellence and continuous improvement is maintained at the MBT Facility. The effectiveness of Odour Control System 1 and Odour Control System 2 will be underpinned by the ability to control bed moisture via the spray humidification system. As such, a mandatory recommendation to optimise the spray humidification system is a mandatory recommendation (refer to **Section 10.2.2** for further details).

9.2.1.16.3 Operational Records at the MBT Facility

The 11th IOA identified that monthly and detailed records by the operators and SCADA system (an example is shown in **Figure 9.7**) are being logged and maintained to an adequate level. These operational records can be supplied with permission and upon request. The SCADA system monitoring extends to RH and biofilter pressure.

The monthly checks of the overall operation and performance of Odour Control System 1 and Odour Control System 2 include, but are not limited to:

- Cross-reference check of sensors on SCADA system;
- Biofilter bed moisture; and
- Visible inspection of the airflow distribution from the surface of the biofilter bed.

Figure 9.7 - An example of the biofilter airflow monitoring records retrieved from the SCADA system for Odour Control System 1 and Odour Control System 2 at the MBT Facility

9.2.1.17 Quality of Compost Product in the Maturation Storage Pad Area

The quality of compost product stored in the maturation storage pad area appeared to vary, with aged and screened material relatively lower in odour compared with aged and unscreened material. The samples from the MBT Maturation Pad were collected to represent the product profile of the stockpile material present at the time, as all stockpiles were mature. The SOER range was between 0.00985 – 0.164 ou.m^3/m^2.s and within expectations for the quality and long age of the fully matured compost product. Notwithstanding this, the odour modelling predictions (refer to **Section 8.5**) indicate that the odour outcome is satisfactory under the conditions found in the 11th IOA.

9.2.1.18 LAP

The LAP was found to have an average SOER of 0.68 ou.m^3/m^2.s, with all samples reporting an 'ammonia, rotten' odour character. Despite the character, the SOER is almost an order of magnitude improvement from the SOER of 5.6 ou.m^3/m^2.s measured during the 10th IOA. Moreover, the LOM samples from the Leachate Dam and V-drain indicate a low odour emissions potential when evaporated, which is consistent with the SOERs measured from the gas samples. This potential will only result in localised detection of the odour characters (ammonia, rotten). This finding is consistent with the relatively small surface areas, which means that these liquid sources only contribute slightly to the overall emissions profile of the local precinct. This is supported by the dispersion modelling results conducted in the 11th IOA (refer to **Section 8.5**).

Notwithstanding this, it is understood that Veolia is still in the process of optimising LAP treatment process performance at the MBT Facility, and this will be evaluated as part of the next IOA and in the context of the MBT OEMP (refer to **Section 9.2.1.19**).

9.2.1.19 MBT OEMP

As noted in **Table 9.1**, the MBT OEMP was submitted to TOU in July 2023 and will be reviewed as part of the next IOA in 2024 (as this timing falls outside of the 11th IOA reporting period).

9.3 CONDITION 7 (C)

Condition 7 (C) of the 11th IOA requirements stipulates that the following will be carried out in the IOA:

- *Review the proponents' production data (that are relevant to the odour audit) and complaint records.*

The production data that is relevant to the 11th IOA include:

- Waste throughput to the Bioreactor between January 2022 and January 2023;
- On-site evaporation data;
- Landfill gas consumption in the generators and flare system;
- Logged meteorological data;
- Odour complaint records; and
- Volume of pond sources (as of 24 March 2023).

The on-site evaporation data, odour complaint records and volume of pond sources reviewed as part of the 11th IOA can be found here. The complaint log records indicate that the necessary fields required by the *EPL Condition M4 Recording of pollution complaints* are being documented by Veolia. The other production data can be supplied with permission and upon request.

Based on the above, the 11th IOA is satisfied that all relevant record-keeping duties continue to be adequately maintained.

9.4 CONDITION 7 (F)

Condition 7 *(F)* of the 11th IOA requirements stipulates that the following will be carried out in the IOA:

- *Determine whether the project is complying with the requirements in this approval to protect receivers against offensive odour.*

The 11th IOA has examined compliance or otherwise with *Condition 7(F)* from two perspectives, namely:

- Odour complaints data review and analysis and associated response from Veolia (discussed in **Section 9.4.1**); and

- Compliance with the modelling-based, project-specific odour performance goal of 6 ou (discussed in **Section 8.6**).

9.4.1 Odour Complaints Analysis and Response from Veolia

The odour complaints data logged by Veolia and associated response letters were reviewed and analysed in the 11th IOA. **Figure 9.8** illustrates the seasonal distribution of logged odour complaints between 30 April 2022 and 30 April 2023. The odour complaints analysis indicated the following:

- Since the 11th IOA, over the period of 30 April 2022 and 30 April 2023, there were 301 logged odour complaints, equivalent to decrease in logged complaints relative to that documented in the 10th IOA;

- The data appears to indicate that the autumn and winter period represent the highest incidence of logged complaints (representing 68% of the total);

- Veolia responded to each logged complaint over the period between 30 April 2022 and 30 April 2023. All responses can be found in here;

- The odour diary community feedback process was not utilised. Instead, the following community liaison pathways were pursued:

    - Quarterly CLC meetings;

    - Monthly Tarago Times articles;

    - Quarterly Newsletter; and

    - Veolia website updates.

With the above in mind, despite the significant improvement in landfill gas extraction in the Void since July 2022 (refer to **Section 9.2.1.3**) and expansion and improvement in the LMS through optimisation of surface water catchments, landfill gas infrastructure design, active tipping practices and optimisation in leachate extraction and treatment capacity, the odour complaints trend appear to reflect the operational challenges associated with the previous high rainfall conditions reported in the 10th IOA period and wet weather conditions. Given the high volume of complaints and vast spatial variability in the nature of the complaint, there is a statistical challenge with conducting a multivariant analysis of this data. Instead, the key message from the complaints data is that there is strong community concern about odour from the Woodlawn Facility, and the lived experience is related to the number of complaints. The likely contributing factors to this increase in complaints are clearly identified in the 11th IOA, minimising the value of such analysis being undertaken. However, the continued ambient H_2S monitoring program (refer to **Section 9.2.1.5**) and its potential refinement as a community advisory tool has been included as a mandatory recommendation (refer to **Section 10.2.1.1**).

As mentioned in **Section 8.6.1**, the unquantifiable impact associated with fugitive gas emission pathways from the Void (assessed via the undertaking of the FAOA survey monitoring program conducted in the 11th IOA in lieu of modelling) is considered to be a key contributing factor in community impacts. As such, this places emphasis on the undertaking of FAOA surveillance survey programs and highlights the importance of community feedback as part of assessing the efficacy of current and proposed optimisation and improvement initiatives by Veolia in the short-to-mid term (refer to **Section 9.2.1.4**).

Overall, based on the findings of the 11th IOA, this project approval condition is not likely being met at all times. Therefore, Veolia should continue its pursuit to enhance its understanding and implementation of effective and targeted odour monitoring, reduction, and minimisation measures of the Bioreactor operations as well as continuing to communicate and collaborate with the community. This is the basis for the mandatory recommendations in **Section 10.2**.

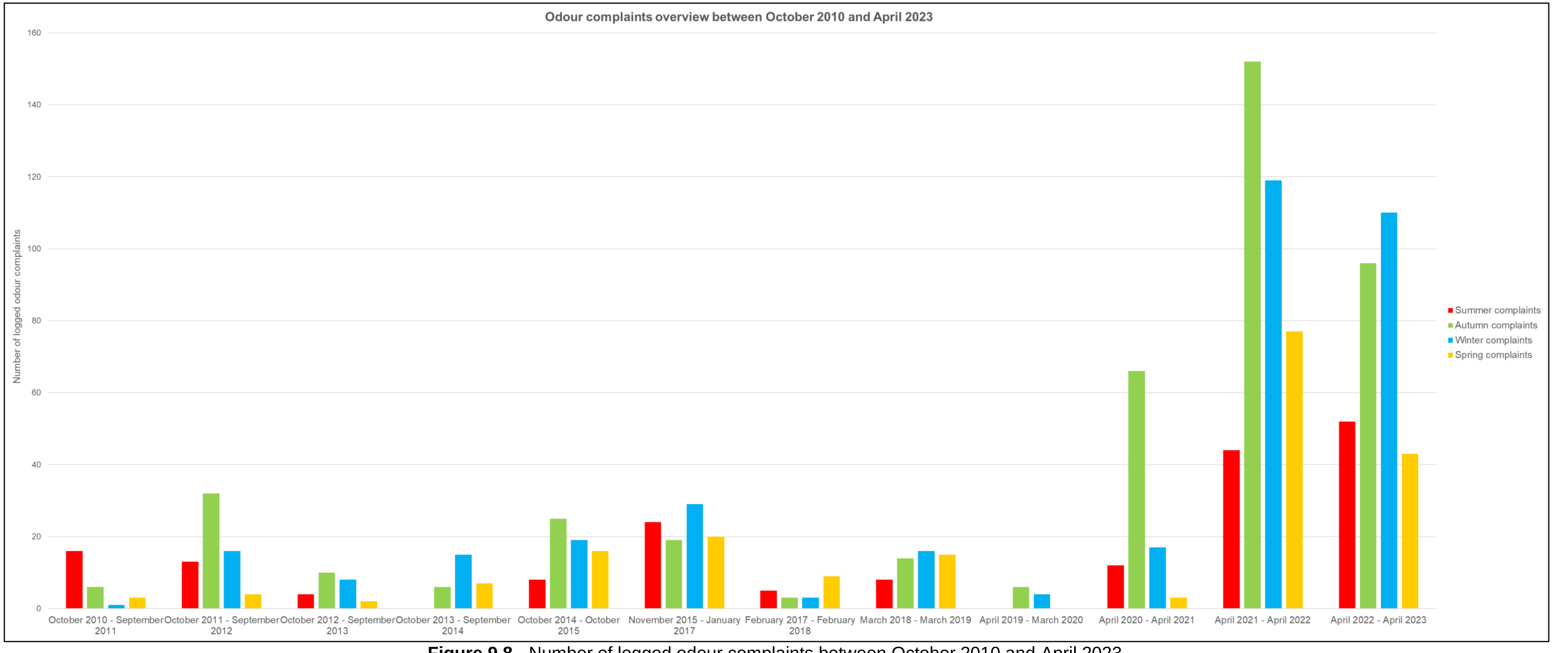

Figure 9.8 - Number of logged odour complaints between October 2010 and April 2023

9.5 ODOUR EMISSIONS INVENTORY DISCUSSION

As per the recommendation of the previous IOAs, the 11th IOA recommends using an overall odour emissions inventory for the Woodlawn Facility and examining it to place the emissions from any single source into context.

Table 9.4 details the odour emission inventory for the Woodlawn Facility as determined by the testing carried out in the 11th IOA and compared these results with predictions of emissions contained in the EA 2010. It also makes a comparison with the impact of the revised areas (where applicable) for each odour emission source as found in the 11th IOA.

It is acknowledged that there are odour emissions not listed in this inventory, emanating mostly from sources where quantitative measurement or even estimates are difficult. These include the fugitive odour releases from the Void, previously described as potential gas pathways, arising from gas leakages from the covered areas and around the walls of the Void and leachate recirculation air pressure relief vent. Despite these omissions, it is considered that the incomplete inventory remains to have real value and is discussed later (refer to **Section 9.5.2**).

Table 9.4 - Measurable odour emission rates for the Woodlawn Facility: 11th IOA ^

Location	Parameters						11th IOA		10th IOA	
Location Description	Current Area (m^2)^^	2021 Area (m^2)	2018 Area (m^2)	2016 Area (m^2)	2014 Area (m^2)	2012 Area (m^2)	SOER ($ou.m^3/m^2.s$)	OER - Current Area ($ou.m^3/s$)^	SOER ($ou.m^3/m^2.s$)	OER ($ou.m^3/s$)
ED3N-1	7,500	n/a	7,500	6,000	6,000	7,000	0.146	1,095	2.57	3,691
ED3N-2 & 3 ^^^	14,015	14,000	12,400	11,000	11,000	13,000	4.67	65,500	0.877	12,300
ED3N-2	7,018	7,250	7,000	5,500	5,500	6,500	9.23	64,800	1.72	12,500
ED3N-3	6,997	6,750	5,400	5,500	5,500	6,500	0.115	805	0.0349	236
ED3N-4	41,026	36,600	39,000	25,000	25,000	16,000	11.3	464,000	0.045	1,780
ED3S1 (formerly ED3S)	81,300	71,500	89,400	89,435	n/a		0.0315	2,560	n/m	n/m
ED3S2 (formerly ED3S-S)**	21,273	22,100	19,000	1,420			0.661	14,100	0.0526	0.0526
ED1 Coffer Dam	62,100	64,700	n/a				0.0474	2,940	0.0372	2,410
Active Tipping Face	2,000	2,000	2,000	6,000	6,000	40,000 *	1.25	2,500	2.20	4,400
LTD	4,028	3,970	5,000	5,000	5,000	2,000	30.7	124,000	0.415	1,650
Construction and Demolition Tip Face	900	900	900	900	500	900	n/a	n/m	n/a	n/a
Storage Pond 7	n/a	n/a	n/a	n/a	n/a	1,200	n/a	n/a	n/a	n/a

Location	9th IOA		8th IOA		7th IOA		6th IOA	
Location Description	SOER ($ou.m^3/m^2.s$)	OER ($ou.m^3/s$)	SOER ($ou.m^3/m^2.s$)	OER - ($ou.m^3/s$)	SOER ($ou.m^3/m^2.s$)	OER - ($ou.m^3/s$)	SOER ($ou.m^3/m^2.s$)	OER - ($ou.m^3/s$)
ED3N-1	n/m	n/m	n/a	n/a	0.356	2,670	0.132	792
ED3N-2 & 3 ^^^	0.361	4,440	0.0745	1,060	0.102	1,260	0.129	1,420
ED3N-2	0.0867	527	0.0881	710	0.169	1,180	0.120	660
ED3N-3	0.635	3,960	0.0609	379	0.035	190	0.139	765
ED3N-4	0.522	19,100	0.0856	3,440	0.095	3,710	0.163	4,080
ED3S1 (formerly ED3S)	6,720	n/m	0.094	0.094	7,250	5,190	0.116	10,400
ED3S2 (formerly ED3S-S)**	1,160	44,000	0.554	0.554	10,600	2,550	1.97	44,700
ED1 Coffer Dam	n/m							
Active Tipping Face	3.24	6,480	5.26	10,500	7.59	15,200	9.52	14,300
LTD	3.07	12,600	9.19	38,300	0.186	930	0.243	1,220
Construction and Demolition Tip Face	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Storage Pond 7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Location	5th IOA		4th IOA		3rd IOA	
Location Description	SOER ($ou.m^3/m^2.s$)	OER - ($ou.m^3/s$)	SOER ($ou.m^3/m^2.s$)	OER - ($ou.m^3/s$)	SOER ($ou.m^3/m^2.s$)	OER - ($ou.m^3/s$)
ED3N-1	0.130	780	0.132	794	0.017	104
ED3N-2 & 3 ^^^	0.175	1,930	0.118	1,300	0.049	543
ED3N-2	0.148	811	0.145	797	0.066	365
ED3N-3	0.20	1,110	0.091	500	0.032	178
ED3N-4	0.248	6,200	0.269	6,720	0.023	575
ED3S1 (formerly ED3S)	0.277	24,700	No previous measurements available as ED3S & ED3S-S are new sources			
ED3S2 (formerly ED3S-S)**	0.437	621				
ED1 Coffer Dam						
Active Tipping Face	8.16	49,000	7.51	45,100	4.28	25,700
LTD	0.27	1,350	0.276	1,380	0.026	129
Construction and Demolition Tip Face	n/a	n/a	0.326	294	n/a^	n/a
Storage Pond 7	n/a	n/a	n/a	n/a	n/m^^	n/a

Location	2nd IOA			1st IOA		EA 2010		
Location Description	SOER ($ou.m^3/m^2.s$)	OER 2012 Area ($ou.m^3/s$)	OER ($ou.m^3/s$)	SOER ($ou.m^3/m^2.s$)	OER ($ou.m^3/s$)	SOER ($ou.m^3/m^2.s$)	OER ($ou.m^3/s$)	OER - 2017 ($ou.m^3/s$)
ED3N-1	0.30	2,100	1,800	394	2,760,000	8.8	61,600	52,800
ED3N-2 & 3 ^^^	11.6	150,000	127,000	0.29	3,800	7.4	96,200	81,400
ED3N-2	20.1	131,000	111,000	0.21	1,350	n/a^^^		
ED3N-3	0.2	1,010	852	0.37	2,430			
ED3N-4	0.0604	966	1,510	0.41	6,600	0.7	11,200	17,500
ED3S1 (formerly ED3S)						0.5	44,700	24,700
ED3S2 (formerly ED3S-S)**						0.159	4,510	226
ED1 Coffer Dam						n/a		
Active Tipping Face	3.04	121,000	18,200	8.36	334,000	7.3	292,000	43,800
LTD	0.323	647	1,620	0.46	920	3.6	7,200 #	18,000
Construction and Demolition Tip Face	0.293	264	147	n/a	n/a	n/a	n/a	n/a
Storage Pond 7	n/m	n/m	n/m	85	102,000	n/m	n/m	n/m

n/a = not applicable. Note: ED3N-1 is empty
n/m = not measured
^ All odour emission rates represent the derived mean SOER values for each location
^^ As advised by Veolia
^^^ as reported in the EA 2010 as a single emission source i.e., ED3N-2 & ED3N-3 as a single area
* as reported in the EA 2010
** Target SOER not obtained from the EA. Source of emission data is the LMS May 2016 Report: Table 2.1.

Based on the result in **Table 9.4**, the following comments are made (excluding the MBT Facility and LTP):

- The total measurable odour emission rate from the Woodlawn Facility found in the 11th IOA was approximately 739,400 ou.m^3/s, representing a significant increase since the 10th IOA (37,700 ou.m^3/s). This also reflects the highest total OER since the 1st IOA. The dominant contributor to this result appears to be the increase in OER from ED3N Pond System (specifically ED3N-2 and ED3N-4) and the LTD, illustrating the importance of monitoring and maintaining optimal treated quality for all pond sources. This result excludes ED1 Coffer Dam, which was not part of the EA 2010. Notwithstanding this, its contribution is low (2,940 ou.m^3/s;
- The ATF and waste covered areas are within normal trends for total measurable odour emissions from the Void and without consideration of fugitive landfill gas emissions;
- Similar to previous IOAs, ED3N-2 & ED3N-3 have been reported both as separate emission sources and a single source (as per the EA 2010) to determine the relative contribution of odour emission from each pond; and
- ED1 Coffer Dam is included in the overall site emissions profile analysis and will form part of future IOAs.

The following sections discuss the results from the odour emissions inventory and Audit in the context of the pond and non-pond sources (refer to **Sections 9.5.1** & **9.5.2,** respectively).

9.5.1 Pond sources

All pond sources at the Woodlawn Facility sampled in the 11th IOA are considered area sources, including:

- ED3N Pond System: this includes ED3N-1, 2, 3 and 4;
- ED3S Pond System: this includes ED3S1 and ED3S2;
- ED1 Coffer Dam;
- LTD; and
- LTP.

The following sections discuss each of the above pond sources.

9.5.1.1 ED3N Pond System

In the context of the odour emissions inventory for the Woodlawn Facility, the 11th IOA identified the following:

- ED3N-1 and ED3N-3 were found to be below the EA 2010 SOER model inputs; and
- ED3N-2 and ED3N-4 represent a higher than historical average when compared to results obtained in previous IOAs and exceed the EA 2010 SOER model inputs.

On the above basis, the 11th IOA finds that the leachate performance targets set by Veolia are appropriate in identifying shifts in treated leachate quality from pond-related sources. As such, it can be considered that any significant deviation of the leachate quality monitoring targets would be a reasonable indicator that there will be an increase in risk potential for odour emission generation from the ED3N Pond System.

9.5.1.2 ED3S Pond System

9.5.1.2.1 ED3S1

In the context of the odour emissions inventory for the Woodlawn Facility, the 11th IOA finds that the current and above performance targets for stormwater quality stored in ED3S represent very low odour emissions since the IOAs began in 2011. Moreover, the measured SOER was below the EA 2010 SOER model inputs.

It is noted that NSW EPA is concerned that the stormwater from the landfill void that is stored in ED3S1 may have come into contact with waste. Based on the previous IOA results and the 11th IOA (refer to **Table 6.2**), there was no evidence of a measurable impact (or change of liquor quality) to demonstrate this occurrence from an odour emissions perspective. In previous IOAs, it has been consistently shown to be a negligible source at the Woodlawn Facility. However, this may change if this area is converted to a wet weather contingency dam for stormwater diversion during high rainfall periods, as outlined in **Section 2.5**.

9.5.1.3 ED3S2

The SOER input from the LMS May 2016 Report used a SOER of 0.159 $ou.m^3/m^2.s$ for the modelling of ED3S2. The mean result derived from the 11th IOA is 0.661 $ou.m^3/m^2.s$ (refer to **Table 6.2**). Whilst this result is higher than the modelled value, the odour modelling analysis and results of the FAOA surveys conducted as part of the 11th IOA indicated that this does not translate to measurable or observable off-site odour impact, particularly in the context of the other sources at the Woodlawn Facility.

9.5.1.4 LTD

The LTD was found to be operating under sub-optimal operating conditions from an odour emissions perspective at the time of the 11th IOA. The mean SOER result derived in the 11th IOA for the LTD is 30.7 $ou.m^3/m^2.s$, representing a significant increase since the previous IOA (0.415 $ou.m^3/m^2.s$). This value is above the EA 2010 SOER value of 3.6 $ou.m^3/m^2.s$ for the LTD and requires further investigation (refer to **Section 10.2.3.1**). This is the likely root cause for the downstream impact observed in ED3N-2 and ED3N-4 (refer to **Section 9.5.1.1**).

9.5.1.5 LTP

A liquid sample from the LTP was collected from the balance tank, anoxic tank, and aerobic tank. All samples were found to be very low in odour, indicating that optimal wastewater treatment conditions were prevailing during the 11th IOA. Overall, the liquid samples from ED1 Coffer Dam indicate that the LTP was performing in an optimum condition at the time of the 11th IOA, despite being in the process-proving phase and receiving abnormally odorous influent from the LTD. This is consistent with the ED1 Coffer Dam SOER results (refer to **Section 9.5.1.6**).

9.5.1.6 ED1 Coffer Dam

The SOER results for ED1 Coffer Dam were very low (0.0474 $ou.m^3/m^2.s$) and consistent with expectations for treated leachate quality at the Woodlawn Facility.

9.5.2 Non-pond sources

The activities within the Void were judged to be similar regarding process operations to those found in the 10th IOA, except for the landform adopted for the ATF within the Void (refer to **Section 9.2.1.4.1.1** and **Section 9.2.1.9** for details). The 11th IOA endorses the continued use of biofiltration cover material and bio-capping/capping material around high-risk areas prone to fugitive gas emission leaks, where required. This is consistent with the guidance provided in Landfill Guideline for the adoption of microbiological gas treatment systems in a landfill application. In addition, the 11th IOA endorses the trial of two (2) portable carbon filter units that can be used on the waste surface to draw in air and treat odour from problematic areas (refer to **Section 9.2.1.13**).

In summary, the 11th IOA odour testing results suggest that the Void continues to remain the major contributor to odour emissions at the Woodlawn Facility through fugitive gas emissions if landfill gas extraction is not effectively maintained. The fugitive landfill gas emissions that arise due to wall effects and cracks in the capping of waste, particularly near landfill gas extraction wells and Void perimeter and impacts of high rainfall events, are an on-going operational challenge at the Woodlawn Facility (refer to **Section 9.2.1.4** and **Section 9.2.1.15.1**). As outlined in previous IOAs, the management of high rainfall events and its impact on the Bioreactor operations represent the current and dominant operational challenge from an odour management perspective at the Woodlawn Facility. As such, the 11th IOA continues to support the development of a strategy and engineering design that focuses on reducing leachate generation by diverting and extracting stormwater. This is a more effective and achievable goal than increasing leachate extraction rates through the LMS, especially during high rainfall or frequent storm events. Notwithstanding this, an optimisation in leachate treatment capacity and intensification of stormwater diversion collectively reflect the desired pathway for a sustainable and practical long-term leachate solution. This is in tandem with enhancing evaporative losses to promote a reduction in the treated leachate and water inventories at the Woodlawn Facility.

Overall, a high flow extraction of stormwater/slightly impacted stormwater, flexible leachate extraction rates, and maximising extractions during summer months for evaporation dams will be beneficial for managing leachate levels in the Bioreactor. Put simply, fugitive emission pathways from the Void surface continue to remain the current focus at the Woodlawn Facility from an odour management perspective (refer to **Section 10.2.4**).

9.5.3 Active Tipping Face

For reasons discussed in **Section 9.2.1.10**, the mean SOER result of 1.25 $ou.m^3/m^2.s$) from the ATF as found in the 11th IOA is not considered significant from an odour impact viewpoint, but demonstrates the importance of continued efforts to minimise the ATF as much as practically possible. Overall, the 11th IOA finds that current practices at the Woodlawn Facility in relation to the ATF are conducive to the minimisation of odour from this source.

10 AUDIT RECOMMENDATIONS

10.1 CONDITION 7 (G & H)

The following section is designed to address the following Audit requirements:

- *Outline all reasonable and feasible measures (including cost/benefit analysis, if required) that may be required to improve odour control at the Woodlawn Facility*; and
- *Recommend and prioritise (mandatory and non-mandatory)recommendations for their implementations*.

Based on the findings from the 11th IOA, the following mandatory and non-mandatory recommendations have been made in **Section 10.2** and **Section 10.3**.

10.2 MANDATORY RECOMMENDATIONS

The mandatory recommendations in the 11th revolve around the following key matters, in order of priority:

- The status of the current LMS from an odour perspective;
- The increase in the number of odour complaints;
- The continuation of odour mitigation from the Void; and
- The optimisation of the odour control infrastructure servicing the MBT Facility.

These matters have been discussed in **Section 10.2.3** and **Section 10.2.2**, respectively and categorised into the following:

- On-going recommendations (refer to **Section 10.2.1**);
- Additional recommendations to address specific matters pertinent to the circumstances prevailing during the 11th IOA (refer to **Section 10.2.3**); and
- Mid-to-long-term recommendations that reflect continuous improvement and will remain in perpetuity and/or until key performance goals/metrics are achieved/met (refer to **Section 10.2.4** to **Section 10.2.2**).

10.2.1 On-going Mandatory Recommendations

At the time of writing, the on-going mandatory recommendations from the previous IOA included:

- The ambient landfill gas composition laboratory analysis (refer to **Section 10.2.1.1**);
- The NSW EPA H_2S monitoring program data interpretation (refer to **Section 10.2.1.2**). It is noted that Veolia is continuing this H_2S monitoring program; and

- Odour mitigation from the MBF Facility (refer to **Section 10.2.2**).

10.2.1.1 Ambient Landfill Gas Composition Laboratory Analysis

As per the recommendation in the previous IOA, a landfill gas composition analysis should be completed to provide technical feedback on the gas analytes present of the landfill gas released to the ambient environment from uncontrolled gas emission release points from the surface of the Void at the Woodlawn Facility. The objective of the landfill gas composition analysis will be to identify the gas analytes present, with a focus on characterising those gas compounds that are known to be odorous, including but not limited to sulphur gases and volatile organic compounds. This data may facilitate in refining the ambient monitoring goals/targets, as the 11th IOA does not consider, on the merit of technical evidence and operational experience, that the predominate or major issue in the community is solely attributable to H_2S from fugitive landfill gas emissions from the Void. To that end, the ambient landfill gas composition laboratory analysis is planned for completion by December 2023 and will be reviewed as part of the next IOA.

10.2.1.2 Ambient H_2S Monitoring Program

If identified to be of value in advising or supporting odour mitigation strategies at the Woodlawn Facility, and to extract further meaning and facilitate sound data interpretation, the H_2S data collected as part of the NSW EPA and Veolia monitoring program will need to be contextualised with prevailing wind conditions, date and time of detection between different locations, and correlated with landfill gas extraction and leachate extraction rates to facilitate in the interpretation of this data. Furthermore, consideration to other potential sources of H_2S that may cause interferences from the local environment need to be considered to improve confidence in the data and evaluate if H_2S as a tracer gas for odour emissions from the Woodlawn Facility can be relied upon as a sole parameter. At the time of writing, the H_2S monitors have been deployed and are active commission in the local community (the H_2S and meteorological data at the monitoring locations can be retrieved here). The logged H_2S data will form part of deliberations as part of the next IOA, with the intent that its interpretation will be completed as part of a separate exercise and reviewed in the next IOA.

10.2.2 Odour Mitigation from the MBT Facility

The 11th IOA continues to recommend a heightened awareness of the operability and maintenance of the biofilter-based odour control system at the MBT Facility, which should be consistent with the Biofilter Manual to ensure optimal and sustained odour removal performance. It is recommended that the MBT Facility improve its overall management of biofilter bed moisture to ensure optimum odour removal performance. This can be achieved by an intensification of the surface drip irrigation system and/or optimisation of the current spray humidification system, with a preference for the latter to achieve an outcome that is sustainable and optimises water usage and leachate generation rates from the biofilter system.

Furthermore, the 11th IOA notes that bed moisture control has been historically limited by leachate treatment capacity at the MBT Facility. With this in mind, it is recommended that opportunities to increase leachate storage capacity should be investigated and implemented in the mid-to-long term so that the biofilter system performance is not impacted in the future, particularly given that the refurbishment of all biofilter beds at the MBT Facility had been completed in early-2023 and prior to the IOA.

10.2.3 Additional Recommendation

At the time of writing, the additional recommendations relate to the LMS (refer to **Section 10.2.3.1**) based on the latest findings of the 11th IOA.

10.2.3.1 Leachate Management System

Given the elevated odour emission rates from the LMS, specifically the LTD, ED3N-2, and ED3N-4 (as found in the 11th IOA), Veolia should investigate the root cause for this variation in pond treatment and storage conditions and continue to adequately maintain, manage, and monitor the LMS to ensure it is operating in an optimum state and meeting the leachate quality monitoring targets as outlined in the *Leachate Treatment Operation Manual* and recommended by Veolia Water. The 11th IOA understands that this elevation in odour emissions may relate to the operating performance of the LTD since the previous IOA – this matter should be investigated as a matter of priority and remediated within a timely manner and prior to the next IOA if reasonably practicable.

Moreover, the performance goals outlined in the WIP 2020 and AQGGMP should continue to be pursued and progressively materialised. In combination with the recommendation in **Section 10.2.4.1.2**, the performance targets for the LMS should include:

- Maximising and optimising leachate extraction from the Bioreactor to meet the design treatment capacity and capability of the existing infrastructure;

- Minimising leachate generation by:

  - Continuation of the existing stormwater diversion program at the Woodlawn Facility; and

  - For high rainfall events, develop acceptable limits for which contaminated but highly diluted stormwater can be rapidly diverted to stormwater storage, minimising leachate generation and pooling in the Void surface.

- Continue to optimise and maximise the volume reduction protocols for ED3N, ED3S, and ED1 Coffer Dam as far as reasonably practicable. The water quality in ED3N, ED3S, and ED1 Coffer Dam remains suitable for mechanical/natural evaporation, given the findings of the LOM testing that indicated that the emission release from the pond surfaces appears to be related to a pathway/mechanism other than mechanical/natural evaporation (refer to **Section 6.1.8**).

10.2.4 Mid-to-Long Term Recommendations

The mid-to-long-term recommendations are those that will continue in perpetuity and/or until key performance goals/metrics are achieved/met. These include:

- Odour mitigation from the Void (refer to **Section 10.2.4.1**);

- ATF (refer to **Section 10.2.4.2**); and

- Refine Investigation of odour issues in the community (refer to **Section 10.2.4.3**).

10.2.4.1 Odour Mitigation from the Void

There are two (2) critical areas of focus with respect to odour mitigation from the Void, namely:

1. Fugitive landfill gas emissions; and
2. Management of high rainfall events.

These two areas are discussed in **Section 10.2.4.1.1** and **Section 10.2.4.1.2**, respectively.

10.2.4.1.1 Fugitive Landfill Gas Emissions

Veolia should continue its mission of enhancing and accelerating its improvement to landfill gas capture from the Bioreactor as reasonably practicable. This continuation is apparent in the WIP 2020 and AQGGMP, which outlines a comprehensive plan that is being implemented to increase and optimise gas capture. The WIP 2020 and AQGGMP also clearly seek to address current areas of concern and the potential solution outcomes that can be implemented. This is an active (and effective) management approach that will continually improve gas capture efficiency and ultimately reduce odour/landfill gas emissions from the Void. It will also assist Veolia in navigating through the high incidence of high odour complaints and impacts from fugitive emissions from the Void surface. To that end, the 11th IOA endorses this strategy as the primary measure to reduce odour emissions from the Void and recommends that Veolia continues the implementation of the gas systems detailed in the WIP 2020 and WIPS5 2022, AQGGMP, including

- The planning and documentation of landfill gas infrastructure, leachate and gas drainage and tipping operations throughout the life of the operations. This ensures that a plan for future infrastructure developments is aligned with filling to maximise landfill gas capture;
- The monitoring and optimisation of the landfill gas wells to maximise landfill gas capture through the current collection network within the Void;
- The augmentation of additional pipework and booster/flare/engine to the current capacity at the Woodlawn Facility. In principle, the addition of the power station engines will increase landfill gas usage capacity, further facilitate the optimisation and minimisation of fugitive landfill gas release from the Void surface;
- The planned infrastructure instalments within each waste lift;
- The continuous improvement of leachate extraction, treatment performance, capacity, and efficiency. This is supported by the implementation of the long-term leachate solution in the form of the LTP, which remains in the process-proving and optimisation phase of operation;
- The continuous improvement in the waste tipping profile, covering and expansion and optimisation of the landfill gas infrastructure;

- The continuous monitoring of leachate and gas extraction;
- The remediation actions in the event of equipment failure and process upset in the Void;
- The continuous awareness of condensate management;
- The implementation of operational management programs, including:
    - leachate management;
    - pumps and pumping solutions; and
    - expansion of wells in the Void for improved/minimisation of leachate recirculation and landfill gas extraction.
- The application of biocover material to manage fugitive landfill gas emissions, as outlined in the WIP 2020.

It should be noted that the WIP 2020 and AQGGMP are live documents that are continually reviewed and updated. Therefore, they will continue to remain an integral part of the IOA.

10.2.4.1.2 Management of High Rainfall Events

As outlined in previous IOAs, the management of high rainfall events and its impact on the Bioreactor operations represent an operational challenge at the Woodlawn Facility. This includes the management of the treated leachate and pond storage capacities. It is notable that this circumstance may potentially be alleviated in the future from the predicted impact of the emerging El Niño forecast in Australia, which is expected to yield warmer and drier weather patterns (valid at the time of writing). Notwithstanding this, as part of prudent planning and good practice, the 11th IOA continues to support the development of a strategy and engineering design that focuses on reducing leachate generation by diverting and extracting stormwater. This is a more effective and achievable goal compared with increasing leachate extraction rates through the LMS, especially during high rainfall or frequency storm events. As outlined in the previous IOA, a leachate management strategy comprising high flow extraction of stormwater/slightly impacted stormwater, flexible leachate extraction rates, and maximising extractions during summer months for evaporation dams will be beneficial for managing leachate levels in the Bioreactor.

10.2.4.2 Active Tipping Face

Veolia should continue to develop strategies for minimising the exposed ATF surface area. It should also proceed and continue with the details in the WIP 2020 and AQGGMP. The 11th IOA notes that changes to the tipping profile to maximise stormwater capture and removal (refer to **Section 10.2.3**) have increased the footprint of the ATF. The target of leachate minimisation through stormwater diversion and management will have a larger material impact on odour compared to the minimisation of the ATF area, given its impact on fugitive gas emission release and landfill gas capture.

10.2.4.3 Refine Investigation of Odour Issues in the Community

Given the number of odour complaints documented in the 11th IOA, the 11th IOA recommends that Veolia continues with its community engagement and liaison process. This is understood to include continued community engagement through various groups (i.e., Tarago and District Progress Association Inc (**TADPAI**), Tarago Times publications & Community Liaison Committee, Open days) and an independent facilitator over several months. The 11th IOA supports the continuation of community engagement as an integral part of the odour management framework at the Woodlawn Facility.

Veolia should also continue to log and monitor odour complaints in the current odour complaints register.

10.3 NON-MANDATORY RECOMMENDATIONS

The non-mandatory recommendations in the 11th IOA revolve around odour mitigation strategies for waste transport activities to the Woodlawn Facility.

10.3.1 IMF and Waste Transport Activities

Based on TOU observations, the 11th IOA suggests that Veolia continue to maintain a practical and measured degree of situational awareness to the waste transport activities supporting the operations at the Woodlawn Facility, with the view of identifying opportunities for improvement if required (noting that these are transient and minor sources of odour that could lead to localised impact).

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Veolia Environmental Services (Australia) Pty Ltd

Woodlawn Bioreactor Expansion Project

Independent Odour Audit #11

October 2023

Appendices

THE ODOUR UNIT

APPENDIX A:

RECORD OF CORRESPONDENCE WITH NSW EPA & DPE

Michael Assal

Subject: Veolia Woodlawn Bioreactor Odour Audit #11 (DA 10_0012) - Consultation
Attachments: Veolia Woodlawn - Odour Audit #11 Proposal [20230206 - External - DPIE + NSW EPA r1].pdf

Importance: High

From: Michael Assal
Sent: Tuesday, February 7, 2023 11:32 AM
To: [redacted]
Cc: [redacted]
Subject: Veolia Woodlawn Bioreactor Odour Audit #11 (DA 10_0012) - Consultation
Importance: High

To whom it may concern,

RE: Woodlawn Bioreactor Facility Odour Audit #11

Relevant Background

We, The Odour Unit (**TOU**), have been engaged by Veolia Environmental Services (**Veolia**) to conduct the eleventh (11th) independent odour audit (the **Odour Audit**) at the Woodlawn Bioreactor Facility, Tarago, NSW (the **Woodlawn Facility**). In accordance with the project approval requirements outlined in *Condition 7* of *Schedule 4* in the *Specific Environmental Conditions - Landfill sites* (DA 10_0012), which states that we need to "*Consult with the Environment Protection Authority (EPA) and the Department of Planning, Industry and Environment (DPIE)",* please regard this email as our **formal** notification for consultation with the relevant regulatory departments for the Odour Audit.

The Odour Audit Proposal

Please find **attached** our proposal as addressed and issued to Veolia for undertaking the Odour Audit at the Woodlawn Facility. The attached proposal details our scope of work, the audit team, deliverables, timeframe, and other details relating to the undertaking of the Odour Audit. The deliverable will be two formal reports, with Report 1 addressing the requirements as specified in DA 10_0012 for the Bioreactor (i.e. the Odour Audit), and Report 2 addressing the MBT Facility and the additional works outlined in *Section 1* and *Section 1.1* of the proposal that are not a requisite of DA 10_0012 but are being completed as part of the Odour Audit.

Consultation Timing

As you will gather from the **attached** proposal, we have scheduled the fieldwork component of the Odour Audit to be completed between **20 February 2023** and **23 February 2023**. As such, it will be appreciated if we could receive any advice or feedback on or before the close of business on **17 February 2023.**

We look forward to hearing from you soon.

Please do not hesitate to contact us if you have any enquiries.

Regards,

Michael Assal MEngSc, B. Eng (Hon)/B.Sc, AMIChemE, MIEAust, CAQP
Operations Manager

The Odour Unit Pty Ltd
Level 3, 12/56 Church Avenue
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DOC23/87190-1

Mr Michal Assal
Operations Manger
The Odour Unit
Level 3, 12/56 Church Avenue
MASCOT NSW 2020

email: massal@odourunit.com.au

17 February 2023

Dear Mr Assal

Woodlawn Waste Expansion Project – Independent Odour Audit #11 Consultation

I am writing in response to your email to the Environment Protection Authority (EPA) dated 7 February 2023 requesting feedback and advice on your proposal for carrying out the eleventh annual Independent Odour Audit for the Woodlawn Waste Expansion Project.

The EPA provides advice in the attachment to this letter (**Attachment A**). This advice should be read in conjunction with the advice provided ahead of the 2022, tenth annual audit (EPA reference DOC22/145599-1) and relates to the following matters:

- Measurement of all key odour sources
- Offensive odour at receptors
- Review of Air Quality and Greenhouse Gas Management Plan
- Effectiveness of Odour Controls
- Odour dispersion modelling
- Recommendations to improve odour control

If you have any questions regarding the above, please contact Nick Feneley on (02) 4224 4144 or at info@epa.nsw.gov.au.

Yours sincerely

LARA BARRINGTON
A/Manager Regulatory Operations

ATTACHMENT A: EPA Feedback and advice on the eleventh annual Independent Odour Audit for the Woodlawn Waste Expansion Project.

ATTACHMENT A: EPA Feedback and advice on the eleventh annual Independent Odour Audit for the Woodlawn Waste Expansion Project.

Measurement of all Key Odour Sources

Condition 7 of Schedule 4 of the Woodlawn Waste Expansion Project Approval (MP10_0012) requires the audit to:

(e) measure all key odour sources on site including:

i. consideration of wet weather conditions providing all raw sampling data used in this analysis;

ii. consideration of (but not limited to) all liquid storage areas, active tipping faces, waste cover area, aged waste areas and recirculation of leachate onto waste in the void; and

iii. a comparison of the results of these measurements against the predictions in the EA;

A thorough air emissions inventory for the premises should be undertaken which identifies all sources of air pollution, the air pollutants emitted from each source, and estimates the emission concentration and rate of all air pollutants emitted. Please refer to our Approved Methods for the Modelling and Assessment of Air Pollutants in NSW and Technical framework: Assessment and management of odour from stationary sources in NSW for further advice.

The audit should clearly identify any gaps in knowledge, assumptions and limitations in the information provided and the steps that will be taken to address these uncertainties.

Emissions from the premises should be demonstrated to comply with the requirements of the EPL and any relevant environment protection regulations.

In relation to the above, the following points should be considered:

- Odour sampling for the previous audit (Odour Audit #10) was generally undertaken at the same sources and using the same methods as previous years' odour audits. Consideration should be given in this year's audit to incorporating sampling of odour and gases using additional techniques (e.g. H2S, PID, open path FTIR, LIDAR, drones) to compliment the static reference method of sampling. Such additional techniques may assist in identifying and better understanding the key sources of odour within a broader sample location.
- Evaporation dam ED1 has received discharges of treated leachate from the ED1 coffer dam since the last audit was undertaken. It has also received discharges of stormwater from the landfill void and from evaporation dam ED3S. Some of this liquid may have the potential to generate odours. As such, ED1 should be included in the emissions inventory.
- Evaporation dam ED3S receives stormwater from the landfill void that may have come into contact with waste. The liquid stored in this dam could contribute to odours from the premises and should be included in the emissions inventory.
- The potential for emissions from specific elements of the Membrane Bioreactor Leachate Treatment Plant (LTP) does not appear to have been considered in previous audits. The LTP is undergoing proving and the risk of odours from storage and treatment processes, plant upsets (e.g. microbiological changes) should be assessed. Potential emission points such as the open top aeration tank should be included in the emissions inventory.
- The EPA has received reports from members of the Tarago community that waste laden trains sometimes park on the rail siding in the Tarago village (e.g. in the vicinity of Tarago Public School) while they await entry into the Crisps Creek Intermodal Facility. The reports allege that these trains may be contributing to odours within the Tarago village. This should be considered by the auditor.

Offensive odour at receptors

Condition 7 of Schedule 4 of the Project Approval requires the audit to:

> *(b) audit the effectiveness of the odour controls on site in regard to protecting receivers against offensive odour;*
>
> *(f) determine whether the project is complying with the requirements in this approval to protect receivers against offensive odour;*

The project approval states, "The Proponent shall not cause or permit the emission of offensive odours from the site, as defined under Section 129 of the POEO Act". Under this Act offensive odour means an odour—

> (*a*) *that, by reason of its strength, nature, duration, character or quality, or the time at which it is emitted, or any other circumstances—*
>
> > *(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or*
> >
> > *(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
>
> *(b) that is of a strength, nature, duration, character or quality prescribed by the regulations or that is emitted at a time, or in other circumstances, prescribed by the regulations.*

The Audit should evaluate compliance and explicitly state whether the premises is complying with offensive odour.

The EPA makes the following observations:

- Odour complaints and odour surveys in IOU#10 indicate that offensive odours are occurring beyond the premise boundary and at receptors.
- The EPA does not consider modelling an appropriate means of assessing compliance with section 129 of the POEO Act for existing facilities. There is inherent uncertainty in using dispersion modelling to assess odour impact. Compliance with odour assessment criterion is one tool that provides an indication of acceptable odour impacts. The benchmark is if the emission of odour is offensive or is being prevented or minimised using best management practices and best available technology.
- Within the most recent Annual Return submitted to the EPA for the EPL No 11436, Veolia have reported a non-compliance with offensive odour provisions (defined under Section 129 of the POEO Act) for the licence reporting period between 4 September 2021 to 5 September 2022.
- On 28 November 2022, the EPA issued Veolia with a Penalty Notice for an alleged contravention of condition L6.1 of the Woodlawn Landfill environment protection licence (EPL 11436) on 17 June 2022. Condition L6.1 provides that there must be no offensive odour emitted from the premises, in accordance with Section 129 of the Protection of the Environment Operations Act 1997, nor emissions to the atmosphere from the landfill that may adversely affect the health or amenity of the community.

Review Air Quality and Greenhouse Gas Management Plan

Condition 7 of Schedule 4 of the Project Approval requires the audit to:

> *(d) review the relevant odour sections of the Air Quality and Greenhouse Gas Management Plan for the project and assess the effectiveness of the odour controls;*

It is noted that Odour Audit #10 recommended the preparation of a site-specific odour management plan for the Bioreactor and MBT operations. Veolia has committed to updating its existing Air Quality and Greenhouse Gas Management Plan to incorporate the recommendations from Odour Audit #10 prior to finalising and submitting to the Department of Planning and Industry for approval.

Amongst other things, Odour Audit #10 recommended that the odour management plan document *"An outline of how the production and migration of emissions is minimised at the Woodlawn Facility, including design (where applicable) and operating practices"*. This should be explained in the plan in the context of a landfill gas mass balance that describes and quantifies:

- gas generated by the landfill (methodologies used for calculating / estimating gas generation should be described in the plan)
- gas recovered (i.e., gas collected and burnt in the flares or engines)
- gas migrated
- gas stored
- gas oxidised by cover materials
- gas emitted

This context is important when using gas collection data to evaluate the effectiveness of the landfill gas collection and extraction system in preventing fugitive gas emissions from the landfill void.

Effectiveness of Odour Controls

Condition 7 of Schedule 4 of the Project Approval requires the audit to:

(b) audit the effectiveness of the odour controls on site in regard to protecting receivers against offensive odour;

(c) review the Proponent's production data (that are relevant to the odour audit) and complaint records

In addressing these aspects of the Audit, the auditor should consider the following:

- The specific mitigations and changes that have occurred to address odour in the period since the last audit was undertaken and their effectiveness;

- The results of Veolia's monthly surface gas monitoring program and the efficacy of their Trigger Action Response Plan for dealing with exceedances. Consideration should be given to the adequacy of current sampling frequencies and whether options might exist for the deployment of real-time (or close to real-time) monitoring as a mechanism for responding to surface emissions as they arise.

  The EPA notes that no exceedances of the 500ppm methane notification threshold were identified by last year's audit, whereas, exceedances have been detected every month between July 2022 and February 2023. The reasons for this should be assessed and discussed.

- The results of meteorological and ambient hydrogen sulfide monitoring conducted at EPA Points 9, 71 and 72 in accordance with the requirements of EPL 11436.

- The overall landfill gas mass balance for the premises, including any gas generation calculations/estimates made for the purposes of the National Greenhouse and Energy Reporting Scheme.

- The efficiency and adequacy of existing gas extraction and utilisation infrastructure (i.e., number collection wells, flares and engines) in the context gas collection data and the total amount of gas needed to be collected and extracted to prevent fugitive emissions to the atmosphere.

- Veolia updated its public website in September 2022 to report that:

"As part of our focus on potential odour sources on site we have identified a storage pond that will need some extra aeration. This will help to further reduce organics, to eliminate the possibility of odour. We have purchased a portable aeration unit which is to be installed on the dam in the coming weeks. We will measure oxygen production and organics reduction. If successful we can order more of these to ensure we have enough capacity to manage any potential odour coming from storage dams.

We are also in the process of acquiring a portable carbon filter that can be used on the waste surface to draw in air and treat potential odour from problematic areas. We plan to purchase 2 units for trialling in the coming months."

The effectiveness of these initiatives should be assessed and discussed.

Re-run of Odour Dispersion Model

It is stated in the audit proposal that the auditor intends to *"re-run of the site-specific odour dispersion model (initially done in the Environmental Assessment Woodlawn Expansion Report dated August 2010 (EA 2010) with the current operational factors and emissions data obtained as part of the Odour Audit"*. In undertaking that work, the auditor should consider that the odour dispersion modelling undertaken for the Woodlawn Advanced Energy Recover Centre (ARC) Project EIS predicted higher odour concentrations from existing landfill operations than what modelling undertaken in previous odour audits has predicted. While the exact reasons for this difference are unknown, EMM (the ARC Project consultant) consider that "a key contributing factor is the adoption of site-specific meteorological data in the ARC modelling (IOA#9 based meteorological predictions on inputs from the BoM Goulburn Airport station)".

Further, for any modelling that is undertaken as part of the odour audit, the auditor should:

- note the EPA's comments on the modelling issues raised in its submission on the Woodlawn ARC Project EIS; and
- include a sensitivity analysis to understand potential impacts associated with variable odour emission scenarios and odour sources excluded from sampling and assessment.

While dispersion modelling may assist in evaluating the efficiency of mitigation and controls, the EPA reiterates its previous advice that it does not consider modelling an appropriate means of assessing compliance with section 129 of the POEO Act for existing facilities. There is inherent uncertainty in using dispersion modelling to assess odour impact. Whilst, compliance with odour assessment criterion is one tool that provides an indication of acceptable odour impacts at the project planning stage, the benchmark for compliance is if the emission of odour is offensive or is being prevented or minimised using best management practices and best available technology.

Recommendations to improve odour control

Condition 7 of Schedule 4 of the Project Approval requires the audit to:

> *(g) outline all reasonable and feasible measures (including a cost/benefit analysis, if required) that may be required to improve odour control at the site; and*
>
> *(h) recommend and prioritise (mandatory and non-mandatory) recommendations for their implementation.*

It is the EPA's expectation that the Audit provides clear and defined recommendations that are measurable, trackable and auditable. This will assist in determining if or how the recommendations from the Odour Audits will be implemented to achieve improved odour control and when they will be implemented.

The Audit should:

- Identify specific actions undertaken to improve odour control since the last odour audit and those that will be undertaken in the short-term, medium-term and long-term.
- Clearly distinguish between ongoing actions from previous odour audits and the additional recommended actions to be undertaken,
- For each recommendation/action state timeframes for commencement and completion,
- Evaluate all reasonable and feasible control options with best practice measures**.**

Department of Planning and Environment

Ms Marea Rakete
Woodlawn Environmental Officer
Veolia Environmental Services (Australia) Pty Ltd
619 Collector Road
TARAGO NSW 2580

08/02/2023

Dear Ms Rakete

Woodlawn Waste Expansion Project (MP 10_0012)
Annual Independent Odour Auditor 2023

I refer to your request of 7 February 2023 seeking approval of Messrs Terry Schulz, Michael Assal and Steven Hayes of The Odour Unit Pty Ltd (the audit team) for the upcoming Annual Independent Odour Audit of Woodlawn Waste Expansion Project (the development), in accordance with Schedule 4, Condition 7 of the development consent MP 10_0012, as modified (the consent).

Having considered the qualifications and experience of the audit team, the Planning Secretary endorses the appointment of the audit team to undertake the Annual Independent Odour Audit in accordance with Schedule 4, Condition 7 of the consent. This approval is conditional on the audit team being independent of the development and maintaining the relevant qualifications and/or certification. The department reserves the right to request an alternate auditor or audit team for future audits.

Please ensure this correspondence is appended to the Audit Report.

The audit is to be conducted in accordance with AS/NZS ISO 19011 Australian/New Zealand Standard: Guidelines for quality and/or environmental management systems auditing. Auditors may wish to have regard to the Independent Audit Guideline dated May 2020. A copy of this guideline can be located at https://www.planning.nsw.gov.au/-/media/Files/DPE/Other/Assess-and-regulate/About-Compliance/independent-audit-post-approval-requirements-2020-05-19.pdf.

The audit report is to include the following:

- consultation with the relevant agencies;
- a compliance table indicating the compliance status of each condition of approval and any relevant EPL;
- not use the term “partial compliance”;
- recommend actions in response to non-compliances;
- review the adequacy of plans and programs required under this consent; and
- identify opportunities for improved environmental management and performance.

Within six weeks of the completion of the Annual Independent Odour Audit, Veolia is to submit a copy of the audit report to the Planning Secretary and the Environment Protection Authority, together with its response to any recommendations contained in the audit report and a timetable to implement the recommendations. Prior to submitting the audit report to the Planning Secretary, it is recommended that Veolia review the report to ensure it complies with the relevant approval condition.

Failure to meet these requirements will require revision and resubmission of the Audit Report.

Should you need to discuss the above, please contact Georgia Dragicevic, Senior Compliance Officer, on (02) 4247 1852 or by email to Georgia.Dragicevic@planning.nsw.gov.au.

Yours sincerely

Katrina O'Reilly
Team Leader - Compliance
Compliance

As nominee of the Planning Secretary

Michael Assal

Subject: Veolia Woodlawn Bioreactor Odour Audit #11 (DA 10_0012) - Consultation

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From: [redacted]
Sent: Friday, February 10, 2023 10:38 AM
To: [redacted]
Cc: [redacted]>
Subject: RE: Veolia Woodlawn Bioreactor Odour Audit #11 (DA 10_0012) - Consultation

Hi Michael,

Thank you for consulting the department on the upcoming odour audit. In addition to the consent requirements, please review the status and effectiveness of the previous audit recommendations and suggest any improvements.

Kind Regards,
Georgia

From: Michael Assal <massal@odourunit.com.au>
Sent: Tuesday, 7 February 2023 11:32 AM
To: Georgia Dragicevic <Georgia.Dragicevic@planning.nsw.gov.au>; Katrina O'Reilly <Katrina.OReilly@planning.nsw.gov.au>; INFOEnvironment <info@environment.nsw.gov.au>; Nicholas Feneley <Nick.Feneley@epa.nsw.gov.au>; Peter Bloem <Peter.BLOEM@epa.nsw.gov.au>
Cc: Marea Rakete <marea.rakete@veolia.com>
Subject: Veolia Woodlawn Bioreactor Odour Audit #11 (DA 10_0012) - Consultation
Importance: High

To whom it may concern,

RE: Woodlawn Bioreactor Facility Odour Audit #11

Relevant Background

We, The Odour Unit (**TOU**), have been engaged by Veolia Environmental Services (**Veolia**) to conduct the eleventh (11^{th}) independent odour audit (the **Odour Audit**) at the Woodlawn Bioreactor Facility, Tarago, NSW (the **Woodlawn Facility**). In accordance with the project approval requirements outlined in *Condition 7* of *Schedule 4* in the *Specific Environmental Conditions - Landfill sites* (DA 10_0012), which states that we need to "*Consult with the Environment Protection Authority (EPA) and the Department of Planning, Industry and Environment (DPIE)",* please regard this email as our **formal** notification for consultation with the relevant regulatory departments for the Odour Audit.

The Odour Audit Proposal

Please find **attached** our proposal as addressed and issued to Veolia for undertaking the Odour Audit at the Woodlawn Facility. The attached proposal details our scope of work, the audit team, deliverables, timeframe, and other details relating to the undertaking of the Odour Audit. The deliverable will be two formal reports, with Report 1 addressing the requirements as specified in DA 10_0012 for the Bioreactor (i.e. the Odour Audit), and Report 2 addressing the MBT

Facility and the additional works outlined in *Section 1* and *Section 1.1* of the proposal that are not a requisite of DA 10_0012 but are being completed as part of the Odour Audit.

Consultation Timing

As you will gather from the **attached** proposal, we have scheduled the fieldwork component of the Odour Audit to be completed between **20 February 2023** and **23 February 2023**. As such, it will be appreciated if we could receive any advice or feedback on or before the close of business on **17 February 2023.**

We look forward to hearing from you soon.

Please do not hesitate to contact us if you have any enquiries.

Regards,

Michael Assal MEngSc, B. Eng (Hon)/B.Sc, AMIChemE, MIEAust, CAQP
Operations Manager

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THE ODOUR UNIT

APPENDIX B:

ODOUR CONCENTRATION LABORATORY TESTING RESULT SHEETS

☒ **Sydney Laboratory**
The Odour Unit Pty Ltd
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2/57 Neumann Road
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E: qldinfo@odourunit.com.au
ABN: 87 102 255 765

Odour Concentration Measurement Report

Sampling and Laboratory Information

Organisation	Veolia Environmental Services	Telephone	+61 2 8588 1362
Contact	M. Rakete	Email	marea.rakete@veolia.com
Sampling Site	Woodlawn, NSW	Sampling Personnel	TOU (TS, AS, JS IF, SH & MG)
Sampling Method	AS/NZS 4323.3 / AS/NZS 4323.4	Laboratory Location	Mascot, NSW

Order and Project Information

Order requested by	M. Rakete	Order accepted by	M. Assal
Date of order	6 February 2023	TOU Project #	N1806L.11
Order number	7100421093	Project Manager	M. Assal
Signed by	M. Rakete	Panel Operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – *Part 3*: '*Determination of odour concentration by dynamic olfactometry* (AS/NZS 4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: TOU-OLF-004
Laboratory Precision	The precision of this laboratory (expressed as repeatability) for sensory quality must be $r \leq 0.477$ in accordance with the AS/NZS 4323.3. $r = 0.461$ Compliance – Yes
Laboratory Accuracy	The accuracy of this laboratory for sensory quality must be $A \leq 0.217$ in accordance with the AS/NZS 4323.3. $A = 0.216$ Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. Note Disclaimers on last page of this document.

Accredited for compliance with ISO/IEC 17025 - Testing.
This report shall not be reproduced, except in full.

Date: Friday, 16 June 2023

Panel Roster Number: SYD20230221_012

A. Schulz
Laboratory Coordinator

I. Farrugia
Authorised Signatory

THE ODOUR UNIT

Accreditation Number:
14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230221_012

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-001 MBT: OCS 2 Biofilter Outlet, Cell 1 (SW)	SC23065	20/02/2023 1249 hrs	21/02/2023 0958 hrs	4	8	861
1806-11-002 MBT: OCS 2 Biofilter Outlet, Cell 2 (SE)	SC23066	20/02/2023 1259 hrs	21/02/2023 1023 hrs	4	8	1,450
1806-11-003 MBT: OCS 2 Biofilter Outlet, Cell 3 (NW)	SC23067	20/02/2023 1305 hrs	21/02/2023 1051 hrs	4	8	3,160
1806-11-005 MBT: OCS 2 Biofilter Outlet, Cell 4 (NE)	SC23068	20/02/2023 1409 hrs	21/02/2023 1138 hrs	4	8	664
1806-11-006 MBT: OCS 1 Biofilter Outlet, Cell 1	SC23069	20/02/2023 1348 hrs	21/02/2023 1204 hrs	4	8	609
1806-11-007 MBT: OCS 1 Biofilter Outlet, Cell 2	SC23070	20/02/2023 1359 hrs	21/02/2023 1259 hrs	4	8	430

Samples Received in Laboratory – From: I. Farrugia Date: 20/02/2023 Time: 1630 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

THE ODOUR UNIT

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230221_012

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-008 MBT: OCS 1 Biofilter Outlet, Cell 3	SC23071	20/02/2023 1337 hrs	21/02/2023 1325 hrs	4	8	609
1806-11-004 MBT: OCS 2 Biofilter Inlet	SC23072	20/02/2023 1409 hrs	21/02/2023 1357 hrs	4	8	4,870
1806-11-009 MBT: OCS 1 Biofilter Inlet	SC23073	20/02/2023 1418 hrs	21/02/2023 1449 hrs	4	8	609
1806-11-010 MBT: Leachate Dam (W), far from Inlet	SC23074	20/02/2023 1400 hrs	21/02/2023 1552 hrs	4	8	724
1806-11-011 MBT: Leachate Dam (E), near to Inlet	SC23075	20/02/2023 1404 hrs	21/02/2023 1616 hrs	4	8	1,450
1806-11-012 MBT: Leachate Dam (W), near to Inlet	SC23076	20/02/2023 1448 hrs	21/02/2023 1650 hrs	4	8	861
1806-11-013 MBT: Leachate Dam (E), far from Inlet	SC23077	20/02/2023 1503 hrs	21/02/2023 1720 hrs	4	8	1,120

Samples Received in Laboratory – From: I. Farrugia Date: 20/02/2023 Time: 1630 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

THE ODOUR UNIT

Accreditation Number:
14974

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS 4323.3 (Yes / No)
n-butanol	SYD20230221_012	51,000	$20 \leq \chi \leq 80$	1,024	50	Yes

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

Sample ID / Location	Laboratory ID	Odour Character
1806-11-001 MBT: OCS 2 Biofilter Outlet, Cell 1 (SW)	SC23065	dirt, soil, garbage, sour
1806-11-002 MBT: OCS 2 Biofilter Outlet, Cell 2 (SE)	SC23066	fermented, dirt, soil, garbage
1806-11-003 MBT: OCS 2 Biofilter Outlet, Cell 3 (NW)	SC23067	dirt, soil, garbage
1806-11-004 MBT: OCS 2 Biofilter Inlet	SC23072	garbage
1806-11-005 MBT: OCS 2 Biofilter Outlet, Cell 4 (NE)	SC23068	dirt, soil, garbage, sour
1806-11-006 MBT: OCS 1 Biofilter Outlet, Cell 1	SC23069	dirt, soil, garbage
1806-11-007 MBT: OCS 1 Biofilter Outlet, Cell 2	SC23070	dirt, soil, garbage
1806-11-008 MBT: OCS 1 Biofilter Outlet, Cell 3	SC23071	dirt, soil, garbage
1806-11-009 MBT: OCS 1 Biofilter Inlet	SC23073	garbage
1806-11-010 MBT: Leachate Dam (W), far from Inlet	SC23074	ammonia, rotten
1806-11-011 MBT: Leachate Dam (E), near to Inlet	SC23075	ammonia, rotten
1806-11-012 MBT: Leachate Dam (W), near to Inlet	SC23076	ammonia, rotten
1806-11-013 MBT: Leachate Dam (E), far from Inlet	SC23077	ammonia, rotten

Departures

Clause 9.5.3 (d) – Cross-sectional distribution of airflow and concentration from port-openings are not checked due to impracticality of the requirement.

Disclaimers

1. Parties, other than The Odour Unit, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit relinquishes The Odour Unit from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit.
4. This report shall not be reproduced, except in full, without written approval of The Odour Unit.

Report Status

Status	Version	Prepared by	Date	Checked by	Date	Change	Reason
Draft	0.1	M. Gilbert	27/03/2023	I. Farrugia	31/03/2023	--	--
Final	1.0	--	--	I. Farrugia	16/06/2023	--	--

END OF DOCUMENT

☒ **Sydney Laboratory**
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ABN: 87 102 255 765

Odour Concentration Measurement Report

Sampling and Laboratory Information

Organisation	Veolia Environmental Services	Telephone	+61 2 8588 1362
Contact	M. Rakete	Email	marea.rakete@veolia.com
Sampling Site	Woodlawn, NSW	Sampling Personnel	TOU (TS, AS, JS IF, SH & MG)
Sampling Method	AS/NZS 4323.3 / AS/NZS 4323.4	Laboratory Location	Mascot, NSW

Order and Project Information

Order requested by	M. Rakete	Order accepted by	M. Assal
Date of order	6 February 2023	TOU Project #	N1806L.11
Order number	7100421093	Project Manager	M. Assal
Signed by	M. Rakete	Panel Operator	A. Schulz

Investigated Item — Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.

Identification — The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

Method — The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – *Part 3*: '*Determination of odour concentration by dynamic olfactometry* (AS/NZS 4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

Measuring Range — The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.

Environment — The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.

Measuring Dates — The date of each measurement is specified with the results.

Instrument Used — The olfactometer used during this testing session was:
TOU-OLF-004

Laboratory Precision — The precision of this laboratory (expressed as repeatability) for sensory quality must be $r \leq 0.477$ in accordance with the AS/NZS 4323.3.
$r = 0.461$ Compliance – Yes

Laboratory Accuracy — The accuracy of this laboratory for sensory quality must be $A \leq 0.217$ in accordance with the AS/NZS 4323.3.
$A = 0.216$ Compliance – Yes

Lower Detection Limit (LDL) — The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.

Traceability — The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. Note Disclaimers on last page of this document.

Accredited for compliance with ISO/IEC 17025 - Testing.
This report shall not be reproduced, except in full.

Date: Friday, 16 June 2023 Panel Roster Number: SYD20230222_013

A. Schulz
Laboratory Coordinator

I. Farrugia
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20230222_013

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-014 ED3N-1 (E Corner) 1 of 2	SC23078	21/02/2023 1014 hrs	22/02/2023 0947 hrs	4	8	83
1806-11-015 ED3N-1 (S Corner) 2 of 2	SC23079	21/02/2023 1010 hrs	22/02/2023 1031 hrs	4	8	395
1806-11-016 ED3N-2 (E Corner) 1 of 2	SC23080	21/02/2023 1015 hrs	22/02/2023 1102 hrs	4	8	12,600
1806-11-017 ED3N-2 (N Corner) 2 of 2	SC23081	21/02/2023 1100 hrs	22/02/2023 1131 hrs	4	8	17,900
1806-11-019 ED3N-3 (S Corner) 1 of 2	SC23082	21/02/2023 1010 hrs	22/02/2023 1216 hrs	4	8	197
1806-11-020 ED3N-3 (N Corner) 2 of 2	SC23083	21/02/2023 1102 hrs	22/02/2023 1353 hrs	4	8	181

Samples Received in Laboratory – From: T. Schulz Date: 21/02/2023 Time: 16:30 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

THE ODOUR UNIT

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230222_013

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-021 ED3N-4 (SE Corner) 1 of 2	SC23084	21/02/2023 1102 hrs	22/02/2023 1425 hrs	4	8	11,600
1806-11-022 ED3N-4 (NW Corner) 2 of 2	SC23085	21/02/2023 1149 hrs	22/02/2023 1456 hrs	4	8	25,300
1806-11-025 ED1 Cofferdam (NE Corner) 1 of 2	SC23086	21/02/2023 1231 hrs	22/02/2023 1550 hrs	4	8	128
1806-11-026 ED1 Cofferdam (SE Corner) 2 of 2	SC23087	21/02/2023 1245 hrs	22/02/2023 1625 hrs	4	8	32
1806-11-027 ED1 / Acid Mine Drain	SC23088	21/02/2023 1128 hrs	22/02/2023 1705 hrs	4	8	49
1806-11-028 ED1 / Acid Mine Drain (N of ED1 Cofferdam)	SC23089	21/02/2023 1335 hrs	22/02/2023 1734 hrs	4	8	45

Samples Received in Laboratory – From: T. Schulz Date: 21/02/2023 Time: 16:30 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS 4323.3 (Yes / No)
n-butanol	SYD20230222_013	51,000	$20 \leq \chi \leq 80$	724	70	Yes

Comments — Odour characters (non-NATA accredited) as determined by odour laboratory panel:

Sample ID / Location	Laboratory ID	Odour Character	Sample ID / Location	Laboratory ID	Odour Character
1806-11-014 ED3N-1 (E Corner) 1 of 2	SC23078	dirty, muddy water	1806-11-021 ED3N-4 (SE Corner) 1 of 2	SC23084	muddy water, rotten egg
1806-11-015 ED3N-1 (S Corner) 2 of 2	SC23079	dirty, muddy water, sour, onion	1806-11-022 ED3N-4 (NW Corner) 2 of 2	SC23085	muddy water, rotten egg
1806-11-016 ED3N-2 (E Corner) 1 of 2	SC23080	dirty, muddy, rotten egg	1806-11-025 ED1 Cofferdam (NE Corner) 1 of 2	SC23086	muddy water, musty
1806-11-017 ED3N-2 (N Corner) 2 of 2	SC23081	muddy water, rotten egg	1806-11-026 ED1 Cofferdam (SE Corner) 2 of 2	SC23087	muddy water, musty
1806-11-019 ED3N-3 (S Corner) 1 of 2	SC23082	muddy water, ammonia	1806-11-027 ED3S1 Stormwater	SC23088	muddy water
1806-11-020 ED3N-3 (N Corner) 2 of 2	SC23083	muddy water, ammonia	1806-11-028 ED1 / Acid Mine Drain (N of ED1 Cofferdam)	SC23089	musty water

Departures — Clause 9.5.3 (d) – Cross-sectional distribution of airflow and concentration from port-openings are not checked due to impracticality of the requirement.

Disclaimers
1. Parties, other than The Odour Unit, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit relinquishes The Odour Unit from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit.
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Report Status

Status	Version	Prepared by	Date	Checked by	Date	Change	Reason
Draft	0.1	M. Gilbert	27/03/2023	I. Farrugia	31/03/2023	--	--
Final	1.0	--	--	I. Farrugia	16/06/2023	--	--

END OF DOCUMENT

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Odour Concentration Measurement Report

Sampling and Laboratory Information

Organisation	Veolia Environmental Services	Telephone	+61 2 8588 1362
Contact	M. Rakete	Email	marea.rakete@veolia.com
Sampling Site	Woodlawn, NSW	Sampling Personnel	TOU (TS, AS, JS IF, SH & MG)
Sampling Method	AS/NZS 4323.3 / AS/NZS 4323.4	Laboratory Location	Mascot, NSW

Order and Project Information

Order requested by	M. Rakete	Order accepted by	M. Assal
Date of order	6 February 2023	TOU Project #	N1806L.11
Order number	7100421093	Project Manager	M. Assal
Signed by	M. Rakete	Panel Operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – *Part 3*: '*Determination of odour concentration by dynamic olfactometry* (AS/NZS 4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: TOU-OLF-004
Laboratory Precision	The precision of this laboratory (expressed as repeatability) for sensory quality must be $r \leq 0.477$ in accordance with the AS/NZS 4323.3. $r = 0.461$ Compliance – Yes
Laboratory Accuracy	The accuracy of this laboratory for sensory quality must be $A \leq 0.217$ in accordance with the AS/NZS 4323.3. $A = 0.216$ Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. Note Disclaimers on last page of this document.

Accredited for compliance with ISO/IEC 17025 - Testing.
This report shall not be reproduced, except in full.

Date: Friday, 16 June 2023

Panel Roster Number: SYD20230223_014

A. Schulz
Laboratory Coordinator

I. Farrugia
Authorised Signatory

THE ODOUR UNIT

Accreditation Number:
14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230223_014

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-023 ED3S2 (NW Corner) 1 of 2	SC23090	22/02/2023 1026 hrs	23/02/2023 1006 hrs	4	8	790
1806-11-024 ED3S2 (NE Corner) 2 of 2	SC23091	22/02/2023 1024 hrs	23/02/2023 1042 hrs	4	8	1,330
1806-11-032 FOGO (Unscreened Pile) 1 of 2	SC23092	22/02/2023 1218 hrs	23/02/2023 1121 hrs	4	8	17
1806-11-33 FOGO (Unscreened Pile) 2 of 2	SC23093	22/02/2023 1256 hrs	23/02/2023 1150 hrs	4	8	21
1806-11-034 FOGO (Screened Pile) 1 of 2	SC23094	22/02/2023 1155 hrs	23/02/2023 1248 hrs	4	8	27
1806-11-035 FOGO (Screened Pile) 2 of 2	SC23095	22/02/2023 1238 hrs	23/02/2023 1320 hrs	4	8	23

Samples Received in Laboratory – From: J. Schulz Date: 22/02/2023 Time: 1405 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

Odour Sample Measurement Results
Panel Roster Number: SYD20230223_014

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Sample Dilution	Dilution Equipment ID	Diluted Odour Concentration (ou)	Final Odour Concentration (ou)
1806-11-036 Biocap Pile 1 of 2	SC23096	22/02/2023 1152 hrs	23/02/2023 1339 hrs	4	8	--	--	--	64
1806-11-037 Biocap Pile 2 of 2	SC23097	22/02/2023 1155 hrs	23/02/2023 1408 hrs	4	8	--	--	--	23
1806-11-038 MSW Pile 1 of 2	SC23098	22/02/2023 1245 hrs	23/02/2023 1437 hrs	4	8	--	--	--	279
1806-11-039 MSW Pile 2 of 2	SC23099	22/02/2023 1245 hrs	23/02/2023 1517 hrs	4	8	--	--	--	197
1806-11-031 Leachate Treatment Dam – Aerobic	SC23100	22/02/2023 1016 hrs	23/02/2023 1549 hrs	4	8	--	--	--	85,000
1806-11-030 Leachate Treatment Dam – anoxic	SC23101	22/02/2023 1017 hrs	23/02/2023 1619 hrs	4	8	10:1	DIL-001 SYD-GSM-001	13,800	138,000

Samples Received in Laboratory – From: J. Schulz Date: 22/02/2023 Time: 1405 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

THE ODOUR UNIT

Accreditation Number: 14974

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS 4323.3 (Yes / No)
n-butanol	SYD20230223_014	51,000	$20 \le \chi \le 80$	724	70	Yes

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

Sample ID / Location	Laboratory ID	Odour Character	Sample ID / Location	Laboratory ID	Odour Character
1806-11-023 ED3S2 (NW Corner) 1 of 2	SC23090	sour, rotten	1806-11-036 Biocap Pile 1 of 2	SC23096	rotten, garbage water
1806-11-024 ED3S2 (NE Corner) 2 of 2	SC23091	rotten, sewage	1806-11-037 Biocap Pile 2 of 2	SC23097	musty water
1806-11-032 FOGO (Unscreened Pile) 1 of 2	SC23092	musty water	1806-11-038 MSW Pile 1 of 2	SC23098	vanilla
1806-11-33 FOGO (Unscreened Pile) 2 of 2	SC23093	musty	1806-11-039 MSW Pile 2 of 2	SC23099	vanilla
1806-11-034 FOGO (Screened Pile) 1 of 2	SC23094	musty water	1806-11-031 Leachate Treatment Dam – aerobic	SC23100	rotten egg, sewage
1806-11-035 FOGO (Screened Pile) 2 of 2	SC23095	musty	1806-11-030 Leachate Treatment Dam – anoxic (near ramp)	SC23101	rotten egg

Departures

Clause 9.5.3 (d) – Cross-sectional distribution of airflow and concentration from port-openings are not checked due to impracticality of the requirement.

Disclaimers

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2. The collection of odour samples by parties other than The Odour Unit relinquishes The Odour Unit from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit.
4. This report shall not be reproduced, except in full, without written approval of The Odour Unit.

Report Status

Status	Version	Prepared by	Date	Checked by	Date	Change	Reason
Draft	0.1	M. Gilbert	27/03/2023	I. Farrugia	31/03/2023	--	--
Final	1.0	--	--	I. Farrugia	16/06/2023	--	--

END OF DOCUMENT

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E: qldinfo@odourunit.com.au
ABN: 87 102 255 765

Odour Concentration Measurement Report

Sampling and Laboratory Information

Organisation	Veolia Environmental Services	Telephone	+61 2 8588 1362
Contact	M. Rakete	Email	marea.rakete@veolia.com
Sampling Site	Woodlawn, NSW	Sampling Personnel	TOU (TS, AS, JS IF, SH & MG)
Sampling Method	AS/NZS 4323.3 / AS/NZS 4323.4	Laboratory Location	Mascot, NSW

Order and Project Information

Order requested by	M. Rakete	Order accepted by	M. Assal
Date of order	6 February 2023	TOU Project #	N1806L.11
Order number	7100421093	Project Manager	M. Assal
Signed by	M. Rakete	Panel Operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – *Part 3*: '*Determination of odour concentration by dynamic olfactometry* (AS/NZS 4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: TOU-OLF-004
Laboratory Precision	The precision of this laboratory (expressed as repeatability) for sensory quality must be $r \leq 0.477$ in accordance with the AS/NZS 4323.3. $r = 0.461$ Compliance – Yes
Laboratory Accuracy	The accuracy of this laboratory for sensory quality must be $A \leq 0.217$ in accordance with the AS/NZS 4323.3. $A = 0.216$ Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. Note Disclaimers on last page of this document.

Accredited for compliance with ISO/IEC 17025 - Testing.
This report shall not be reproduced, except in full.

Date: Friday, 16 June 2023

Panel Roster Number: SYD20230224_015

A. Schulz
Laboratory Coordinator

I. Farrugia
Authorised Signatory

THE ODOUR UNIT

Accreditation Number:
14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230224_015

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-040 Bioreactor: CC1	SC23102	23/02/2023 1030 hrs	24/02/2023 1019 hrs	4	8	166
1806-11-041 Bioreactor: CC2	SC23103	23/02/2023 1037 hrs	24/02/2023 1045 hrs	4	8	304
1806-11-042 Bioreactor: BC1	SC23104	23/02/2023 1021 hrs	24/02/2023 1125 hrs	4	8	256
1806-11-043 Bioreactor: BC2	SC23105	23/02/2023 1021 hrs	24/02/2023 1159 hrs	4	8	166
1806-11-044 Bioreactor: IC5	SC23106	23/02/2023 1210 hrs	24/02/2023 1301 hrs	4	8	35
1806-11-045 Bioreactor: IC4	SC23107	23/02/2023 1120 hrs	24/02/2023 1325 hrs	4	8	< 16
1806-11-046 Bioreactor: IC3	SC23108	23/02/2023 1123 hrs	24/02/2023 1419 hrs	4	4 ^	19

Samples Received in Laboratory – From: I. Farrugia Date: 23/02/2023 Time: 1830 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

^ Insufficient sample volume for second round

THE ODOUR UNIT

Accreditation Number:
14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230224_015

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-047 Bioreactor: IC2	SC23109	23/02/2023 1117 hrs	24/02/2023 1400 hrs	4	8	17
1806-11-048 Bioreactor: IC1	SC23110	23/02/20023 1125 hrs	24/02/2023 1513 hrs	4	8	91
1806-11-049 Bioreactor: DC1	SC23111	23/02/2023 1257 hrs	24/02/2023 15:46	4	8	64
1806-11-050 Bioreactor: DC2	SC23112	23/02/2023 1224 hrs	24/02/2023 1619 hrs	4	8	609
1806-11-051 Bioreactor: AC1	SC23113	23/02/2023 1216 hrs	24/02/2023 1649 hrs	4	8	4,470
1806-11-052 Bioreactor: AC2	SC23114	23/02/2023 1216 hrs	24/02/2023 1715 hrs	4	8	2,660

Samples Received in Laboratory – From: I. Farrugia Date: 23/02/2023 Time: 1830 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

THE ODOUR UNIT

Accreditation Number: 14974

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS 4323.3 (Yes / No)
n-butanol	SYD20230224_015	51,000	$20 \leq \chi \leq 80$	1,024	50	Yes

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

Sample ID / Location	Laboratory ID	Odour Character	Sample ID / Location	Laboratory ID	Odour Character
1806-11-040 Bioreactor: CC1	SC23102	sour, pineapple, garbage	1806-11-047 Bioreactor: IC2	SC23109	musty
1806-11-041 Bioreactor: CC2	SC23103	rotten, pineapple, garbage	1806-11-048 Bioreactor: IC1	SC23100	rubber
1806-11-042 Bioreactor: BC1	SC23104	rotten, pineapple, garbage	1806-11-049 Bioreactor: DC1	SC23111	musty, vanilla
1806-11-043 Bioreactor: BC2	SC23105	rotten, dirty water	1806-11-050 Bioreactor: DC2	SC23112	pineapple
1806-11-044 Bioreactor: IC5	SC23106	musty	1806-11-051 Bioreactor: AC1	SC23113	garbage
1806-11-045 Bioreactor: IC4	SC23107	musty	1806-11-052 Bioreactor: AC2	SC23114	garbage
1806-11-046 Bioreactor: IC3	SC23108	musty			

Departures

Clause 9.5.3 (d) – Cross-sectional distribution of airflow and concentration from port-openings are not checked due to impracticality of the requirement.

Disclaimers

1. Parties, other than The Odour Unit, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit relinquishes The Odour Unit from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit.
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Report Status

Status	Version	Prepared by	Date	Checked by	Date	Change	Reason
Draft	0.1	M. Gilbert	27/03/2023	I. Farrugia	31/03/2023	--	--
Final	1.0	--	--	I. Farrugia	16/06/2023	--	--

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E: qldinfo@odourunit.com.au
ABN: 87 102 255 765

Odour Concentration Measurement Report

Sampling and Laboratory Information

Organisation	Veolia Environmental Services	Telephone	+61 2 8588 1362
Contact	M. Rakete	Email	marea.rakete@veolia.com
Sampling Site	Woodlawn, NSW	Sampling Personnel	TOU (TS, AS, JS IF, SH & MG)
Sampling Method	AS/NZS 4323.3 / AS/NZS 4323.4	Laboratory Location	Mascot, NSW

Order and Project Information

Order requested by	M. Rakete	Order accepted by	M. Assal
Date of order	6 February 2023	TOU Project #	N1806L.11
Order number	7100421093	Project Manager	M. Assal
Signed by	M. Rakete	Panel Operator	A. Schulz

Investigated Item: Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.

Identification: The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

Method: The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – *Part 3*: '*Determination of odour concentration by dynamic olfactometry* (AS/NZS 4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

Measuring Range: The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.

Environment: The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.

Measuring Dates: The date of each measurement is specified with the results.

Instrument Used: The olfactometer used during this testing session was:
TOU-OLF-004

Laboratory Precision: The precision of this laboratory (expressed as repeatability) for sensory quality must be $r \leq 0.477$ in accordance with the AS/NZS 4323.3.
$r = 0.365$ Compliance – Yes

Laboratory Accuracy: The accuracy of this laboratory for sensory quality must be $A \leq 0.217$ in accordance with the AS/NZS 4323.3.
$A = 0.216$ Compliance – Yes

Lower Detection Limit (LDL): The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.

Traceability: The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. Note Disclaimers on last page of this document.

Accredited for compliance with ISO/IEC 17025 - Testing.
This report shall not be reproduced, except in full.

Date: Friday, 16 June 2023

Panel Roster Number: SYD20230228_016

A. Schulz
Laboratory Coordinator

I. Farrugia
Authorised Signatory

THE ODOUR UNIT

Odour Sample Measurement Results
Panel Roster Number: SYD20230228_016

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-053 ED3N-1 - LOM 1 of 3	SC23115	28/02/2023 0929 hrs	28/02/2023 1101 hrs	4	8	76
1806-11-054 ED3N-1 – LOM 2 of 3	SC23116	28/02/2023 0939 hrs	28/02/2023 1134 hrs	4	8	41
1806-11-055 ED3N-1 – LOM 3 of 3	SC23117	28/02/2023 0951 hrs	28/02/2023 1216 hrs	4	8	17
1806-11-056 ED3N-2 – LOM 1 of 3	SC23118	28/02/2023 1006 hrs	28/02/2023 1323 hrs	4	8	152
1806-11-057 EN3N-2 – LOM 2 of 3	SC23119	28/02/2023 1010 hrs	28/02/2023 1355 hrs	4	8	41

Samples Received in Laboratory – From: M. Assal Date: 28/02/2023 Time: 0852 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

THE ODOUR UNIT

Accreditation Number:
14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230228_016

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-058 ED3N-2 – LOM 3 of 3	SC23120	28/02/2023 1015 hr	28/02/2023 1422 hrs	4	8	49
1806-11-059 ED3N-2 – LOM 1 of 3	SC23121	28/02/2023 1022 hrs	28/02/2023 1429 hrs	4	8	49
1806-11-060 ED3N-3 – LOM 2 of 3	SC23122	28/02/2023 1027 hrs	28/02/2023 1514 hrs	4	4^	16
1806-11-061 ED3N-3 – LOM 3 of 3	SC23123	28/02/2023 1031 hrs	28/02/2022 1531 hrs	4	4^	23

Samples Received in Laboratory – From: M. Assal Date: 28/02/2023 Time: 0852 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

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2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

^ insufficient sample for second round

THE ODOUR UNIT

THE ODOUR UNIT

NATA

Accreditation Number:
14974

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS 4323.3 (Yes / No)
n-butanol	SYD20230228_016	51,000	$20 \leq \chi \leq 80$	724	70	Yes

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

Sample ID / Location	Laboratory ID	Odour Character	Sample ID / Location	Laboratory ID	Odour Character
1806-11-053 ED3N-1 – LOM. 1 of 3	SC23115	muddy water	1806-11-058 ED3N-2 – LOM. 3 of 3	SC23120	muddy water, ammonia
1806-11-054 ED3N-1 – LOM. 2 of 3	SC23116	muddy water	1806-11-059 ED3N-2 – LOM. 1 of 3	SC23121	muddy water, ammonia
1806-11-055 ED3N-1 – LOM. 3 of 3	SC23117	muddy water	1806-11-060 ED3N-3 – LOM. 2 of 3	SC23122	muddy water, ammonia
1806-11-056 ED3N-2 – LOM. 1 of 3	SC23118	muddy water, ammonia	1806-11-061 ED3N-3 – LOM. 3 of 3	SC23123	musty
1806-11-057 EN3N-2 – LOM .2 of 3	SC23119	muddy water, ammonia			

Departures

Clause 9.5.3 (d) – Cross-sectional distribution of airflow and concentration from port-openings are not checked due to impracticality of the requirement.

Disclaimers

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Report Status

Status	Version	Prepared by	Date	Checked by	Date	Change	Reason
Draft	0.1	M. Gilbert	27/03/2023	I. Farrugia	31/03/2023	--	--
Final	1.0	--	--	I. Farrugia	16/06/2023	--	--

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ABN: 87 102 255 765

Odour Concentration Measurement Report

Sampling and Laboratory Information

Organisation	Veolia Environmental Services	Telephone	+61 2 8588 1362
Contact	M. Rakete	Email	marea.rakete@veolia.com
Sampling Site	Woodlawn, NSW	Sampling Personnel	TOU (TS, AS, JS IF, SH & MG)
Sampling Method	AS/NZS 4323.3 / AS/NZS 4323.4	Laboratory Location	Mascot, NSW

Order and Project Information

Order requested by	M. Rakete	Order accepted by	M. Assal
Date of order	6 February 2023	TOU Project #	N1806L.11
Order number	7100421093	Project Manager	M. Assal
Signed by	M. Rakete	Panel Operator	A. Schulz

Investigated Item	Odour concentration in odour units ‘ou’, determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – *Part 3*: ‘*Determination of odour concentration by dynamic olfactometry* (AS/NZS 4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the ‘Comments’ section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: TOU-OLF-004
Laboratory Precision	The precision of this laboratory (expressed as repeatability) for sensory quality must be $r \leq 0.477$ in accordance with the AS/NZS 4323.3. $r = 0.365$ Compliance – Yes
Laboratory Accuracy	The accuracy of this laboratory for sensory quality must be $A \leq 0.217$ in accordance with the AS/NZS 4323.3. $A = 0.216$ Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. Note Disclaimers on last page of this document.

Accredited for compliance with ISO/IEC 17025 - Testing.
This report shall not be reproduced, except in full.

Date: Friday, 16 June 2023

Panel Roster Number: SYD20230301_017

A. Schulz
Laboratory Coordinator

I. Farrugia
Authorised Signatory

THE ODOUR UNIT

Accreditation Number:
14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230301_017

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-062 ED3N-4 – LOM 1 of 3	SC23124	01/03/2023 0906 hrs	01/03/2023 1031 hrs	4	8	49
1806-11-063 ED3N-4 – LOM 2 of 3	SC23125	01/03/2023 0916 hrs	01/03/2023 1059 hrs	4	8	38
1806-11-064 ED3N-4 – LOM 3 of 3	SC23126	01/03/2023 0921 hrs	01/03/2023 1128 hrs	4	8	41
1806-11-065 ED3S2 – LOM 1 of 3	SC23127	01/03/2023 0926 hrs	01/03/2023 1153 hrs	4	8	54
1806-11-066 ED3S2 – LOM 2 of 3	SC23128	01/03/2023 0928 hrs	01/03/2023 1258 hrs	4	8	42

Samples Received in Laboratory – From: I. Farrugia Date: 01/03/2023 Time: 0942 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

THE ODOUR UNIT

Accreditation Number:
14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230301_017

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-067 ED3S2 – LOM 3 of 3	SC23129	01/03/2023 0932 hrs	01/03/2023 1328 hrs	4	8	32
1806-11-068 ED1 Stormwater – LOM 1 of 2	SC23130	01/03/2023 0936 hrs	01/03/2023 1355 hrs	4	8	<16
1806-11-069 ED1 Stormwater – LOM 2 of 2	SC23131	01/03/2023 0938 hrs	01/03/2023 1415 hrs	4	4^	<16
1806-11-070 ED1 Cofferdam – LOM 1 of 2	SC23132	01/03/2023 0941 hrs	01/03/2023 1433 hrs	4	4^	<16

Samples Received in Laboratory – From: I. Farrugia Date: 01/03/2023 Time: 0942 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

^ Insufficient sample for second round

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS 4323.3 (Yes / No)
n-butanol	SYD20230301_017	51,000	$20 \le \chi \le 80$	724	70	Yes

Comments — Odour characters (non-NATA accredited) as determined by odour laboratory panel:

Sample ID / Location	Laboratory ID	Odour Character	Sample ID / Location	Laboratory ID	Odour Character
1806-11-062 ED3N-4 – LOM. 1 of 3	SC23124	muddy water	1806-11-067 ED3S2 – LOM .3 of 3	SC23129	musty water
1806-11-063 ED3N-4 – LOM. 2 of 3	SC23125	muddy water, ammonia	1806-11-068 ED1 Stormwater – LOM .1 of 2	SC23130	musty water
1806-11-064 ED3N-4 – LOM. 3 of 3	SC23126	musty water	1806-11-069 ED1 Stormwater – LOM. 2 of 2	SC23131	musty water
1806-11-065 ED3S2 – LOM. 1 of 3	SC23127	musty water	1806-11-070 ED1 Cofferdam – LOM. 1 of 2	SC23132	musty water
1806-11-066 ED3S2 – LOM. 2 of 3	SC23128	musty water			

Departures — Clause 9.5.3 (d) – Cross-sectional distribution of airflow and concentration from port-openings are not checked due to impracticality of the requirement.

Disclaimers
1. Parties, other than The Odour Unit, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit relinquishes The Odour Unit from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit.
4. This report shall not be reproduced, except in full, without written approval of The Odour Unit.

Report Status

Status	Version	Prepared by	Date	Checked by	Date	Change	Reason
Draft	0.1	M. Gilbert	27/03/2023	I. Farrugia	31/03/2023	--	--
Final	1.0	--	--	I. Farrugia	16/06/2023	--	--

END OF DOCUMENT

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ABN: 87 102 255 765

Odour Concentration Measurement Report

Sampling and Laboratory Information

Organisation	Veolia Environmental Services	Telephone	+61 2 8588 1362
Contact	M. Rakete	Email	marea.rakete@veolia.com
Sampling Site	Woodlawn, NSW	Sampling Personnel	TOU (TS, AS, JS IF, SH & MG)
Sampling Method	AS/NZS 4323.3 / AS/NZS 4323.4	Laboratory Location	Mascot, NSW

Order and Project Information

Order requested by	M. Rakete	Order accepted by	M. Assal
Date of order	6 February 2023	TOU Project #	N1806L.11
Order number	7100421093	Project Manager	M. Assal
Signed by	M. Rakete	Panel Operator	A. Schulz

Investigated Item: Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.

Identification: The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

Method: The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – *Part 3*: '*Determination of odour concentration by dynamic olfactometry* (AS/NZS 4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

Measuring Range: The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.

Environment: The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.

Measuring Dates: The date of each measurement is specified with the results.

Instrument Used: The olfactometer used during this testing session was:
TOU-OLF-004

Laboratory Precision: The precision of this laboratory (expressed as repeatability) for sensory quality must be $r \leq 0.477$ in accordance with the AS/NZS 4323.3.
$r = 0.365$ Compliance – Yes

Laboratory Accuracy: The accuracy of this laboratory for sensory quality must be $A \leq 0.217$ in accordance with the AS/NZS 4323.3.
$A = 0.216$ Compliance – Yes

Lower Detection Limit (LDL): The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.

Traceability: The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. Note Disclaimers on last page of this document.

Accredited for compliance with ISO/IEC 17025 - Testing.
This report shall not be reproduced, except in full.

Date: Friday, 16 June 2023

Panel Roster Number: SYD20230302_018

A. Schulz
Laboratory Coordinator

I. Farrugia
Authorised Signatory

THE ODOUR UNIT

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230302_018

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-071 ED1 Cofferdam – LOM 2 of 2	SC23133	02/03/2023 0920 hrs	02/03/2023 1045 hrs	4	4^	<16
1806-11-072 ED3S1 - LOM	SC23134	02/03/2023 0926 hrs	02/03/2023 1110 hrs	4	4^	<16
1806-11-073 MBT: Leachate Dam - LOM 1 of 2	SC23135	02/03/2023 0929 hrs	02/03/2023 1135	4	8	19
1806-11-074 MBT: Leachate Dam - LOM 2 of 2	SC23136	02/03/2022 0933 hrs	02/03/2023 1204 hrs	4	8	45
1806-11-075 MBT: Maturation Pad, V Drain - LOM 1 of 2	SC23137	02/03/2023 0937 hrs	02/03/2023 1315 hrs	4	8	38

Samples Received in Laboratory – From: I. Farrugia Date: 02/03/2023 Time: 0953 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

1. The collection of samples by a method that is not prescribed by AS/NZS 4323.3.
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

^ Insufficient sample for second round

THE ODOUR UNIT

Accreditation Number:
14974

Odour Sample Measurement Results
Panel Roster Number: SYD20230302_018

Sample ID / Location	Laboratory ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Final Odour Concentration (ou)
1806-11-076 MBT: Maturation Pad, V Drain - LOM 2 of 2	SC23138	02/03/2023 0940 hrs	02/03/2023 1343 hrs	4	8	45
1806-11-077 Leachate Treatment Plant (anoxic) LOM	SC23139	02/03/2023 0946 hrs	02/03/2023 1421 hrs	4	8	99
1806-11-078 Leachate Treatment Plant (aerobic) LOM	SC23140	02/03/2023 0949 hrs	02/03/2023 1450 hrs	4	8	59
1806-11-079 Leachate Treatment Plant (balance) LOM	SC23141	02/03/2023 0953 hrs	02/03/2023 1511 hrs	4	8	91

Samples Received in Laboratory – From: I. Farrugia Date: 02/03/2023 Time: 0953 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit:

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2. Final results that have been modified by the dilution factors where parties other than The Odour Unit have performed the dilution of samples.

THE ODOUR UNIT

Accreditation Number:
14974

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS 4323.3 (Yes / No)
n-butanol	SYD20230302_018	51,000	$20 \leq \chi \leq 80$	724	70	Yes

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

Sample ID / Location	Laboratory ID	Odour Character
1806-11-071 ED1 Cofferdam – LOM 2 of 2	SC23133	musty
1806-11-072 ED3S1 – LOM	SC23134	musty
1806-11-073 MBT: Leachate Dam – LOM 1 of 2	SC23135	musty
1806-11-074 MBT: Leachate Dam – LOM 2 of 2	SC23136	musty
1806-11-075 MBT: Maturation Pad, V Drain – LOM 1 of 2	SC23137	muddy water, ammonia, rotten
1806-11-076 MBT: Maturation Pad, V Drain – LOM 2 of 2	SC23138	muddy water, ammonia
1806-11-077 Leachate Treatment Plant (anoxic) LOM	SC23139	muddy water, ammonia, mouldy
1806-11-078 Leachate Treatment Plant (aerobic) LOM	SC23140	muddy, ammonia, wastewater
1806-11-079 Leachate Treatment Plant (balance) LOM	SC23141	muddy water, ammonia

Departures

Clause 9.5.3 (d) – Cross-sectional distribution of airflow and concentration from port-openings are not checked due to impracticality of the requirement.

Disclaimers

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Draft	0.1	M. Gilbert	27/03/2023	I. Farrugia	31/03/2023	--	--
Final	1.0	--	--	I. Farrugia	16/06/2023	--	--

END OF DOCUMENT

APPENDIX C:

TECHNICAL DOCUMENTATION RELEVANT TO THE AUDIT

VEOLIA'S RESPONSE TO THE 10TH IOA RECOMMENDATIONS

Woodlawn Eco-Precinct Independent Odour Audit (IOA) 2022 Recommendation Responses

***Table 1:* Mandatory Recommendations**

No.	Recommendation	Action	Due Date	Status
1	<u>Odour Management Plan</u> Veolia should prepare a site-specific odour management plan for the Bioreactor and MBT operations, that documents the following features as a minimum: ● Accepted waste streams and description of process operations; ● Standard operating procedures (SOP) that are employed in each key process area to anticipate the formation of emissions and minimise their potential impact on the local airshed (e.g., failure of pump equipment and/or high rainfall events); ● An outline of how the production and migration of emissions is minimised at the Woodlawn Facility, including design (where applicable) and operating practices; ● The monitoring and control protocols required to assist in the management of emissions; ● Critical odour emissions risk and control points; ● An outline of the key staff and responsibilities with respect to odour management; and ● An outline of the reporting requirements with respect to emissions present.	Develop and implement a site specific Odour Management Plan with the key objective of the updated Odour Management Plan will be to find a balance between continuous improvement, operational excellence and the ability to control air emissions. A draft version of the Odour Management Plan was submitted to the EPA for review during the reporting period, however further amendments in accordance with the Audit's recommendations will be incorporated prior to finalising and submitting to the Department of Planning and Industry for approval.	31 March 2023	Not yet completed

No.	Recommendation	Action	Due Date	Status
2	<u>Odour Mitigation from the Void</u> Veolia should continue to manage fugitive landfill gas pathways from the surface using the existing toolkit such as biocover material. This continuation is apparent in the WIP 2020, which outlines a comprehensive plan that is being implemented to increase gas capture. As such, the Audit endorses this strategy as the primary measure to reduce odour emissions from the Void and recommends that Veolia continues the implementation of the gas systems detailed in the WIP 2020, including: ● The augmentation of additional pipework and booster/flare/engine to the current capacity at the Woodlawn Facility. In principle, the addition of the power station engines will increase landfill gas usage capacity, further facilitate the optimisation and minimisation of fugitive landfill gas release from the Void surface; ● the planned infrastructure instalments within each waste lift; ● the continuous improvement to leachate extraction, treatment performance, capacity, and efficiency. This is supported by the implementation of the long- term leachate solution in the form of the LTP that is the process-proving phase of operation; ● the continuous improvement in the waste tipping profile, covering and expansion and optimisation of the landfill gas infrastructure; ● the continuous monitoring of leachate and gas extraction; ● remediation actions in the event of equipment failure and process upset in the Void;	Implement the gas systems described in WIP 2020 including: ● Expansion of the gas capture system to promote gas collection: ○ Install and commission a additional flare and blower in order to manage excess landfill gas extraction; and ○ Install additional wells and extend the existing gas capture pipework accordingly. ● Improve leachate treatment capacity and efficiency; ○ Install an additional UF train at Leachate Treatment Plant; and ○ Hire a boiler unit to maintain heat during the winter; ● Improve balancing of leachate quality in LTD prior to going to LTP; ○ Refurbish and install additional aerators; and ○ Reconfigure the delivery recirculation pipework. ● Improve management and maintenance of intermediate cover: ○ Carry out maintenance of the interface between the waste and the rock face by compacting clay and maintaining biofilters; and ○ Modify the tipping slope grade for long exposure batter to achieve better intermediate cover. ● Improve stormwater interception and reduced leachate production by redesigning the waste surface;	June 2022 April 2022 June 2022 July 2022 February 2023 November 2022 July 2022 June 2023	Complete Complete Complete Ongoing Not yet completed Complete Ongoing Complete

No.	Recommendation	Action	Due Date	Status

	• continuous awareness of condensate management;
	• The implementation of operational management programs, including:
	  ○ Leachate management;
	  ○ Pumps and pumping solutions; and
	  ○ The expansion of wells in the Void for improved/minimisation of leachate recirculation and landfill gas extraction.
	• application of biocover material to manage fugitive landfill gas emissions, as outlined in the WIP 2020.
		○ Design and implement a gable shape on the waste surface for easier collection and extraction of stormwater.
		• Design and implement leachate infrastructure in a low lying area to maximise leachate extraction and increase gas capture;
		  ○ Install subsurface drainage channels for leachate; and
		  ○ Design and construct new leachate transfer infrastructure (Western Unity Area).
		• Enhance maintenance and compaction of gas well and surface cover interfaces:
		  ○ Using a wheel compactor attachment for excavators to compact around wells; and
		  ○ Develop and implement a program to identify and address interface issues at wells as part of an ongoing routine maintenance program.
		• Optimise gas well suction pressure to maximize gas capture rates;
		  ○ Install double suction line for gas wells with high LFG production performance to assure sufficient collection capacity and minimise fugitive emission.
		• Ensure timely identification and rectification of fugitive emissions using daily and monthly surface gas monitoring:
		  ○ Conduct monthly landfill surface gas surveys using an independent expert;
		  ○ Conduct daily inspections of the landfill void; and
		  ○ Develop and implement a Trigger action response plan in consultation with the EPA,
			January 2022
			
			N/A
			
			June 2022
			
			N/A
			
			July 2022
			
			January 2022
			
			N/A
			
			N/A
			
			July 2022
				Complete
				
				Ongoing
				
				Complete
				
				Ongoing
				
				Ongoing
				
				Ongoing
				
				Ongoing
				
				Ongoing
				
				Complete

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No.	Recommendation	Action	Due Date	Status
3	Management of High Rainfall Events The Audit continues to support the development of a strategy and engineering design that focuses on reducing leachate generation by diverting and extracting stormwater. This is a more effective and achievable goal compared with increasing leachate extraction rates through the LMS, especially during high rainfall or frequency storm events. As outlined in the Leachate Assessment, a leachate management strategy comprising high flow extraction of stormwater/slightly impacted stormwater, flexible leachate extraction rates, and maximising extractions during summer months for evaporation dams will be beneficial for managing leachate levels in the Bioreactor.	Implement a leachate management strategy comprising high flow extraction of stormwater/slightly impacted stormwater, flexible leachate extraction rates, and maximising extractions during summer months for evaporation dams.	June 2022	Complete
4	Leachate Management System Veolia should continue to adequately maintain, manage, monitor the upgraded LMS to ensure it is operating in an optimum state and meeting the leachate quality monitoring targets as outlined in the Leachate Treatment Operation Manual and recommended by Veolia Water. Moreover, the performance goals outlined in the Woodlawn Infrastructure Plan (WIP) 2020 should continue to be pursued and materialised.	Pursue and materialise the performance goals outlined in the Woodlawn Infrastructure Plan (WIP) 2020 and minimise leachate generation ny: ○ Maintaining the existing stormwater diversion program; ○ Establishing acceptable limits for the rapid diversion of contaminated but highly diluted stormwater to stormwater storage during high rainfall events and submitting to the EPA for approval.	30 May 2022 September 2023	Ongoing Not yet completed
5	Active Tipping Face Veolia should continue to develop strategies for the minimising of the exposed active tipping face surface area. It should also proceed and continue with the details in the WIP 2020. The Audit notes that changes to the tipping profile to maximise stormwater capture and removal (refer to Section 10.2.3) has increased the footprint of the ATF.	Develop strategies for the minimising of the exposed active tipping face surface area, inclusive of details in the WIP 2020. Following the completion of the gable profile, consideration will be given to an east to west slope to allow stormwater removal.	N/A	Ongoing

No.	Recommendation	Action	Due Date	Status
	The target of leachate minimisation through stormwater diversion and management will have a larger material impact on odour compared to the minimisation of the active tipping area, given its impact on fugitive gas emission release and landfill gas capture.			
6	<u>Refine Investigation of Odour Issues in the Community</u> Veolia should continue with its community engagement and liaison process. Furthermore, in view of the limited efficacy of ambient H2S monitoring with existing sensory technology (as outlined in Section 9.2.1.3), the Audit recommends calibration and training of Veolia staff in the undertaking of field ambient odour assessment surveillance surveys to provide an additional tool in the TARP (refer to Section 9.2.1.2.1.2 for details) in lieu of the odour diary program (refer to Section 10.2.5.1).	Continue to progress with its community engagement and liaison process by way of: • Quarterly CLC meetings; • Monthly Tarago Times articles; • Quarterly Newsletter; and • Veolia website updates. Undertake the calibration and training of Veolia staff to conduct field ambient odour assessment surveillance surveys.	N/A April 2023	Ongoing Not yet completed
7	<u>Status of Odour Diaries</u> The Audit has reviewed the retrieved data from the collected diaries and it is not considered a suitable community feedback tool in its current form to provide valuable data. As such, the odour diary program should be discontinued unless participating community members are professionally trained on its use and data entry protocols.	Identify any community members who are professionally trained to implement and use the odour diary program. If no members are professionally trained to use the diary, remove the odour diary from use.	1 February 2023	Not yet completed

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No.	Recommendation	Action	Due Date	Status
8	Ambient Landfill Gas Composition Laboratory Analysis A landfill gas composition analysis should be completed to provide technical feedback on the gas analytes present of the landfill gas released to the ambient environment from uncontrolled gas emission release points from the surface of the Void at the Woodlawn Facility. The objective of the landfill gas composition analysis will be to identify the gas analytes present, with a focus on characterising those gas compounds that are known to be odorous including, but not limited to sulphur gases and volatile organic compounds.	Veolia has engaged a suitably qualified expert for the undertaking of this analysis and will utilise the gas composition data to refine its ambient monitoring objectives and targets.	December 2022	Not yet completed
9	NSW EPA H2S Monitoring Program Data Interpretation To extract further meaning and facilitate in sound data interpretation, the H2S data collected as part of the NSW EPA monitoring program should be be contextualised with prevailing wind conditions, date and time of detection between different locations, and correlated with landfill gas extraction and leachate extraction rates to facilitate in the interpretation of this data.	Seek contextualisation of the EPA's H2S monitoring data as part of a separate study to the Audit, and completed by March 2023 and before the next IOA.	March 2023	Not yet completed

No.	Recommendation	Action	Due Date	Status
10	Odour Mitigation from the MBT Facility The Audit recommends a heightened awareness of the operability and maintenance of the biofilter-based odour control system at the MBT Facility, which should be consistent with the Biofilter Manual to ensure optimal and sustained odour removal performance. It is recommended that the MBT Facility improve its overall management of biofilter bed moisture to ensure optimum odour removal performance. This can be achieved by an intensification of the surface drip irrigation system and/or optimisation of the current spray humidification system.	Veolia will carry out a complete biofilter refurbishment at the MBT which will be completed in early 2023 and undertake scheduled maintenance to optimise the spray humidification system.	March 2023	Not yet completed

Table 2: **Improvement Opportunities**

No.	Recommendation	Action	Due Date	Status
1	IMF and Waste Transport Activities Veolia should continue to review the following aspects relating to the use of the IMF and waste transport activities to further improve its odour performance as a minor and transient source of odour, namely: • The washing practice associated with the sealed containers; and • The maintenance of the sealed containers.	Continue to monitor the operation of the container and truck wheel washing practices on site and maintain the integrity of the container fleet on an automated maintenance schedule.	N/A	Complete

THE ODOUR UNIT

EMISSION TESTING REPORTS: WOODLAWN BIOGAS POWER STATION:

R011837R & R013467

Ektimo

Veolia Environmental Services (Australia) Pty Ltd

Woodlawn Biogas Power Station, Tarago

Emission Testing Report

Report Number R011837r

Document Information

Template Version 211117

Client Name:	Veolia Environmental Services (Australia) Pty Ltd
Report Number:	R011837r
Date of Issue:	11 July 2022
Attention:	Christian Chang
Address:	619 Collector Rd Tarago NSW 2580
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Amendment Record

Original Document Number	Initiator	Original Report Date	Section (s)	Reason for revision
R011837	Client (CCh)	24 May 2022	Page 8. Results Page 12. Test Methods	EPA 8 engine 2 volumetric flow rate reported twice. Duplicate now removed. Dry gas Density & molecular weight (TM-23) added to test methods.

Report Authorisation

Scott Woods
Air Monitoring Consultant

NATA Accredited Laboratory
No. 14601

Steven Cooper
Ektimo Signatory

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation. This does not include comments, conclusions or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 Executive Summary

1.1 Background

Ektimo was engaged by Veolia Environmental Services (Australia) Pty Ltd to perform emission testing at their Tarago plant. Testing was carried out in accordance with Environment Protection Licence 11436.

1.2 Project Objective

The objective of the project was to quantify emissions from 3 discharge points to determine compliance with Veolia Environmental Services (Australia) Pty Ltd's Environmental Licence.

Monitoring was performed as follows:

Location		Test Parameters*
EPA 8 – Engine 2 Exhaust Stack	14 December 2021	Hydrogen sulfide Sulfuric acid mist and sulfur trioxide (as SO_3) Nitrogen oxides, carbon monoxide, sulfur dioxide, carbon dioxide, oxygen Volatile organic compounds (VOCs) Destruction efficiency
EPA 5 – LFG Supply	14 December 2021	Carbon dioxide, oxygen Volatile organic compounds (VOCs)
EPA 7 – Flare 1	14 December 2021	Hydrogen sulfide

* Flow rate, velocity, temperature, molecular weight, dry gas density and moisture were also determined at EPA 8.

All results are reported on a dry basis at STP.

At EPA 5 (LFG Supply) temperature and flowrate parameters were supplied by Veolia personnel.

At EPA 7 (Flare 1) temperature and flowrate parameters were unable to be tested as it was not safe to do so.

Plant operating conditions have been noted in the report.

1.3 Licence Comparison

The following licence comparison table shows that all analytes highlighted in green are within the licence limit set by the NSW EPA as per licence 11436 (last amended on 21 September 2021).

EPA No.	Location Description	Pollutant	Units	Licence Limit	Detected Values	Detected values (corrected to 7% O_2)
8	Engine 2 Exhaust Stack	Hydrogen Sulfide	mg/m^3	5	<0.7	**<0.8**
		Sulfuric acid mist and sulfur trioxide (as SO_3)	mg/m^3	100	0.87	**0.96**
		Nitrogen Oxides	mg/m^3	450	290	**320**
		Volatile organic compound destruction efficiency	%	≥ 98	**99.6**	-

Please note that the measurement uncertainty associated with the test results was not considered when determining whether the results were compliant or non-compliant.

Refer to the Test Methods table for the measurement uncertainties.

2 Sampling Plane Compliance

Ektimo assessed the engine exhaust stack sampling plane criteria and selection of sampling points outlined in NSW TM-1 (Australian Standard 4323.1 -1995). In this method, the selection of sampling plane position calls for an Ideal sampling plane to be located in a straight, preferably vertical section of stack or duct away from any flow obstructions which may cause a disturbance or other instability to the gas flow. This position will be found to exist at 7-8 hydraulic diameters downstream and 2-3 hydraulic diameters upstream from a flow disturbance. In the case of the EPA point 8 engine exhaust stack, the sampling plane is located 4 hydraulic diameters downstream of a junction and 2 hydraulic diameters from the exit. See table 1 for details.

TABLE 1
CRITERIA FOR SELECTION OF SAMPLING PLANES

Type of flow disturbance	Minimum distance upstream from disturbance, diameters (*D*)	Minimum distance downstream from disturbance, diameters (*D*)
Bend, connection, junction, direction change	>2*D*	>6*D*
Louvre, butterfly damper (partially closed or closed)	>3*D*	>6*D*
Axial fan	>3*D*	>8*D* (see Note)
Centrifugal fan	>3*D*	>6*D*

NOTE: The plane should be selected as far as practicable from a fan. Flow straighteners may be required to ensure the position chosen meets the check criteria listed in Items (a) to (f) below.

In addition the following criteria must be met.

a) *The gas velocity is basically in the same direction at all points along each sampling traverse.*
b) *The gas velocity at all sampling points is greater than 3 m/s.*
c) *The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of 15° to the duct axis, when measured near the periphery of a circular sampling plane*
d) *The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean.*
e) *The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing the use of impingers, the gas velocity ratio across the sampling plane should not exceed 1.6:1*
f) *The gas temperature at the sampling plane should preferably be above the dewpoint.*

If the criteria of items (a) to (f) cannot be achieved a new sampling position shall be selected. The EPA point 8 engine exhaust stack meets all criteria of (a) to (f) and is suitable, therefore a new sampling position is not required, although an increased number of sampling points shall be used in accordance with clause 4.2 (non-ideal sampling positions) of AS 4323.1-1995.

Clause 4.2 proposes that if the criteria of table 1 cannot be met then a greater number of points shall be used in order to retain as much accuracy as is practicable, by applying the appropriate sampling point factors from *table 2*. The product of both the upstream and downstream factors multiplied by the total number of sampling points from *table 3* should then be raised to the next even number of sampling points for each sampling traverse.

TABLE 2
SAMPLING POINT FACTORS

Non-ideal situation	Sampling point factors
Sampling plane downstream from disturbance:	
Diameters less than Table 1	
0	1.00
1	1.05
2	1.10
3	1.15
4 or more	1.20
Sampling plane upstream from disturbance:	
Diameters less than Table 1	
0	1.00
0.5	1.05
1.0	1.10
1.5 or more	1.15

TABLE 3
MINIMUM NUMBER OF SAMPLING POINTS FOR CIRCULAR SAMPLING PLANES

Sampling plane diameter m	Minimum number of sampling traverses	Minimum number of access holes	Minimum number of sampling points per radius	Minimum total number of sampling points
>0.20 ≤0.35	2	2	1	4
>0.35 ≤0.70	2	2	2	8
>0.70 ≤1.50	2	2	3	12
>1.50 ≤2.50	2	4	4	16
>2.50 ≤4.00	2	4	6	24
>4.00 ≤6.00	3	6	5	30
>6.00	3	6	6	36

By example, the EPA point 8 engine exhaust stack has a sampling plane diameter of 350mm. If an ideal sampling plane was available the total number of sampling points would equate to 4. For this location, we have used a sampling point factor of 1.10 which yields a total number of sampling points of 8.

3 Results

3.1 EPA 8 – Engine 2 Exhaust Stack

Date	14/12/2021	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R011837	**Stack ID**	EPA 8 - Engine 2
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Scott Woods and Steven Cooper	**State**	NSW
Process Conditions	Engine Load: 954kW		*211203*

Sampling Plane Details		
Sampling plane dimensions	350 mm	
Sampling plane area	0.0962 m²	
Sampling port size, number	4" Flange (x2)	
Access & height of ports	Elevated work platform	10 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	2 D
Upstream disturbance	Junction	4 D
No. traverses & points sampled	2	8
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal	

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	12	
Gas molecular weight, g/g mole	29.0 (wet)	30.4 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.36 (dry)
Gas density at discharge conditions, kg/m³	0.45	
% Oxygen correction & Factor	7 %	1.11
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1105 & 1323	
Temperature, °C	446	
Temperature, K	719	
Velocity at sampling plane, m/s	44	
Volumetric flow rate, actual, m³/s	4.2	
Volumetric flow rate actual, m³/h	15000	
Volumetric flow rate (wet STP), m³/s	1.5	
Volumetric flow rate (wet STP), m³/h	5400	
Volumetric flow rate (dry STP), m³/s	1.3	
Volumetric flow rate (dry STP), m³/h	4700	
Mass flow rate (wet basis), kg/hour	6800	

Ektimo

Date	14/12/2021	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R011837	**Stack ID**	EPA 8 - Engine 2
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Scott Woods and Steven Cooper	**State**	NSW
Process Conditions	Engine Load: 954kW		211203

Gas Analyser Results	Average			Minimum			Maximum		
Sampling time	1110 - 1210			1110 - 1210			1110 - 1210		
Combustion Gases	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	290	320	23	270	300	21	310	340	24
Sulfur dioxide	680		53	370		29	730		57
Carbon monoxide	870		68	850		66	890		70
		Concentration %v/v			Concentration %v/v			Concentration %v/v	
Carbon dioxide		12.1			12			12.1	
Oxygen		8.3			8.2			8.5	
Sampling time		1201-1309			1201 - 1309			1201-1309	
Total Organic Compounds (TOC)	Concentration mg/m³		Mass Rate g/min	Concentration mg/m³		Mass Rate g/min	Concentration mg/m³		Mass Rate g/min
VOC (as n-propane)	36		2.8	<4		<0.3	130		11

Hydrogen Sulfide	Results		
Sampling time		1115-1215	
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Hydrogen Sulfide	<0.7	<0.8	<0.05

Isokinetic Results	Results		
Sampling time		1115-1222	
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Sulfur trioxide and/or Sulfuric acid (as SO_3)	0.87	0.96	0.068
Isokinetic Sampling Parameters			
Sampling time, min		64	
Isokinetic rate, %		101	
Velocity difference, %		<1	

Testing Parameter	Total Hydrocarbons (g/min)		
	LFG Inlet	Stack Outlet	Destruction Efficiency %
EPA Point 8 (Engine 2) Stack	770	2.8	99.6

3.2 EPA 5 – LFG Supply

Date	14/12/2021	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R11837	**Stack ID**	EPA 5 - LFG Supply
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Scott Woods and Steven Cooper	**State**	NSW
Process Conditions	5 Engines in operation		211203

Sampling Plane Details		
Sampling plane dimensions	370 mm	
Sampling plane area	0.108 m²	
Sampling port size, number	1" BSP (x1)	
Access & height of ports	Ground level	1.5 m
Duct orientation & shape	Horizontal	Circular
Downstream disturbance	Change in diameter	2.2 D
Upstream disturbance	Connection	1.3 D
No. traverses & points sampled	1	1

Comments
Temperature and flow data supplied by Veolia personnel

Stack Parameters		
Moisture content, %v/v	0.63	
Gas molecular weight, g/g mole	34.0 (wet)	34.1 (dry)
Gas density at STP, kg/m³	1.52 (wet)	1.52 (dry)
Gas density at discharge conditions, kg/m³	1.63	
Gas Flow Parameters		
Temperature, °C	4	
Temperature, K	277	
Velocity at sampling plane, m/s	6.7	
Volumetric flow rate, actual, m³/s	0.72	
Volumetric flow rate, actual, m³/h	2600	
Volumetric flow rate (wet STP), m³/s	0.77	
Volumetric flow rate (wet STP), m³/h	2800	
Volumetric flow rate (dry STP), m³/s	0.77	
Volumetric flow rate (dry STP), m³/h	2800	
Mass flow rate (wet basis), kg/hour	4200	

Gas Analyser Results	Average	
Sampling time	1210 - 1310	
	Concentration % v/v	
Carbon dioxide	36.6	
Oxygen	3.4	
Sampling time	1202 - 1310	
Total Organic Compounds (TOC)	Concentration mg/m³	Mass Rate g/min
VOC (as n-propane)	17000	770

3.3 EPA 7 – Flare 1

Date	14/12/2021	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R011837	**Stack ID**	EPA 7 - Flare 1
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Scott Woods and Steven Cooper	**State**	NSW
Process Conditions	Please refer to client records.		

Hydrogen Sulfide	Results
Sampling time	1558-1658
	Concentration mg/m^3
Hydrogen sulfide	<0.6

4 Plant Operating Conditions

On the day of sampling the Engine Load was 954kW

See Veolia Environmental Services (Australia) Pty Ltd's records for complete process conditions.

5 Test Methods

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sampling points - Selection	NSW EPA TM-1	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW EPA TM-2	NSW EPA TM-2	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22	NSW EPA TM-22	19%	✓	✓
Molecular weight	NA	NSW EPA TM-23	not specified	NA	✓
Dry gas density	NA	NSW EPA TM-23	not specified	NA	✓
Carbon dioxide	NSW EPA TM-24	NSW EPA TM-24	13%	✓	✓
Carbon monoxide	NSW EPA TM-32	NSW EPA TM-32	12%	✓	✓
Nitrogen oxides	NSW EPA TM-11	NSW EPA TM-11	12%	✓	✓
Oxygen	NSW EPA TM-25	NSW EPA TM-25	13%	✓	✓
Sulfur dioxide	NSW EPA TM-4	NSW EPA TM-4	12%	✓	✓
Volatile organic compounds	NSW EPA TM-34	NSW EPA TM-34	not specified	✓	✓
Hydrogen sulfide	NSW EPA TM-5	NSW EPA TM-5	not specified	✓	✓†
Sulfuric acid mist and/or sulfur trioxide	NSW EPA TM-3	Ektimo 235	16%	✓	✓†

220110

* Uncertainties cited in this table are estimated using typical values and are calculated at the 95% confidence level (coverage factor = 2).

† Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601. Results were reported on
22 December 2021 in report R011837 – H_2S (Method 11).
5 January 2022 in report LV-002353.

6 Quality Assurance/Quality Control Information

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APAC (Asia Pacific Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through mutual recognition arrangements with these organisations, NATA accreditation is recognised worldwide.

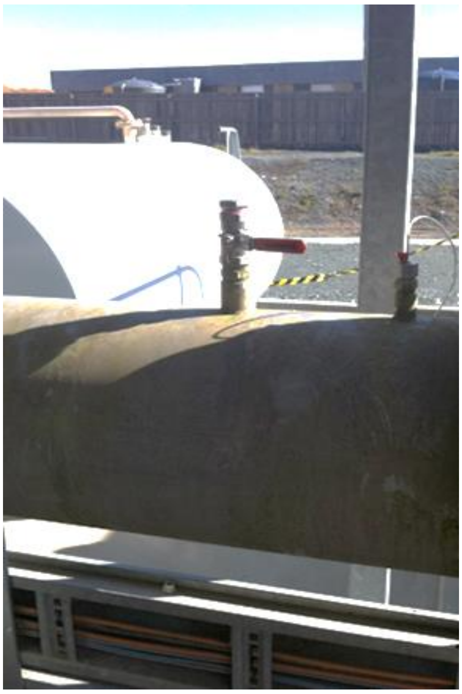
7 Definitions

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American Public Health Association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM/CEMS	Continuous Emission Monitoring/Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone is defined as the particle diameter at which the cyclone achieves a 50% collection efficiency i.e. half of the particles are retained by the cyclone and half pass through it. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety Committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
ITE	Individual threshold estimate
Lower bound	When an analyte is not present above the detection limit, the result is assumed to be equal to zero.
Medium bound	When an analyte is not present above the detection limit, the result is assumed to be equal to half of the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	Odour unit. One OU is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis. PSA provides a distribution of geometric diameters, for a given sample, determined using laser diffraction.
RATA	Relative accuracy test audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration is determined by matching the area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test method
TOC	The sum of all compounds of carbon which contain at least one carbon-to-carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity difference	The percentage difference between the average of initial flows and after flows.
Vic EPA	Victorian Environment Protection Authority
VOC	Volatile organic compound. A carbon-based chemical compound with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the given conditions of use. VOCs may contain oxygen, nitrogen and other elements. VOCs do not include carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray diffractometry
Upper bound	When an analyte is not present above the detection limit, the result is assumed to be equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

8 Appendix 1: Site Location Photos

EPA Point 8 - Engine 2 Exhaust Stack



EPA Point 5 - LFG Supply

EPA 7 – Flare 1

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Cockburn Central
WA 6164
AUSTRALIA

BRISBANE
3/109 Riverside Place
Morningside
QLD 4170
AUSTRALIA

Ektimo

Veolia Environmental Services (Australia) Pty Ltd

Woodlawn Biogas Power Station, Tarago

Emission Testing Report

Report Number R013467

Ektimo

Document Information

Template Version 190722

Client Name:	Veolia Environmental Services (Australia) Pty Ltd
Report Number:	R013467
Date of Issue:	24 October 2022
Attention:	Christian Chang
Address:	619 Collector Rd Tarago NSW 2580
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Steven Cooper
Ektimo Signatory

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation as described in the Test Methods table. This does not include calculations that use data supplied by third-parties, comments, conclusions, or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 Executive Summary

1.1 Background

Ektimo was engaged by Veolia Environmental Services (Australia) Pty Ltd to perform emission testing at their Tarago plant. Testing was carried out in accordance with Environment Protection Licence 11436.

1.2 Project Objective

The objective of the project was to quantify emissions from 3 discharge points to determine compliance with Veolia Environmental Services (Australia) Pty Ltd's Environmental Licence.

Monitoring was performed as follows:

Location	Test Date	Test Parameters
EPA 7 – Landfill Gas Flare 1	5 September 2022	Temperature
EPA 69 – Landfill Gas Flare 2		Temperature, hydrogen sulfide
EPA 70 – Landfill Gas Flare 3		

All results are reported on a dry basis at STP.

EPA 7 (Flare 1), EPA 69 (Flare 2) & EPA 70 (Flare 3) flowrate parameters were unable to be tested as it was not safe to do so.

Plant operating conditions have been noted in the report.

1.3 Licence Comparison

The following licence comparison table shows that all analytes highlighted in green are within the licence limit set by the NSW EPA as per licence 11436 (last amended on 25 July 2022).

EPA No.	Location Description	Parameter	Units	Licence Specification	Detected Values
7	EPA 7 - Landfill Gas Flare 1	Minimum Temperature (K)	K	933	1293
69	EPA 69 - Landfill Gas Flare 2	Minimum Temperature (K)	K	933	1288
70	EPA 70 - Landfill Gas Flare 3	Minimum Temperature (K)	K	933	1473

Please note that the measurement uncertainty associated with the test results was not considered when determining whether the results were compliant or non-compliant.

Refer to the Test Methods table for the measurement uncertainties.

2 Results

2.1 EPA 7 – Flare 1

Date	5/09/2022	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R013467	**Stack ID**	EPA 7 - Landfill Gas Flare 1
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Aaron Davis	**State**	NSW
Process Conditions	Please refer to client records.		220818

Sampling Plane Details	
Sampling plane dimensions	1370 mm
Sampling plane area	1.47 m²
Sampling port size, number	4" Flange (x4)
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 0.75 D
Upstream disturbance	Junction >8 D
No. traverses & points sampled	1 1
Sample plane conformance to USEPA Method 1	Compliant

Stack Parameters		
Moisture content, %v/v	6.1	
Gas molecular weight, g/g mole	29.2 (wet)	29.9 (dry)
Gas density at STP, kg/m³	1.30 (wet)	1.34 (dry)
Gas density at discharge conditions, kg/m³	0.25	
Gas Flow Parameters		
Temperature, °C	1020	
Temperature, K	1293	

Gas Analyser Results	Average
Sampling time	1149 - 1151
	Concentration %v/v
Carbon dioxide	8.6
Oxygen	10.7

2.2 EPA 69 – Flare 2

Date	5/09/2022	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R013467	**Stack ID**	EPA 69 - Landfill Gas Flare 2
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Aaron Davis	**State**	NSW
Process Conditions	Please refer to client records.		220818

Sampling Plane Details	
Sampling plane dimensions	1725 mm
Sampling plane area	2.34 m²
Sampling port size, number	4" Flange (x4)
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 0.7 D
Upstream disturbance	Junction >8 D
No. traverses & points sampled	1 1
Sample plane conformance to USEPA Method 1	Compliant

Stack Parameters		
Moisture content, %v/v	5.6	
Gas molecular weight, g/g mole	29.2 (wet)	29.9 (dry)
Gas density at STP, kg/m³	1.30 (wet)	1.33 (dry)
Gas density at discharge conditions, kg/m³	0.26	
% Oxygen correction & Factor	3 %	2.13
Gas Flow Parameters		
Temperature, °C	1015	
Temperature, K	1288	

Gas Analyser Results	Average
Sampling time	1243 - 1335
	Concentration %v/v
Carbon dioxide	7.7
Oxygen	12.5

Non-isokinetics	Results	
Sampling time	1245-1345	
	Concentration mg/m³	Corrected to 3% O2 mg/m³
Hydrogen sulfide	<0.8	<2

2.3 EPA 70 – Flare 3

Date	5/09/2022	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R013467	**Stack ID**	EPA 70 - Landfill Gas Flare 3
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Aaron Davis	**State**	NSW
Process Conditions	Please refer to client records.		220818

Sampling Plane Details	
Sampling plane dimensions	1725 mm
Sampling plane area	2.34 m²
Sampling port size, number	4" Flange (x4)
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 0.7 D
Upstream disturbance	Junction >8 D
No. traverses & points sampled	1 1
Sample plane conformance to USEPA Method 1	Compliant

Stack Parameters		
Moisture content, %v/v	7	
Gas molecular weight, g/g mole	29.5 (wet)	30.3 (dry)
Gas density at STP, kg/m³	1.31 (wet)	1.35 (dry)
Gas density at discharge conditions, kg/m³	0.23	
% Oxygen correction & Factor	3 %	1.40
Gas Flow Parameters		
Temperature, °C	1200	
Temperature, K	1473	

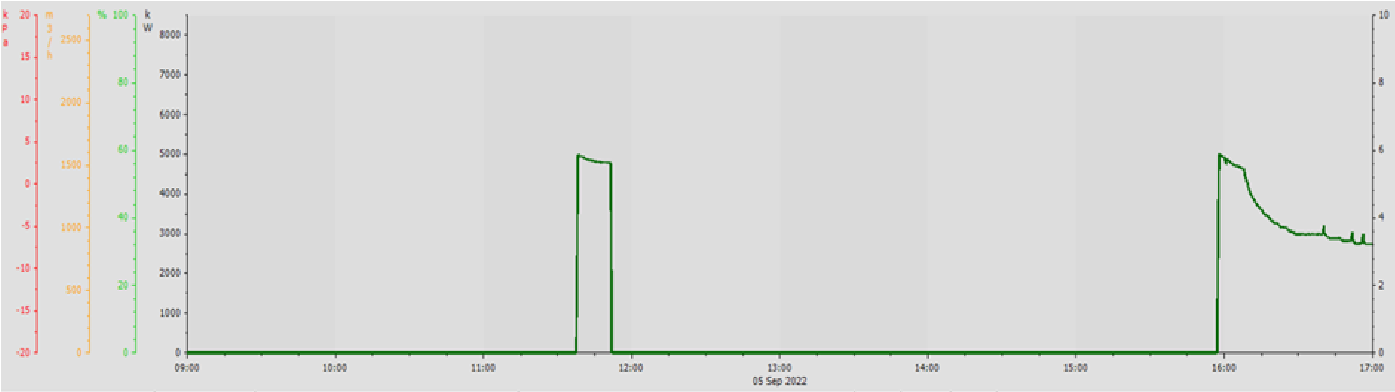
Gas Analyser Results	Average
Sampling time	1431 - 1519
	Concentration %v/v
Carbon dioxide	11.7
Oxygen	8.1

Non-isokinetics	Results	
Sampling time	1425-1525	
	Concentration mg/m³	Corrected to 3% O2 mg/m³
Hydrogen sulfide	<0.8	<1

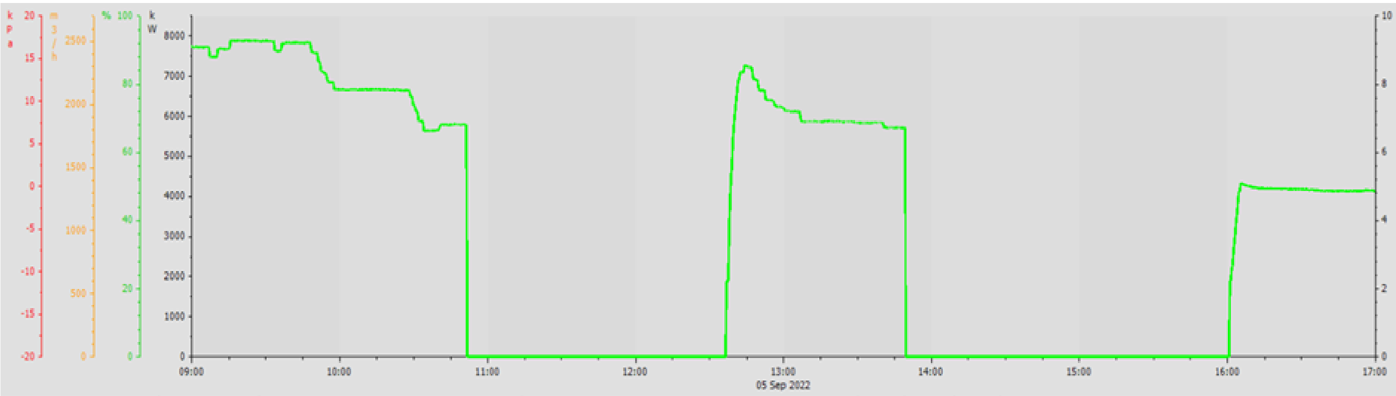
3 Plant Operating Conditions

5 September 2022, 0900 - 1700

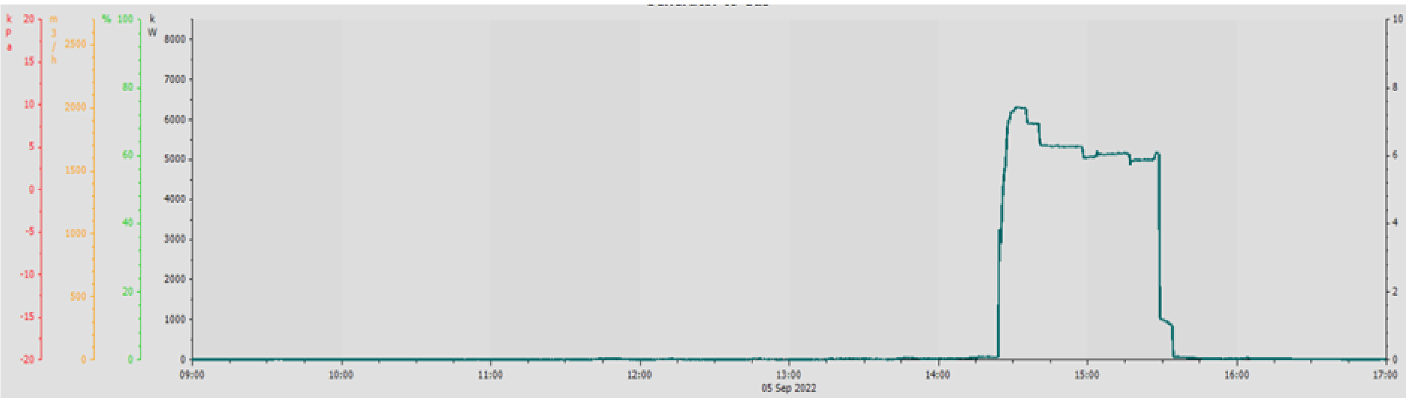
Flare 1: (Min = 0 m^3/hr, Max = 1599.48 m^3/hr, Mean = 1174.46 m^3/hr)



Flare 2: (Min = 0 m^3/hr, Max = 2529.35 m^3/hr, Mean = 1913.77 m^3/hr)



Flare 3: (Min = 0 m^3/hr, Max = 2012.39 m^3/hr, Mean = 575.86 m^3/hr)



See Veolia Environmental Services (Australia) Pty Ltd's records for complete process conditions.

4 Test Methods

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling method	Analysis method	Uncertainty*	NATA accredited Sampling	NATA accredited Analysis
Sampling points - Selection	NSW EPA TM-1 (USEPA Method 1)	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW EPA TM-2 (USEPA Method 2)	NSW EPA TM-2 (USEPA Method 2)	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22 (USEPA Alt-Method 008)	NSW EPA TM-22 (USEPA Alt-Method 008)	19%	✓	✓
Molecular weight	NA	NSW EPA TM-23 (USEPA Method 3)	not specified	NA	✓
Dry gas density	NA	NSW EPA TM-23 (USEPA Method 3)	not specified	NA	✓
Carbon dioxide	NSW EPA TM-24 (USEPA Method 3A)	NSW EPA TM-24 (USEPA Method 3A)	13%	✓	✓
Oxygen	NSW EPA TM-25 (USEPA Method 3A)	NSW EPA TM-25 (USEPA Method 3A)	13%	✓	✓
Hydrogen sulfide	NSW EPA TM-5 (USEPA Method 11)	NSW EPA TM-5	not specified	✓	✓†

220803

* Uncertainties cited in this table are estimated using typical values and are calculated at the 95% confidence level (coverage factor = 2).

† Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.
Results were reported on 16 September 2022 in report R013467 - H2S (Method 11)

5 Quality Assurance/Quality Control Information

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% v/v	Volume to volume ratio, dry or wet basis
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D	Duct diameter or equivalent duct diameter for rectangular ducts
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DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier transform infra-red
ISC	Intersociety Committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
ITE	Individual threshold estimate
Lower bound	When an analyte is not present above the detection limit, the result is assumed to be equal to zero.
Medium bound	When an analyte is not present above the detection limit, the result is assumed to be equal to half of the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	Odour unit. One OU is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
PM_{10}	Particulate matter having an equivalent aerodynamic diameter less than or equal to 10 microns (μm).
$PM_{2.5}$	Particulate matter having an equivalent aerodynamic diameter less than or equal to 2.5 microns (μm).
PSA	Particle size analysis. PSA provides a distribution of geometric diameters, for a given sample, determined using laser diffraction.
RATA	Relative accuracy test audit
Semi-quantified VOCs	Unknown VOCs (those for which an analytical standard is not available), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration is determined by matching the area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0 °C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa.
TM	Test method
TOC	Total organic carbon. This is the sum of all compounds of carbon which contain at least one carbon-to-carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity difference	The percentage difference between the average of initial flows and after flows.
Vic EPA	Victorian Environment Protection Authority
VOC	Volatile organic compound. A carbon-based chemical compound with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the given conditions of use. VOCs may contain oxygen, nitrogen and other elements. VOCs do not include carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray diffractometry
Upper bound	When an analyte is not present above the detection limit, the result is assumed to be equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

7 Appendix 1: Site Photos

EPA 7 – Landfill Gas Flare 1

EPA 69 – Landfill Gas Flare 2

EPA 70 – Landfill Gas Flare 3

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Cockburn Central
WA 6164
AUSTRALIA

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3/109 Riverside Place
Morningside
QLD 4170
AUSTRALIA

THE ODOUR UNIT

EVAPORATION DATA SUPPLIED BY VEOLIA:

MAY 2007 – JUNE 2012

Evaporation	2006 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	2006 Sep	Oct	Nov	Dec	2007 Jan	Feb	Mar	Apr	May	Jun
1	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	5.60	6.80	5.00	3.00	1.50	1.41
2	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	2.20	2.60	4.80	3.60	2.40	1.04
3	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	2.60	5.00	3.80	3.80	3.19	1.16
4	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	5.00	6.40	7.60	2.80	4.52	1.30
5	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	6.80	7.40	6.60	3.00	2.68	0.69
6	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.20	8.20	3.60	4.60	2.52	1.00
7	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.60	7.00	5.00	2.40	2.43	0.67
8	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	5.80	4.60	3.60	1.40	1.87	0.83
9	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	6.60	6.80	5.00	2.40	1.37	0.48
10	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.40	5.20	4.80	2.00	1.41	0.73
11	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.60	3.60	5.40	3.20	1.48	1.24
12	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	11.40	2.20	7.00	3.60	1.74	0.77
13	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	13.40	3.80	3.60	2.60	2.19	1.23
14	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.40	4.40	2.80	3.00	1.51	1.02
15	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.80	5.80	4.80	3.60	2.03	0.43
16	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.40	6.20	6.20	4.00	2.09	0.64
17	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.80	3.80	4.60	2.80	1.47	0.84
18	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.20	5.60	2.40	3.40	1.49	0.75
19	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	6.00	1.60	2.00	3.80	0.72	0.63
20	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.60	3.60	0.20	2.20	1.53	0.43
21	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	11.00	6.80	2.20	2.60	2.14	1.13
22	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.40	7.40	3.40	2.60	2.21	1.12
23	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.60	5.60	4.40	2.60	1.69	1.35
24	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	9.40	5.20	4.80	1.80	1.59	1.11
25	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.20	4.60	4.00	0.60	1.81	1.16
26	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.00	4.20	2.60	1.20	1.75	0.57
27	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	12.40	3.60	2.80	2.40	1.56	0.27
28	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	10.60	3.00	2.80	1.40	2.20	0.42
29	8.20		4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.80		4.20	1.40	1.75	0.79
30	8.20		4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.00		3.00	1.80	2.65	1.27
31	8.20		4.10		1.70		1.20	1.90		3.90		6.20	10.00		3.40		1.24	
Total Month	**203.8**	**151.2**	**127.1**	**78**	**52.7**	**33**	**37.2**	**58.9**	**84**	**120.9**	**150**	**192.2**	**246.8**	**141**	**126.4**	**79.6**	**60.68**	**26.47**
Accumulated Year	**204**	**355**	**482.1**	**560.1**	**612.8**	**645.8**	**683**	**741.9**	**825.9**	**946.8**	**1096.8**	**1289**	**246.8**	**387.8**	**514.2**	**593.8**	**654.48**	**681**

Evaporation data recorded from the Goulburn Tafe W

						2008												2009	
Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1.21	1.13	4.17	4.49	2.73	2.82	7.058	4.079	4.42	3.876	2.082	1.889	2.563	2.158	1.339	3.822	8.25	5.487	6.915	7.353
0.82	1.27	2.87	5.04	4.66	2.286	7.126	2.908	4.566	3.485	1.918	0.485	1.146	0.953	2.667	4.838	2.408	7.579	8.11	6.754
1.21	2.29	3.26	5.41	4.31	5.675	7.446	4.000	4.257	5.316	1.977	0.828	1.139	1.469	2.828	6.486	3.711	6.729	6.339	6.712
1.75	0.94	2.94	8.39	1.49	4.147	2.006	4.788	4.536	2.663	2.314	0.46	1.32	1.967	1.616	6.588	3.963	6.955	5.254	5.055
1.18	1.59	2.46	5.05	3.30	4.956	7.4	1.496	4.274	3.13	2.225	0.771	0.847	1.659	1.006	1.318	5.035	5.046	6.369	4.618
0.72	1.67	1.44	5.48	2.40	1.109	6.6	1.512	4.457	3.239	2.423	0.76	1.387	1.263	1.288	2.328	3.928	5.442	8.86	6.982
1.06	1.65	1.87	5.68	4.5	4.2	6.883	4.498	5.111	2.656	2.177	1.026	1.22	1.656	1.162	3.205	6.31	7.507	8.46	7.344
1.02	1.71	1.38	3.90	2.097	3.395	6.251	3.381	3.829	2.231	2.323	1.351	1.312	1.147	2.65	3.387	3.199	6.765	8.21	8.81
0.70	2.11	1.61	3.89	2.106	4.31	6.6	2.689	4.053	1.712	2.209	0.5	1.227	1.663	2.508	4.196	3.801	6.172	3.146	8.3
0.90	2.39	2.04	3.91	2.929	6.974	5.175	2.861	4.623	1.81	2.056	1.211	0.51	1.35	3.038	4.017	5.71	6.895	4.802	2.73
1.19	3.15	2.55	4.12	4.648	3.645	6.945	4.415	4.768	2.685	2.026	0.588	0.875	0.664	2.896	4.264	5.541	3.662	4.78	1.038
1.44	3.09	1.69	4.89	5.543	1.426	7.747	4.853	4.954	3.052	1.296	0.865	1.079	1.452	3.56	3.963	5.464	1.874	4.981	4.292
1.09	2.27	2.29	3.87	5.421	5.00	5.179	3	4.862	2.614	1.532	1.672	1.215	1.511	4.341	4.769	6.244	0.951	4.415	1.801
1.02	1.69	3.53	4.15	6.033	4.40	7.447	1.161	4.992	2.11	1.757	1.089	1.621	1.801	5.149	4.463	6.274	4.303	6.69	3.05
0.86	1.02	4.08	4.78	6.794	5.362	1.344	3.54	4.861	2.854	1.874	1.572	2.064	1.693	2.177	1.793	6.243	3.726	9	2.4
1.06	1.08	3.46	6.31	6.455	5.385	6.369	5.299	5.892	2.901	1.997	1.141	1.281	1.726	4.05	3.63	6.192	5.567	9.69	2.225
1.04	1.87	3.82	7.67	5.901	0.933	4.194	5.042	4.894	2.611	1.468	0.794	1.247	1.834	2.663	4.097	4.685	6.225	7.435	3.11
1.34	0.82	2.25	4.52	6.297	4.659	4.4	4.186	4.841	1.902	1.245	1.042	1.28	2.186	2.098	4.755	5.378	3.919	6.079	2.313
1.30	0.95	3.21	4.95	5.31	4.40	2.054	4.73	5.056	2.09	1.432	1.056	1.051	1.361	3.326	4.845	3.55	4.689	6.418	3.187
1.52	0.78	4.30	5.30	6.444	2.116	1.72	4.48	2.672	1.27	1.881	0.842	1.652	2.009	4.809	5.672	2.603	5.48	7.43	5.529
1.49	0.94	1.92	5.45	6.425	1.79	3.779	5.237	4.843	1.596	1.602	0.297	1.258	2.209	5.661	4.572	3.418	4.656	7.28	3.265
1.15	1.14	3.13	7.20	6.425	5.306	2.357	2.445	1.335	2.494	1.74	1.192	1.394	2.44	4.423	3.561	5.702	5.765	7.637	4.303
0.78	0.88	3.23	6.92	0.573	2.921	4.681	5.397	1.763	1.229	1.673	1.271	1.551	1.138	4.422	3.28	2.389	6.683	5.991	3.535
1.51	1.16	3.62	4.15	1.268	4.309	5.547	6.058	3.212	2.211	1.193	1.118	1.17	1.594	2.527	3.602	2.16	3.337	6.481	4.391
1.60	1.70	4.87	1.97	2.786	4.859	6.208	5.649	1.777	1.685	1.456	1.126	1.146	2.284	2.461	4.178	5.332	1.37	7.481	6.763
1.99	2.03	4.68	1.29	5.691	5.20	4.636	4.078	0.872	1.569	1.499	1.623	1.547	2.553	3.68	5.96	4.286	6.181	4.449	5.653
1.86	2.98	3.07	2.36	4.37	6.216	6.022	5.26	2.734	3.338	1.253	1.242	1.2	2.669	4.221	5.949	3.299	7.006	6.364	5.124
1.30	3.73	3.92	4.32	6.6	3.844	6.413	3.85	3.058	2.642	1.484	1.607	0.866	2.212	5.675	8	5.683	4.365	4.688	4.802
1.73	4.86	5.73	4.75	5.35	6.515	5.972	0.894	2.139	1.338	1.37	1.198	1.235	1.744	6.15	5.297	3.178	5.461	6.868	
1.18	3.51	3.62	5.87	3.106	6.941	6.752		3.646	2.208	1.425	1.927	1.503	1.283	3.495	1.819	5.458	7.121	7.29	
1.56	3.98		5.56		7.736	6.868		3.861		1.726		1.703	2.13		5.019		6.405	7.182	
38.56	**60.372**	**92.97**	**151.606**	**131.946**	**132.835**	**169.179**	**111.786**	**121.158**	**74.517**	**54.633**	**32.543**	**40.609**	**53.778**	**97.886**	**133.673**	**139.394**	**163.323**	**205.09**	**131.44**
719.5	**779.88**	**872.8**	**1024.45**	**1156.4**	**1289.23**	**169**	**280.965**	**402.123**	**476.64**	**531.273**	**563.816**	**604.425**	**658.203**	**756.089**	**889.762**	**1029.16**	**1192.48**	**205**	**336.533**

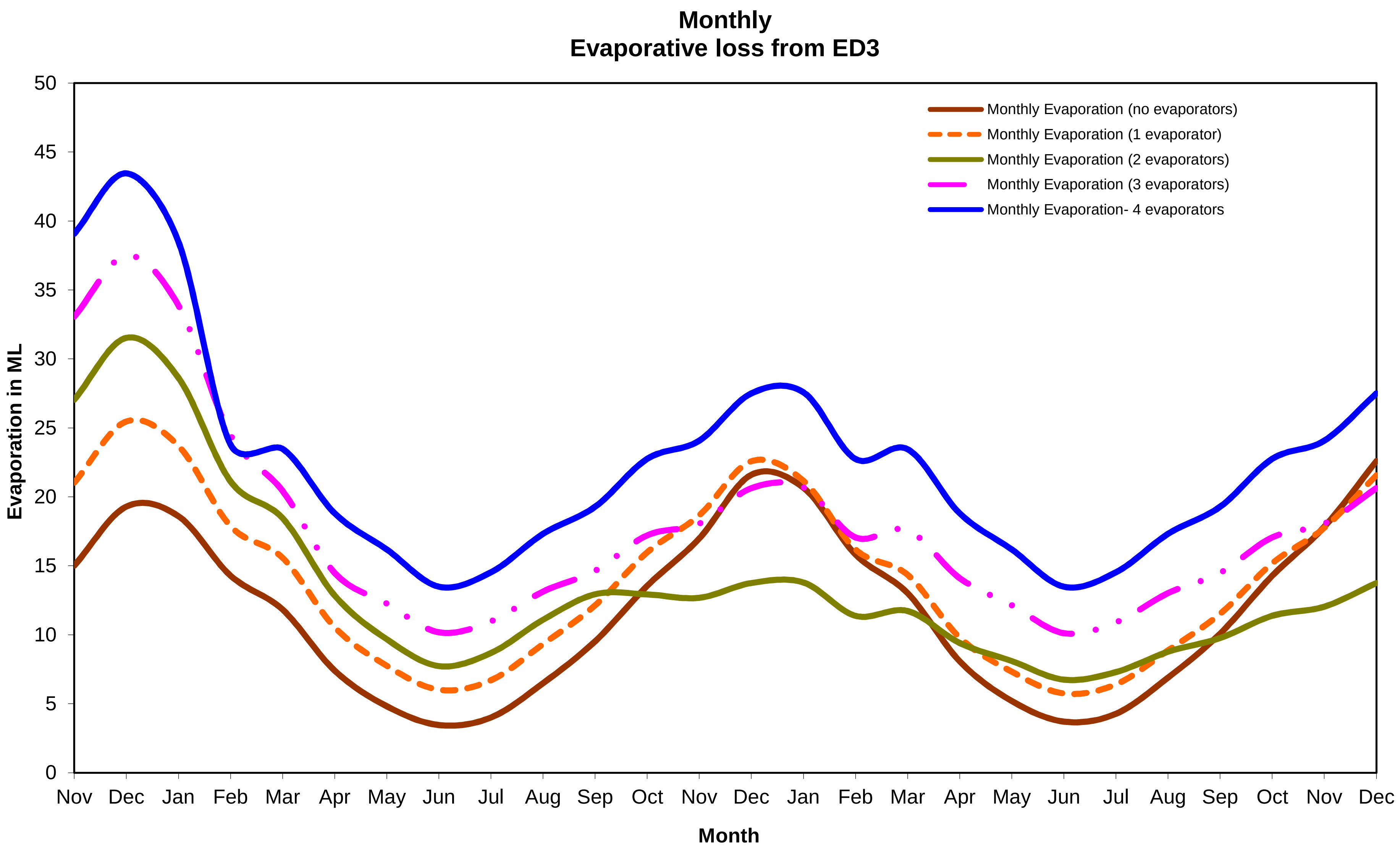
eather Station

										2010					
Mar	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
6.917	2.423	1.755	1.077	1.847	1.551	1.984	4.057	4.662	2.028	3.998	5.099	3.148	2.332	1.695	0.878
4.472	1.71	2.372	0.801	1.384	1.814	2.912	6.426	5.645	5.513	6.6	6.074	1.88	3.354	1.916	1.125
3.878	1.453	1.88	0.787	1.089	1.202	2.841	1.895	5.112	5.577	4.735	5.207	2.762	2.975	2.831	1.087
3.498	3.908	2.072	0.56	1.165	2.058	1.365	0.766	7.929	7.173	4.158	3.146	3.891	2.655	1.683	0.855
5.725	2.928	2.129	0.701	1.104	1.529	2.454	1.152	5.29	6.583	4.044	3.664	4.055	2.152	2.958	0.907
4.923	3.621	1.981	1.211	1.493	1.623	3.174	2.186	1.641	6.23	5.176	2.508	1.321	3.063	1.433	1.303
4.612	2.546	2.117	1.313	0.921	1.996	3.339	2.677	2.032	6.638	7.148	2.434	3.007	1.81	2.05	1.055
4.945	2.97	2.058	0.786	1.202	2.192	1.115	1.318	4.208	7.695	3.889	1.551	1.534	1.5	1.903	1.346
2.91	3.12	1.763	1.105	0.611	2.206	2.108	3.38	5.156	7.358	5.272	1.77	3.112	3.291	1.955	1.332
3.338	3.284	2.182	0.895	0.771	1.865	1.68	2.502	6.205	4.17	7.378	5.177	3.092	2.66	1.906	0.827
3.617	1.841	1.215	1.285	0.927	1.887	2.787	2.709	6.607	6.303	7.771	4.201	2.743	3.463	2.485	1.431
4.376	2.073	1.848	1.049	0.982	1.502	3.644	2.501	6.865	6.729	7.485	6.063	3.919	3.058	3.087	1.381
3.763	2.514	1.946	0.691	2.192	1.643	5.067	1.654	6.934	7.03	9.3	4.934	2.812	3.207	1.911	1.201
1.961	0.469	2.119	1.578	1.559	2.055	6.87	3.239	4.736	6.693	5.012	0.81	3.277	2.865	2.033	1.074
3.811	1.969	1.581	1.521	0.818	1.996	2.964	2.22	6.605	3.489	2.788	0.918	2.577	3.386	1.734	1.141
4.779	4.187	1.602	1.015	1.049	2.365	3.78	2.346	5.514	6.185	3.759	3.496	3.634	2.66	1.728	1.179
4.66	3.699	1.789	0.784	1.013	3.062	3.287	3.11	7.546	8	3.442	4.03	4.26	2.696	1.379	1.443
4.282	2.983	1.842	1.059	1.434	2.581	3.727	3.306	5.807	11.73	6.841	5.162	4.197	2.758	0.917	0.864
4.783	2.608	1.432	1.027	1.474	2.222	2.763	3.298	5.604	1.331	4.313	4.24	4.181	2.507	1.724	1.379
3.871	1.738	1.076	1.456	1.814	2.725	3.061	4.18	6.838	6.966	6.507	3.96	3.73	2.511	1.701	0.776
4.548	1.094	1.284	1.107	2.203	2.918	3.498	5.517	8	3.649	7.994	4.726	4.999	2.921	0.885	1.32
4.535	1.638	1.287	0.589	2.459	1.673	3.687	5.776	4.833	7.337	7.766	6.52	4.999	2.688	1.165	1.185
4.201	1.488	0.719	1.161	2.013	2.523	2.501	4.272	6.697	6.719	9.95	6.017	3.975	2.918	1.664	0.491
5.067	1.991	1.288	0.863	0.761	2.127	1.283	5.039	0.884	7.524	9.65	5.734	4.213	3.392	1.157	1.154
6.118	1.73	1.478	0.824	1.547	1.984	3.13	5.359	1.841	8.85	4.516	4.929	3.705	1.498	0.839	0.983
5.434	1.438	1.413	1.087	1.784	2.257	4.556	1.522	6.292	0.754	6.134	4.726	4.034	2.387	0.64	1.076
3.611	1.52	0.777	0.838	0.859	2.071	1.988	1.903	5.591	0.895	7.369	4.487	4.923	2.272	0.491	0.995
2.982	1.68	1.037	1.244	1.546	3.473	1.579	2.641	4.326	3.024	6.039	4.945	4.015	1.531	0.891	1.21
3.861	1.917	0.689	0.798	1.562	4.048	2.576	4.087	8.2	4.501	3.961		4.129	2.867	1.166	1.24
4.352	1.667	0.843	0.898	1.621	1.767	3.663	2.571	3.657	6.765	6.124		1.592	2.643	0.628	1.417
2.855		0.777		1.283	2.321		5.037		6.318	3.125		0.785		0.27	
132.69	**68.21**	**48.35**	**30.11**	**42.49**	**67.24**	**89.38**	**98.65**	**161.26**	**179.76**	**182.24**	**116.53**	**104.50**	**80.02**	**48.83**	**33.66**
469.218	**537.425**	**585.776**	**615.886**	**658.373**	**725.609**	**814.992**	**913.638**	**1074.895**	**1254.652**	**182**	**298.77**	**403.27**	**483.29**	**532.12**	**565.77**

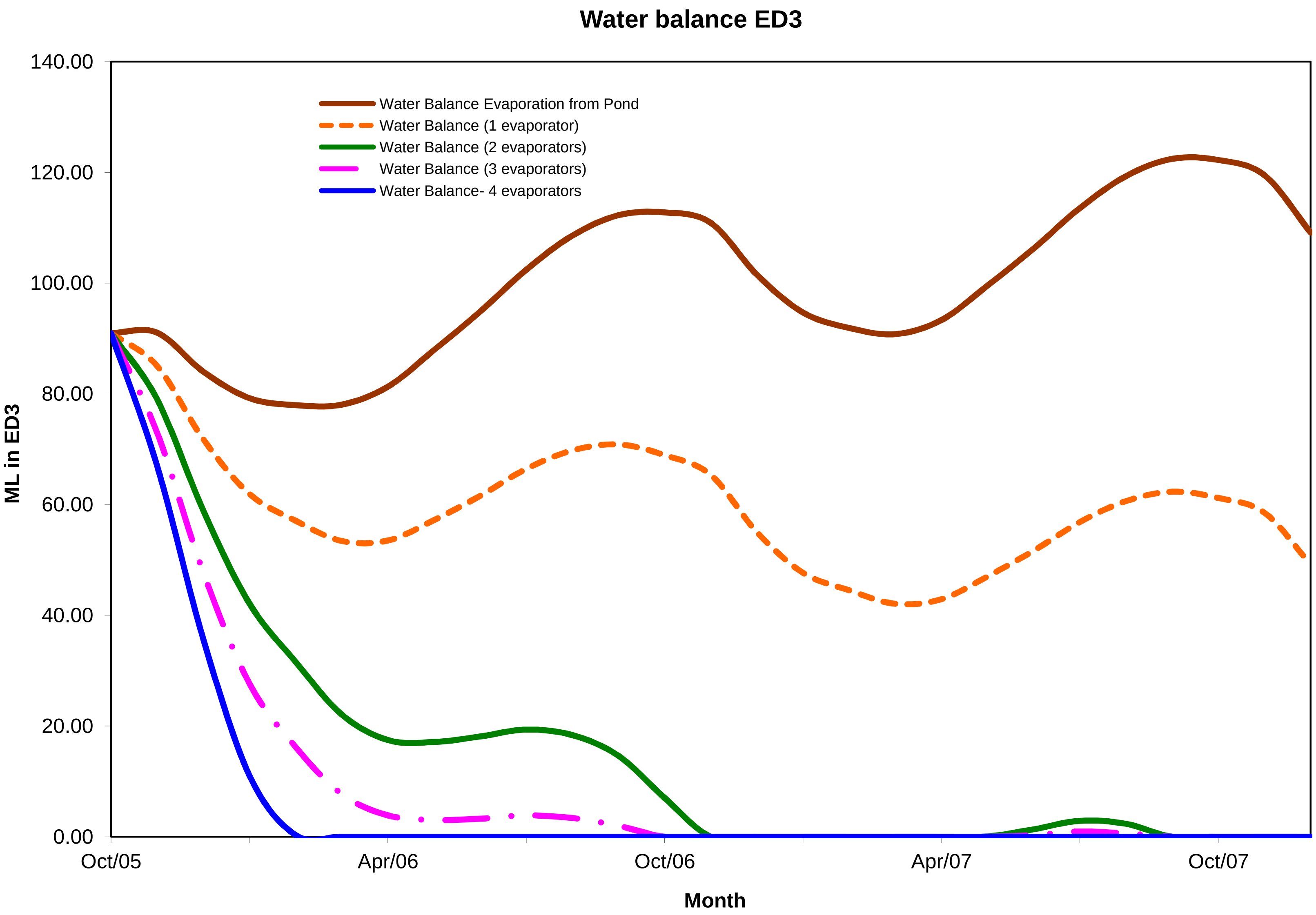
						2011							
Jul	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
1.268	1.296	2.57	3.375	4.13	1.186	7.051	7.012	2.274	1.106	1.672	0.987	1.048	1.254
1.044	1.432	3.342	2.595	1.913	1.338	7.866	9.26	4.678	3.107	1.878	1.056	0.911	2.284
0.452	1.033	0.811	2.4	2.259	3.215	3.502	5.421	3.477	3.304	0.655	1.016	1.027	1.942
1.215	1.468	1.109	1.091	4.22	2.258	0.963	3.908	5.296	3.294	1.914	1.53	1.616	3.34
1.111	1.031	0.862	2.602	1.355	3.228	2.593	2.614	5.187	3.215	2.064	0.861	1.293	3.226
1.077	1.714	1.645	4.097	1.948	4.476	5.333	6.545	3.419	1.963	2.11	1.51	1.004	3.188
0.573	1.737	1.99	3.927	2.165	3.351	3.727	1.692	3.268	1.802	1.676	1.527	0.864	1.604
1.348	1.679	2.243	3.864	4.228	5.486	3.458	4.228	4.416	2.223	2.087	1.093	1.247	1.912
1.326	1.577	2.275	3.793	4.414	4.11	4.247	3.948	4.142	3.183	2.375	0.862	1.228	0.946
0.814	1.94	1.779	2.713	3.68	1.728	2.307	3.324	3.978	3.395	1.6	1.092	1.16	1.769
0.855	0.94	2.288	2.238	3.89	4.773	2.736	4.659	1.385	1.308	2.051	1.078	1.079	1.23
0.7	0.917	1.423	2.36	5.513	5.854	1.677	2.874	1.6	2.148	1.193	1.34	1.41	0.462
1.493	0.976	1.389	3.446	5.371	5.957	4.233	2.073	3.28	1.747	1.684	0.956	1.458	1.427
0.631	2.024	1.307	1.812	6.154	5.745	3.408	1.502	4.49	1.923	1.434	0.744	0.815	1.582
1.03	1.39	0.437	3.58	3.953	4.113	3.981	4.138	0.749	2.724	1.743	0.804	1.333	1.771
1.381	1.588	1.027	1.264	1.957	6.395	5.885	3.005	2.157	2.568	1.959	0.557	1.19	1.495
1.225	1.2	3.789	2.281	4.89	3.684	6.391	1.15	2.357	2.236	1.344	0.813	0.589	1.994
1.302	1.883	2.998	3.349	4.525	5.331	7.255	3.479	1.534	2.029	1.467	1.074	1.178	0.561
1.433	1.683	2.743	3.847	6.084	3.731	5.497	2.893	0.69	2.608	1.735	1.222	0.831	0.867
0.826	1.684	2.645	3.02	2.109	3.686	4.004	3.746	1.547	2.338	1.71	1.208	0.475	0.819
1.377	1.882	2.91	3.964	5.642	2.636	4.759	4.729	1.814	1.341	1.56	1.517	1.369	0.957
1.379	1.539	3.202	4.17	6.288	5.074	6.263	4.947	0.758	2.355	1.738	0.914	0.853	1.532
1.336	2.092	2.737	4.903	5.996	5.285	4.855	4.657	3.055	2.246	1.803	0.864	0.721	1.235
1.201	1.533	2.271	3.476	4.515	6.343	6.291	4.763	2.44	2.209	0.854	1.412	1.208	1.695
1.573	1.865	3.718	2.227	5.96	2.143	5.118	4.651	2.026	2.329	1.129	1.207	0.621	2.437
1.431	1.816	2.922	2.794	5.9	5.442	6.436	4.057	3.047	1.251	1.797	1.25	0.674	3.024
1.326	1.186	4.061	4.945	4.33	3.951	7.204	5.033	2.824	1.474	1.694	1.653	1.431	3.163
1.452	1.803	3.858	4.318	5.672	3.478	6.509	2.284	2.365	1.764	1.191	1.369	1.506	2.636
0.515	2.243	3.876	3.221	1.734	5.219	5.086	[redacted]	3.328	1.206	1.303	0.969	2.089	2.91
0.838	2.186	3.174	4.233	1.189	6.065	5.724	[redacted]	2.678	1.313	1.275	0.918	2.003	2.894
0.86	1.966	[redacted]	4.17	[redacted]	6.422	6.781	[redacted]	3.709	[redacted]	0.946	[redacted]	2.083	1.518
34.39	**49.30**	**71.40**	**100.08**	**121.98**	**131.70**	**151.14**	**112.592**	**87.968**	**65.709**	**49.641**	**33.403**	**36.314**	**57.674**
600.17	**649.47**	**720.87**	**820.94**	**942.93**	**1074.63**	**151.14**	**263.732**	**351.7**	**417.409**	**467.05**	**500.453**	**536.767**	**594.441**

				2012									
Sep	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
2.471	2.435	4.777	2.325	5.891	5.284	0.9	3.54	1.227	1.373	1.384			
2.241	1.588	4.316	4.913	6.209	2.501	1.154	2.845	2.177	0.793	0.822			
2.59	1.69	3.187	3.823	6.572	0.926	0.938	2.605	1.285	0.278	1.289			
3.132	3.258	2.896	5.667	7.179	1.351	0.919	3.164	2.134	0.594	1.277			
3.208	3.717	5.035	2.502	3.869	5.308	1.289	2.861	1.909	1.126				
2.879	2.781	6.021	4.276	5.369	6.111	4.487	2.241	1.845	0.44				
3.472	1.184	5.481	2.521	4.112	3.608	2.485	3.182	1.434	1.351				
2.624	1.667	4.105	4.129	6.458	1.226	1.009	3.775	1.077	1.279				
2.148	2.349	3.484	1.996	2.415	1.754	1.291	3.02	2.012	1.112				
1.354	2.354	4.679	5.002	6.068	2.106	3.155	2.901	2.752	1.18				
2.113	3.671	3.949	4.417	5.436	4.055	4.215	2.367	3.317	1.241				
1.992	2.976	4.623	3.436	3.858	2.691	3.676	2.476	2.556	0.629				
3.06	3.96	5.283	2.506	5.435	3.405	1.858	2.471	2.095	0.589				
2.947	3.783	4.932	2.187	6.049	3.371	3.285	2.797	1.384	1.253				
3.867	2.61	7.31	4.185	2.996	4.062	2.97	1.622	1.75	1.101				
3.495	3.47	6.555	5.44	2.083	4.704	4.013	2.658	1.504	1.735				
4.641	4.797	1.852	2.785	4.367	5.012	3.449	2.979	1.687	0.388				
4.808	4.456	4.183	5.786	5.552	3.774	2.386	1.349	1.343	1.027				
5.481	4.215	5.886	3.902	6.141	3.874	3.566	1.094	1.883	1.354				
5.343	4.925	7.084	1.302	6.487	4.644	2.513	2.241	1.763	1.264				
2.999	5.604	2.288	4.018	4.825	2.77	3.803	2.089	0.999	1.125				
3.491	5.794	4.966	2.69	4.856	4.255	4.005	1.749	1.613	1.895				
4.132	4.353	1.416	4.248	4.142	3.313	1.574	1.236	2.124	0.979				
5.552	5.458	2.959	5.868	3.036	4.821	3.37	2.224	2.66	1.068				
0.677	6.477	1.808	6.049	4.872	5.508	3.169	1.13	1.581	1.355				
1.441	0.997	0.889	6.216	2.176	5.785	2.475	0.934	1.061	1.264				
2.871	1.547	4.708	2.701	3.709	2.374	3.162	1.885	0.925	0.88				
3.301	2.761	4.889	4.081	2.485	2.673	1.564	1.73	1.416	0.587				
1.057	4.003	5.752	4.757	4.831	1.274	1.226	2.061	0.983	1.278				
1.649	2.008	5.654	6.255	5.77		3.304	1.868	1.428	1.283				
	4.498		3.977	2.548		3.262		1.146					
91.036	**105.386**	**130.967**	**123.96**	**145.796**	**102.54**	**80.472**	**69.094**	**53.07**	**31.821**	**4.772**	**0**	**0**	**0**
685.477	**790.863**	**921.83**	**1045.79**	**145.796**	**248.336**	**328.808**	**397.902**	**450.972**	**482.793**	**487.565**	**487.565**	**487.565**	**487.565**

Nov	Dec
0	0
487.565	487.565



Monthly
Evaporative loss from ED3
Monthly Evaporation (no evaporators)
Monthly Evaporation (1 evaporator)
Monthly Evaporation (2 evaporators)
Monthly Evaporation (3 evaporators)
Monthly Evaporation- 4 evaporators
Evaporation in ML
0
5
10
15
20
25
30
35
40
45
50
Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month



Water balance ED3
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
ML in ED3
Oct/05
Apr/06
Oct/06
Apr/07
Oct/07
Month
Water Balance Evaporation from Pond
Water Balance (1 evaporator)
Water Balance (2 evaporators)
Water Balance (3 evaporators)
Water Balance- 4 evaporators

	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December
	30	31	31	28	31	30	31	30	31	31	30	31	30	31	31	28	31	30	31	30	31	31	30	31	30	31
	58.7	46.1	59.8	51.2	55.6	49.3	47.5	37.9	52.4	47.6	65.2	61.9	58.7	46.1	59.8	51.2	55.6	49.3	47.5	37.9	52.4	47.6	65.2	61.9	58.7	46.1
	5	6.2	6.3	5.5	4.1	2.6	1.6	1.1	1.2	1.9	2.8	3.8	5	6.2	6.3	5.5	4.1	2.6	1.6	1.1	1.2	1.9	2.8	3.8	5	6.2
Average Monthly Pan Evaporation (mm- total)	0.1725	0.22165	0.2232	0.1778	0.1488	0.093	0.0589	0.0405	0.04495	0.06975	0.099	0.13795	0.1725	0.22165	0.2232	0.1778	0.1488	0.093	0.0589	0.0405	0.04495	0.06975	0.099	0.13795	0.1725	0.22165

Estimated monthly evaporation (M3) attributed to 1 evaporator (350 l/min)	6019	6875	6895	5686	5862	4701	4046	3371	3632	4330	4820	5687	6019	6875	6895	5686	5862	4701	4046	3371	3632	4330	4820	5687	6019	6875
Estimated monthly evaporation (M3) attributed to 2 evaporators (350 l/min)	12037	13751	13789	11372	11725	9402	8093	6742	7264	8659	9640	11375	12037	13751	13789	11372	11725	9402	8093	6742	7264	8659	9640	11375	12037	13751
Estimated monthly evaporation (M3) attributed to 3 evaporators (350 l/min)	18056	20626	20684	17058	17587	14103	12139	10113	10895	12989	14460	17062	18056	20626	20684	17058	17587	14103	12139	10113	10895	12989	14460	17062	18056	20626
Estimated monthly evaporation (M3) attributed to 4 evaporator(s) (350 l/min)	24075	27502	27578	22744	23449	18804	16186	13484	14527	17318	19280	22750	24075	27502	27578	22744	23449	18804	16186	13484	14527	17318	19280	22750	24075	27502
Estimated Evaporation (M3) attributed to surface evaporation (no evaporator)	15006.3	19291.2	18596.0	14286.3	11827.1	7397.5	4816.0	3457.6	4001.9	6488.1	9529.3	13544.4	16982.3	21601.0	20657.1	15814.9	13016.6	8081.2	5197.2	3706.7	4272.1	6895.5	10083.4	14273.9	17829.0	22594.3
Estimated Evaporation (M3) attributed to surface evaporation (1 evaporator)	15006.3	18586.8	16798.5	12188.2	9715.6	5845.2	3705.0	2647.1	3070.1	4994.2	7313.1	10292.7	12643.1	15705.6	14263.7	10500.7	8482.3	5096.7	3274.3	2374.8	2773.1	4542.8	6698.9	9492.6	11738.3	14684.1
Estimated Evaporation (M3) attributed to surface evaporation (2 evaporator)	15006.3	17777.3	14847.0	9755.6	6725.4	3443.3	1581.8	988.8	1414.3	2427.2	3296.7	1550.3	643.3	0.0	0.0	0.0	0.0	0.0	0.0	1.5	32.2	107.1	123.3	0.0	0.0	0.0
Estimated Evaporation (M3) attributed to surface evaporation (3 evaporator)	15006.3	16861.3	13193.4	7424.1	2837.6	382.6	121.3	65.6	78.0	143.4	178.4	144.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	35.5	30.9	0.0	0.0	0.0
Estimated Evaporation (M3) attributed to surface evaporation (4 evaporator(s))	15006.3	15950.5	10922.7	1049.4	25.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Evaporator evaporation as % of Surface Evaporation (1 evaporator)	40.1%	35.6%	37.1%	39.8%	49.6%	63.5%	84.0%	97.5%	90.8%	66.7%	50.6%	42.0%	35.4%	31.8%	33.4%	36.0%	45.0%	58.2%	77.9%	90.9%	85.0%	62.8%	47.8%	39.8%	33.8%	30.4%
Evaporator evaporation as % of Surface Evaporation (2 evaporators)	80.2%	71.3%	74.2%	79.6%	99.1%	127.1%	168.0%	195.0%	181.5%	133.5%	101.2%	84.0%	70.9%	63.7%	66.8%	71.9%	90.1%	116.3%	155.7%	181.9%	170.0%	125.6%	95.6%	79.7%	67.5%	60.9%
Evaporator evaporation as % of Surface Evaporation (3 evaporator(s))	120.3%	106.9%	111.2%	119.4%	148.7%	190.6%	252.1%	292.5%	272.3%	200.2%	151.7%	126.0%	106.3%	95.5%	100.1%	107.9%	135.1%	174.5%	233.6%	272.8%	255.0%	188.4%	143.4%	119.5%	101.3%	91.3%
Evaporator evaporation as % of Surface Evaporation (4 evaporator(s))	160.4%	142.6%	148.3%	159.2%	198.3%	254.2%	336.1%	390.0%	363.0%	266.9%	202.3%	168.0%	141.8%	127.3%	133.5%	143.8%	180.1%	232.7%	311.4%	363.8%	340.0%	251.2%	191.2%	159.4%	135.0%	121.7%
Evaporation from Pond	15006.33158	19291.2246	18595.96903	14286.305	11827.0785	7397.5361	4815.98473	3457.57676	4001.9273	6488.09051	9529.31306	13544.40844	16982.28	21600.97867	20657.05538	15814.9363	13016.6113	8081.18995	5197.22556	3706.71156	4272.10208	6895.50571	10083.4006	14273.9441	17829.0205	22594.3205
Incident Rainfall	10081.5	7243.5	8819.25	8027.25	6913.5	5626.5	6435	5395.5	6575.25	7656	8217	9050.25	10081.5	7243.5	8819.25	8027.25	6913.5	5626.5	6435	5395.5	6575.25	7656	8217	9050.25	10081.5	7243.5
Water Pumped In	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000

	Initial Volume stored in ED3																										
Progressive Water Balance (no evaporators)	90976	91051	84003	79226	77967	78054	81283	87902	94840	102413	108581	112268	112774	110874	101516	94678	91891	90787	93333	99571	106259	113562	119323	122457	122233	119485	109135
Progressive RL of dam	789.09	789.09	789.02	788.96	788.95	788.95	788.99	789.06	789.13	789.21	789.27	789.31	789.31	789.29	789.20	789.13	789.10	789.09	789.11	789.18	789.25	789.32	789.38	789.41	789.41	789.38	789.27
Progressive Water Balance (1 evaporator)	90976	85032	71813	61939	57093	53428	53509	57192	61569	66443	69775	70859	68929	65349	55011	47672	44513	42082	42911	47025	51674	56845	60628	62327	61197	58521	49205
Progressive RL of dam	789.09	789.03	788.87	788.73	788.67	788.62	788.62	788.67	788.73	788.79	788.84	788.85	788.83	788.78	788.64	788.55	788.50	788.46	788.48	788.54	788.60	788.67	788.72	788.74	788.73	788.69	788.57
Progressive Water Balance (2 evaporators)	90976	79013	58919	42151	31618	22091	17471	17108	18114	19355	18358	14622	7005	0	0	0	0	0	0	68	1346	2885	2339	0	0	0	0
Progressive RL of dam	789.09	788.96	788.70	788.46	788.26	788.07	787.81	787.75	787.93	788.02	787.98	787.28	785.83	784.50	784.50	784.50	784.50	784.50	784.50	784.51	784.76	785.05	784.94	784.50	784.50	784.50	784.50
Progressive Water Balance (3 evaporators)	90976	72995	47751	27693	16238	7727	3868	3042	3259	3861	3385	1963	0	0	0	0	0	0	0	0	282	955	587	0	0	0	0
Progressive RL of dam	789.09	788.88	788.55	788.18	787.58	785.97	785.23	785.08	785.12	785.23	785.14	784.87	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.55	784.68	784.61	784.50	784.50	784.50	784.50
Progressive Water Balance- 4 evaporators	90976	66976	35767	11085	320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Progressive RL of dam	789.09	788.80	788.34	786.60	784.56	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50

	1/11/2005	1/12/2005	1/01/2006	1/02/2006	1/03/2006	1/04/2006	1/05/2006	1/06/2006	1/07/2006	1/08/2006	1/09/2006	1/10/2006	1/11/2006	1/12/2006	1/01/2007	1/02/2007	1/03/2007	1/04/2007	1/05/2007	1/06/2007	1/07/2007	1/08/2007	1/09/2007	1/10/2007	1/11/2007	1/12/2007
Monthly Evaporation (no evaporators)	15.006	19.291	18.596	14.286	11.827	7.398	4.816	3.458	4.002	6.488	9.529	13.544	16.982	21.601	20.657	15.815	13.017	8.081	5.197	3.707	4.272	6.896	10.083	14.274	17.829	22.594
Monthly Evaporation (1 evaporator)	21.025	25.462	23.693	17.874	15.578	10.546	7.752	6.018	6.702	9.324	12.133	15.980	18.662	22.581	21.158	16.187	14.345	9.798	7.321	5.746	6.405	8.872	11.519	15.180	17.757	21.560
Monthly Evaporation (2 evaporators)	27.044	31.528	28.636	21.127	18.450	12.845	9.675	7.731	8.678	11.086	12.937	12.925	12.681	13.751	13.789	11.372	11.725	9.402	8.093	6.744	7.296	8.766	9.763	11.375	12.037	13.751
Monthly Evaporation (3 evaporators)	33.063	37.487	33.877	24.482	20.425	14.485	12.261	10.179	10.973	13.132	14.638	17.207	18.056	20.626	20.684	17.058	17.587	14.103	12.139	10.113	10.902	13.024	14.491	17.062	18.056	20.626
Monthly Evaporation- 4 evaporators	39.081	43.452	38.501	23.793	23.475	18.804	16.186	13.484	14.527	17.318	19.280	22.750	24.075	27.502	27.578	22.744	23.449	18.804	16.186	13.484	14.527	17.318	19.280	22.750	24.075	27.502

Net pan evaporation (inches/month)	Percentage of volume pumped by evaporator	Net pan evaporation (inches/month)	Percentage of volume pumped by evaporator
1.5	20	7.0	40
2.0	28	7.5	41
2.5	29	8.0	42
3.0	30	8.5	43
3.5	32	9.0	44
4.0	34	9.5	45
4.5	35	10	46
5.0	36	10.5	47
5.5	37	11	48
6.0	38	11.5	49
6.5	39	12	50
7.0	40	12+	up to 85

Net pan evaporation	Percentage of volume pumped by evaporator (from manufacturer specifications)			
1.5	20%	38.1	21.8%	21.8%
2	28%	50.8	24.4%	24.4%
2.5	29%	63.5	26.7%	26.7%
3	30%	76.2	28.7%	28.7%
3.5	32%	88.9	30.5%	30.5%
4	34%	101.6	32.2%	32.2%
4.5	35%	114.3	33.8%	33.8%
5	36%	127	35.2%	35.2%
5.5	37%	139.7	36.6%	36.6%
6	38%	152.4	37.9%	37.9%
6.5	39%	165.1	39.1%	39.1%
7	40%	177.8	40.3%	40.3%
7.5	41%	190.5	41.4%	41.4%
8	42%	203.2	42.5%	42.5%
8.5	43%	215.9	43.5%	43.5%
9	44%	228.6	44.6%	44.6%
9.5	45%	241.3	45.5%	45.5%
10	46%	254	46.5%	46.5%
10.5	47%	266.7	47.4%	47.4%
11	48%	279.4	48.3%	48.3%
11.5	49%	292.1	49.1%	49.1%
12	50%	304.8	50.0%	50.0%
12+	up to 86			

THE ODOUR UNIT

DAM VOLUMES AS OF 24 MARCH 2023

LandTeam
FOCUSED. DRIVEN. NOW.
SOUTHERN TABLELANDS
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PO Box 1040
Goulburn NSW 2580
P: (02) 4821 1033
E: goulburn@landteam.com.au
LandTeam Australia PTY Limited ABN 35 300 283 592

Our Ref: 16700

29 March 2023

Veolia Environmental Services
Woodlawn Bioreactor
619 Collector Road
TARAGO NSW 2580

DAM VOLUMES: 24 March 2023

Dam Name	Volume of Water	Water Surface Level
ED1N	1,321,201 m^3	788·66
ED1 Coffer Dam 1	159,519 m^3	789·46
ED3N1	24,318 m^3	791·53
ED3N2	17,401 m^3	791·01
ED3N3	18,828 m^3	791·60
ED3N4	128,007 m^3	791·91
ED3S1	183,970 m^3	791·57
ED3S2	107,184 m^3	793·45
Leachate Dam	11,316 m^3	788·45

Please note: There is only limited survey information available for the surface of dam ED1N. Survey information is not available for a substantial area of the floor of the dam and volumes shown are approximate only.

The volume shown for ED3N1 is also approximate only. A re-survey of this dam for the determination of accurate volumes is pending completion of works on the dam currently which are currently ongoing.

Regards,

Jackson Boyt
Survey Technician

APPENDIX D:

LIQUID ODOUR MEASUREMENT METHODOLOGY

LOM Methodology

The LOM methodology is comprised of the following components:

- Evaporation of a known amount of liquid in a known volume of dry N_2 contained in a Nalophan odour sample bag;
- Determination of the odour concentration of the gaseous sample by Dynamic Dilution Olfactometry following AS/NZS 4323.3; and
- Calculation of the odour concentration in the liquid from the gaseous odour concentration (ou/m^3) and the volume of liquid evaporated to produce the gaseous sample.

Procedure

Liquid Sample Storage

The liquid samples analysed from the Woodlawn Facility were collected from stored leachate in lagoons including ED3N-1, ED3N-2, ED3N-3, ED3N-4, ED3S1, ED3S2, LTD, LAP, ED1 Coffer Dam, ED1 Stormwater/Acid Mine Drainage. These were refrigerated prior to testing. A liquid sample was extracted immediately from the refrigerated sample bottle and not allowed to warm to room temperature. This is the general procedure when carrying out the liquid odour measurement method for aqueous samples.

Liquid Sample Size

The volume of liquid is determined by the requirement to produce a gaseous sample with a RH of less than 100%. This equates to less than 2.3% v/v water at 20º C, or for a 25 L sample, 413 microlitres (**µL**) of aqueous sample. The method development work carried out to date has shown that 413 µL of liquid sample in 20 L dry nitrogen will evaporate in approximately 30 mins. The nominal liquid sample size required for the Liquid Odour method can be specified as 340-413 µL, which provides a gaseous sample with 80-100% RH. For the liquids samples collected at the Woodlawn Facility, 413 µL of liquid sample was used in 25 L dry nitrogen.

Table D1 details a range of liquid volumes and approximate evaporation times observed from the method development work carried out to date.

Table D1 - Liquid sample volumes, evaporation and equilibration time

Volume µL (% saturation)	Approximate evaporation time (in 25 L dry nitrogen)	Recommended equilibration time (in 25 L dry nitrogen)
280 µL (60%)	~30 min	60 min
340 µL (80%)	~40 min	60 min
413 µL (100%)	~60 min	60 min

Sample Equilibration and Ageing

The development work to date has shown that condensate derived odour samples are not stable and degrade significantly over time. However, the degradation appears insignificant in the first 2-4 hours after preparation of the gaseous samples. Therefore, samples must be tested within that time period after preparation. For samples prepared at 100% saturation or below, the equilibration time can be standardised to 1 hour.

Sample Preparation and Odour Testing Procedure

The gaseous sample for odour testing is prepared as follows:

1. Dispense 25 L of dry nitrogen into a conditioned Nalophan bag.
2. Place a piece of clear packaging tape (approximately 100 mm long) onto the wall of the bag halfway between the ends. Ensure that at least a 1 cm^2 section of tape completely adheres to the bag with no air bubbles trapped between the tape and bag that could allow a leak of gas to the edge of the tape.
3. Remove the liquid sample from cold storage.
4. Rinse the microlitre syringe (5 x) with the liquid sample.
5. Draw up the required volume of liquid sample (refer to *Liquid Sample Size* and **Table D1**) and record the exact volume in the syringe.
6. Inject the liquid through the tape and wall of the bag at the point where the tape has completely adhered to the bag. Tap the syringe to displace residual drop that adheres to the needle and withdraw the syringe from the bag.
7. Place the second piece of packaging tape over the first piece such that the puncture hole is sealed. Ensure no air bubbles are trapped between the layers of tape such that a leak could occur.
8. Vigorously shake the bag to disperse the liquid droplets inside the bag (to aid in the evaporation rate).
9. Store the bag in the laboratory for the prescribed equilibration time (refer to *Sample Equilibration and Ageing* and **Table D1**) to allow all the liquid to evaporate.
10. At the completion of the equilibration time, carry out the measurement of odour concentration using AS/NZS 4323.3.

Calculation of Liquid Odour Concentration

The odour concentration from a liquid (ou per mL) is calculated from the gaseous sample odour concentration, the volume of liquid used to prepare the gaseous sample and the volume of dry nitrogen:

$$[odour]_{liquid} = \frac{\left(\frac{OU}{m^3} \times \frac{litres_{Nitrogen}}{1000}\right)}{mL_{liquid}}$$

An example of the calculation is presented in **Table D2**.

Table D2 – Example calculation of liquid odour concentration for ED3N-4		
Parameter	**Value**	**Unit**
Volume of liquid from ED3N-4	0.413	mL
Volume of dry N_2	0.025	m^3
Measured odour concentration	49^	ou
Calculated liquid odour concentration	= (49 x 0.025)/(0.413) = 2.97	ou.m^3/mL

^ TOU Sample Number SC23124 – refer to **Table 6.6** in the Main Report of the 11th IOA

Calculation of Odour Emission Rates from Evaporation of Liquids

A primary driver for the development of a liquid odour measurement is the requirement to predict odour emission rates from liquids area sources (such as storage ponds) as well as condensates. In particular, evaporation of condensates or other odorous refinery waters in cooling towers has been implicated as a significant contributor to refinery odour. With a measurement of the odour from liquids now available, the estimation of emission rates can be considered.

An example is presented below for treated leachate stored in ED3N-4 (SC23124) which returned a measured odour concentration of 2.97 ou.m^3/mL (refer to **Table D2**) with an evaporation rate of 1.396 L/s (based on on-site evaporation data collected by Veolia between May 2007 and June 2012 and current pond surface area):

Odour concentration = 2.97 ou.m^3/mL

Ambient pond evaporation rate = 1.447 L/s

Odour emission rate = 2.97 ou.m^3/mL x 1,447 mL/s
= 4,300 ou.m^3/sec (refer **Table 6.7** in the Main Report of the 11th IOA)