Bioelektra Australia Pty Ltd

West Nowra Resource Recovery Park – Stage 2

Air Quality Assessment

May 2021

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1. Introduction

1.1 Purpose of this report

Bioelektra Australia Pty Ltd (Bioelektra) proposes to construct and operate an integrated resource recovery facility at West Nowra (referred to in this report as ‘the project’). This report has been prepared by GHD Pty Ltd (GHD) to provide an assessment of air quality associated with the project as an input to the environmental impact statement (EIS). Bioelektra is the proponent of the project and the EIS is being prepared by GHD in accordance with the requirements of Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (the EP&A Act).

The report addresses the requirements of the Secretary of the NSW Department of Planning, Industry and Environment (the Secretary’s Environmental Assessment Requirements (SSD 9887)) dated February 2021.

1.2 Staged project approval

In 2016 Shoalhaven City Council (Council) sought approval for a Concept Proposal for a resource recovery park with a combined capacity of 130,000 tonnes per year (the West Nowra Resource Recovery Park). The Concept Proposal included:

- Stage 1 – clearing of land and provision of basic infrastructure on the nominated site, which would be undertaken by Council or contractors appointed by Council as part of early construction works.
- Stage 2 – construction and operation of a resource recovery park which would be undertaken by an alternative waste technology provider/facility operator, selected through a tendering process to provide the specialised resource recovery facilities.

Council sought Project Approval for stage 1 as part of the same application.

A staged approach was adopted to enable Stage 1 to commence (subject to planning approval) while a contractor was appointed and the details of Stage 2 were determined via the tendering and design process.

Council received Concept Approval and Stage 1 Project Approval for the West Nowra Resource Recovery Park on 25 August 2016 (SSD 7015). The approved Stage 1 works included:

- Demolition of the existing animal shelter
- Site preparation and clearing of the site
- Construction of perimeter, entry/exit and service roads and line marking
- Installation of perimeter/boundary fencing
- Weighbridge and weighbridge office
- Staff and visitor car parking, including line marking
- Detention and sedimentation dams/basins
- Identification of asset protection zones

Council subsequently awarded Bioelektra with the contract to construct and operate Stage 2 of the works.

1.3 Project description

The project would comprise a range of waste and resource processing activities aimed at maximising resource recovery and minimising the amount of waste destined for landfill disposal.

The project is defined as the construction and operation of a resource recovery facility with pre-treatment for mixed municipal waste of up to 130,000 tonnes per year, comprising:

- Shredder operations
- Sterilisation of waste through autoclaving
- Sorting and processing operations
- Other areas for processing and storing and receiving processed material
- Transformer area
- Boiler room
- Wastewater treatment plant
- Transfer station
- Offices and amenities (2 levels)

The project also includes ancillary infrastructure including:

- Weighbridges and weighbridge offices
- Covered holding bays
- Circulation roadways and road reserves
- Staff and visitor car parking, including line marking
- Two new sediment / detention basins
- Substation
- Liquid Petroleum Gas (LPG) station
- Fencing around the perimeter of the site
- Asset protection zones (APZs)
- Pump house and firefighting tanks

A schematic of the project is shown in Figure 1-1.

The Concept Approval included construction and demolition (C&D) waste processing and an alternative waste treatment (AWT)/materials recovery facility (MRF).

C&D processing is no longer proposed part of the project and the waste processing technology proposed by Bioelektra includes sterilisation of waste through autoclaving and materials recovery through various sorting operations.

Other ancillary infrastructure not included as part of the Concept Approval but proposed for this project include the transfer station, covered holding bays, boiler room, substation, transformer hall, LPG station and pumping station and firefighting tank.

Construction activities relating to this project would include:

- Bulk earthworks for shaping of the site including access roads, parking area and construction hardstand
- Construction of surface water detention ponds, surface water drains and utilities connections

- Construction of concrete floor slab for the building
- Construction of structures and connection to utilities
- Pavement construction for access roads and parking area
- Fit out and installation of processing equipment and office furnishings

1.4 Location of the project

The project site is approximately five kilometres to the west of the Nowra Central Business District and is accessed from Flatrock Road, off Yalwal Road in West Nowra (refer to Figure 1-2).

The site is adjacent to the existing landfill and is located on an approximate 3.6 ha parcel of land (Lot 342 DP 257515).

Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park Stage 2

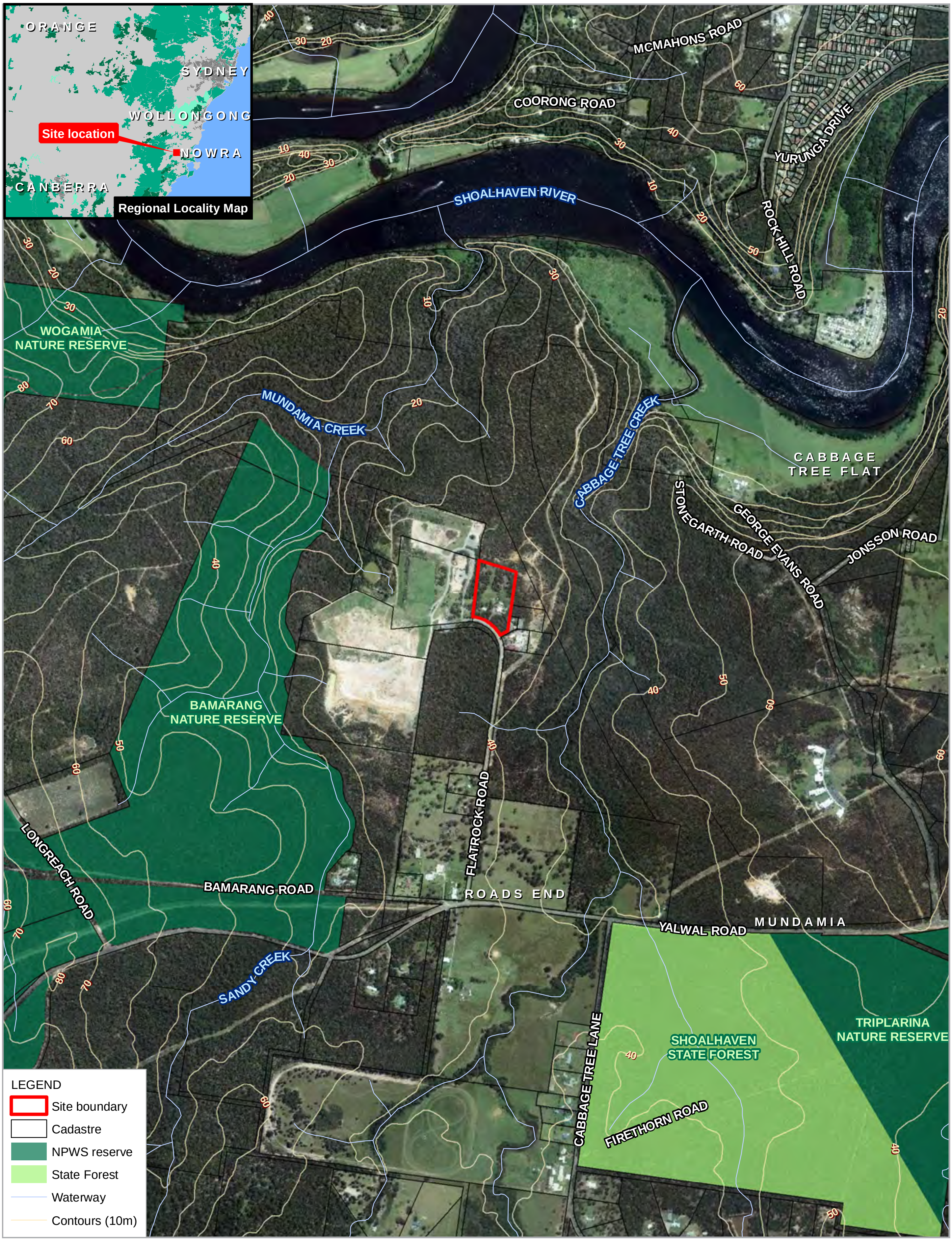
Site Plan

Job Number 12536311
Revision A
Date December 2020

Figure 1-1

Level 15, 133 Castlereagh Street, Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com

Plot Date: 11 December 2020 - 2:31 PM Plotted by: Daniela Taylor Cad File No: Drawing1.dwg



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Grid: GDA 1994 MGA Zone 56

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Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park Stage 2

Site Location

Project No. 12536311
Revision No. -
Date 28 Sep 2020

FIGURE 1-2

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Data source: Aerial imagery - Sixmaps 2020 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Inset map - Geoscience Australia. Created by: jrprice

1.5 Secretary's Environmental Assessment Requirements and agency requirements

The specific SEARs and agency requirements (New South Wales Environmental Protection Authority (NSW EPA)) addressed in this report are summarised in Table 1-1.

Table 1-1 Secretary's Environmental Assessment Requirements and agency requirements

Assessment requirements	Where addressed in report
• a quantitative assessment of the potential air quality, dust and odour impacts of the development in accordance with relevant Environment Protection Authority guidelines;	Whole report. Assessment results provided in Section 6
• the details of buildings and air handling systems and strong justification for any material handling, processing or stockpiling external to buildings;	Section 5
• details of proposed mitigation, management and monitoring measures.	Section 7
Agency requirements (NSW EPA)	
The proposal	
• Identify all sources or potential sources of air emissions from the development. Note: emissions can be classed as either: ○ point (e.g. emissions from stack or vent); or ○ fugitive (from wind erosion, leakages or spillages, associated with loading or unloading, conveyors, storage facilities, plant and yard operation, vehicle movements (dust from road, exhausts, loss from load), land clearing and construction works).	Section 5
• Provide details of the project that are essential for predicting and assessing air impacts including:	Section 5
○ the quantities and physio-chemical parameters (e.g. concentration, moisture content, bulk density, particle sizes etc) of materials to be used, transported, produced or stored;	Refer EIS
○ an outline of procedures for handling, transport, production and storage; and	Refer EIS
○ the management of solid, liquid and gaseous waste streams with potential to generate emissions to air.	Refer EIS
The location	
• Describe the topography and surrounding land uses. Provide details of the exact locations of dwellings, schools and hospitals. Where appropriate provide a perspective view of the study area such as the terrain file used in dispersion models.	Section 3.1
• Describe surrounding buildings that may effect plume dispersion.	Section 2.3

• Provide and analyse site representative data on following meteorological parameters:
  ○ temperature and humidity;
  ○ rainfall, evaporation and cloud cover;
  ○ wind speed and direction;
  ○ atmospheric stability class;
  ○ mixing height (the height that emissions will be ultimately mixed in the atmosphere);
  ○ katabatic air drainage; and
  ○ air re-circulation.
	Section 3.2, Appendix A and refer EIS

The environmental issues	
Describe baseline conditions • Provide a description of existing air quality and meteorology, using existing information and site representative ambient monitoring data.	Section 3

Assess impacts
• Identify all pollutants of concern and estimate emissions by quantity (and size for particles), source and discharge point.
• Estimate the resulting ground level concentrations of all pollutants. Where necessary (e.g. potentially significant impacts and complex terrain effects), use an appropriate dispersion model to estimate ambient pollutant concentration. Discuss choice of model and parameters with the EPA.
• Describe the effects and significance of pollutant concentration on the environment, human health, amenity and regional ambient air quality standards or goals.
• Describe the contribution that the development will make to regional and global pollution, particularly in sensitive locations.
• For potentially odorous emissions provide the emission rates in terms of odour units (determined by techniques compatible with EPA procedures). Use sampling and analysis techniques for individual or complex odours and for point or diffuse sources, as appropriate.
• Reference should be made to:
  ○ Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016);
  ○ Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC, 2007);
  ○ Assessment and Management of Odour from Stationary Sources in NSW (DEC, 2006);
  ○ Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW (DEC, 2006); and
  ○ Environmental Guidelines: Composting and Relating Organics Processing Facilities (DECC, 2004).
	Section 5 and 6

Describe management and mitigation measures • Outline specifications of pollution control equipment (including manufacturer's performance guarantees where available) and management protocols for both point and fugitive emissions. Where possible, this should include cleaner production processes.	Section 7

1.6 Scope and structure of the report

1.6.1 Scope of report

The key tasks undertaken in this assessment are as follows:

- Review surrounding environment including terrain and landuse to inform dispersion modelling and identify sensitive receptors
- Review the local climate and recorded background air quality concentrations
- Identify air quality assessment criteria applicable to this assessment
- Development of an air quality emissions inventory
- Meteorological and dispersion modelling to predict potential air quality impacts
- Preparation of this report

1.6.2 Structure of report

- **Chapter 1 – Introduction** – This chapter introduces the project
- **Chapter 2** – **Assessment methodology** – This chapter describes the methodology for the assessment
- **Chapter 3 – Existing environment** – This chapter describes the project location, existing air environment and sensitive receivers in the project area
- **Chapter 4 – Air quality criteria** – This chapter identifies the criteria for assessment
- **Chapter 5 – Project air quality emissions**– This chapter estimates emissions to air from the project
- **Chapter 6 – Air quality impact assessment** – This chapter examines the potential air quality impacts associated with the project
- **Chapter 7 – Recommended mitigation measures** – This chapter identifies mitigation measures relating to air quality
- **Chapter 8 – Conclusions** – This chapter summarises the assessment conclusions
- **Chapter 9 – References** – This chapter provides a reference list

1.7 Limitations

This report: has been prepared by GHD for Bioelektra Australia Pty Ltd and may only be used and relied on by Bioelektra Australia Pty Ltd for the purpose agreed between GHD and the Bioelektra Australia Pty Ltd as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Bioelektra Australia Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.8 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Bioelektra Australia Pty Ltd and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.8 Assumptions

This air quality assessment relied upon the following assumptions:

- Project description including details of the project were provided by Bioelektra
- Emissions to air from the project were estimated based on the methodology outlined in Section 5. Odour emissions rates were estimated based on sampling undertaken at similar facilities including odour sampling data sourced from Poland provided in Otto Engineering Polsk (2021). Odour Concentration test report No. LB/007/02/21 attached as Appendix C
- Air quality emission source properties including combustion pollutant and dust emission rates were provided by Bioelektra
- Meteorological modelling was undertaken in accordance with the methodology outlined in Section Appendix A
- Cumulative odour concentrations were assessed via anodour dispersion model using modelling files provided by SLR Consulting prepared for *Additional Air Quality Modelling and Assessment (SLR Consulting, 2020)* and *West Nowra Recycling & Waste Facility Proposed Stage 4 Landfill Extension Air Quality Impact Assessment (SLR Consulting, 2019)*

2. Assessment methodology

2.1 General

This air quality assessment was undertaken to assess potential worst-case air quality impacts from the project. The air pollutants considered in this report include:

- Odour
- Particulate matter (Total Suspended Particulates (TSP) and particulate matter with diameter smaller than 10 microns (PM_{10}). As the primarily source of particulate matter is from manual handling and transfer of waste, it is anticipated the majority of particulate matter would have a relatively large diameter. Consequently, TSP and PM_{10} were the fractions of particulate matter examined.)
- Products of combustion including Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO)

This assessment was undertaken in accordance the NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (2016) (the Approved Methods).

2.2 Approach

2.2.1 Methodology approach

Based on a review of the project description and identification of the likely air quality emissions from the project, the following approach was adopted:

- Construction – a qualitative based approach was adopted to assess the construction of the project. The most significant construction activities likely to generate emissions to air (primarily dust) are the early construction works (clearing of land and provision of basic infrastructure on the nominated site) which were assessed in the Stage 1 air quality assessment in *West Nowra Recovery Park EIS Air Quality Assessment* (GHD, 2015). The remaining construction activities to be assessed as part of Stage 2 are considered relatively minor and unlikely to results in air quality impacts. Consequently no further quantitative assessment was considered necessary. It is expected that the implementation of appropriate mitigation measures would effectively control dust generation for the construction of the project. Mitigation measures to minimise air quality impacts during the construction of the project are provided in Section 7.1.
- Operation – a quantitative based approach utilising air quality dispersion modelling was adopted to assess the operation of the project.

2.2.2 Cumulative assessment

Cumulative odour impacts (impacts as a result of the operation of the project and the existing West Nowra landfill) were accounted for by using the dispersion model prepared by SLR Consulting in their assessment of landfill operations associated with the West Nowra Landfill Extension in *Additional Air Quality Modelling and Assessment (SLR Consulting, 2020)* and *West Nowra Recycling & Waste Facility Proposed Stage 4 Landfill Extension Air Quality Impact Assessment (SLR Consulting, 2019).*

All odour sources including odour source properties were extracted from SLR's modelling files and imported into the model prepared for this assessment (refer to *Additional Air Quality Modelling and Assessment (SLR Consulting, 2020)* and *West Nowra Recycling & Waste Facility*

Proposed Stage 4 Landfill Extension Air Quality Impact Assessment (SLR Consulting, 2019) for odour emission rates and source locations for landfill operations.

Two possible scenarios have been assessed to determine worst-case cumulative odour concentrations at each receptor, being:

- Bioelektra + current landfill operations
- Bioelektra + proposed stage 4 Landfill Extension

With respect to cumulative odour emissions, it is anticipated that all incoming waste would be diverted to the project for treatment and recovery prior to application to land. Consequently, the volume of waste delivered to the landfill would be significantly lower than current quantities and therefore the landfill operating areas (active tipping face, daily cover and intermediate cover areas) would be significantly smaller resulting in relatively reduced emissions to air. The cumulative odour modelling conservatively does not account for this potential reduction in incoming waste.

Particulates from the project have been estimated and incremental impacts predicted at nearby sensitive receptors. Low predicted particulates from the project would be offset by an associated reduction in landfilling operations which are the highest source of particulates at the site. As the predicted incremental particulate concentrations are low (refer Section 6.2.2), no cumulative particulate impacts are expected.

2.3 Modelling methodology

2.3.1 Environmental impact dispersion model selection

A review of the surrounding terrain, air quality emission sources and distance to nearby receptors was undertaken to inform the choice of dispersion model used for this assessment. The review identified the CALPUFF dispersion model as the most appropriate model for use in this assessment.

2.3.2 Dispersion modelling

Predicted air quality impacts were modelled in accordance with the Approved Methods using an approved computer software model CALPUFF. CALPUFF is a non-steady-state, Gaussian puff dispersion model. It is accepted for use by the NSW EPA for application in environments where wind patterns and plume dispersion is strongly influenced by complex terrain, the land-sea interface or where there is a high frequency of stable, calm night-time conditions.

All CALPUFF model settings were selected based on the recommendations provided in the *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia* (J Barclay and J Scire, Atmospheric Studies Group TRC Environmental Corporation, 2011) except for the MDISP parameter which was chosen as the model default value.

For this assessment, the CALPUFF dispersion model was used to predict worst case ground-level pollutant concentrations from the project in accordance with air quality modelling guidance supplied in the Approved Methods. The averaging period and percentile of each air quality species was chosen to align with its assessment criteria.

Building wake affects were modelled using the PRIME Building Profile Input Program (BPIP) algorithm. The facility was modelled as a 60 metre by 115 metre hall with height of 13 metres.

Due to modelling constraints, the CALPUFF model calculates concentrations at 1 hour averaged intervals. As the Approved Methods specifies a one second nose response time for assessing odour concentrations, Peak to Mean (P/M60) ratios were applied to odour modelling in accordance with the Approved Methods (refer Section 6.6 of Approved Methods).

The grid size used in the CALPUFF model was equivalent to the CALMET domain (use of CALMET further discussed in Section 2.3.3). The same grid resolution of 200 metres used for the CALMET model was used in CALPUFF. A sampling grid resolution of 200 metres was used in the CALPUFF model to present predicted air quality concentrations.

Pollutant emission rates utilised in the dispersion modelling are detailed in Section 5.

2.3.3 Meteorology

Local meteorology including long term wind speed and direction, as well as atmospheric stability, influence how air pollutants are dispersed into the local environment.

Site specific meteorology for the project was produced using a model called CALMET to produce a three-dimensional wind field which also takes into account local variations in the terrain. The CALMET simulation produced a 3D wind field for the modelled year. Prognostic data from the Air Pollution Model (TAPM) was inputted into the CALMET model. A meteorological dataset of the 2019 calendar year was created.

2019 was chosen for the modelling year based on a representative year analysis which examined meteorological trends from nearby Bureau of Meteorology (BoM) weather stations in the last 5 complete calendar years (01/012015 – 31/12/2019). The analysis concluded that 2019 exhibited ‘typical’ meteorological condition which best matched trends identified across the 5 year dataset. Further details of the representative year analysis are provided in Appendix A.

Details of the procedure undertaken to produce the site-specific meteorology are provided in Appendix A.

3. Existing environment

3.1 Study area and surrounding land uses

The site is approximately five kilometres (km) to the west of the Nowra Central Business District and is accessed from Flatrock Road, off Yalwal Road in Mundamia.

The site is adjacent to the existing landfill and is located on an approximate 3.6 ha parcel of land (Lot 342 DP 257515), which is owned by the Council.

3.2 Climate

Climate statistics were sourced from the Bureau of Meteorology Nowra RAN air station. Morning (9 am) and afternoon (3 pm) climate statistics recorded from the from 2000 – 2010 are provided in Table 3-1 and mean monthly climate statistics from 2000 – 2020 are provided in Figure 3-1.

The climate data indicates the following observations:

- Mean monthly maximum and minimum temperatures are lowest during winter months (June to August) and highest during the summer months (December to February).
- Mean monthly rainfall varies across the year with the lowest occurring in September and highest occurring in February.
- Higher speed winds typically occur in the afternoon (3 pm) compared to the morning (9 am)

Table 3-1 Climate statistics (Nowra RAN Air Station AWS, 2000 – 2010)

Statistic	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean 9am temperature (°C)	22	21	19	18	14	12	11	13	16	18	19	20
Mean 9am relative humidity (%)	67	75	75	68	69	71	69	60	57	55	66	64
Mean 9am wind speed (km/h)	12	12	12	14	15	17	17	18	17	15	13	12
Mean 3pm temperature (°C)	25	24	23	21	18	16	15	17	19	20	23	24
Mean 3pm relative humidity (%)	57	63	59	57	55	56	53	46	47	52	56	55
Mean 3pm wind speed (km/h)	21	20	19	18	17	17	18	22	23	22	21	22

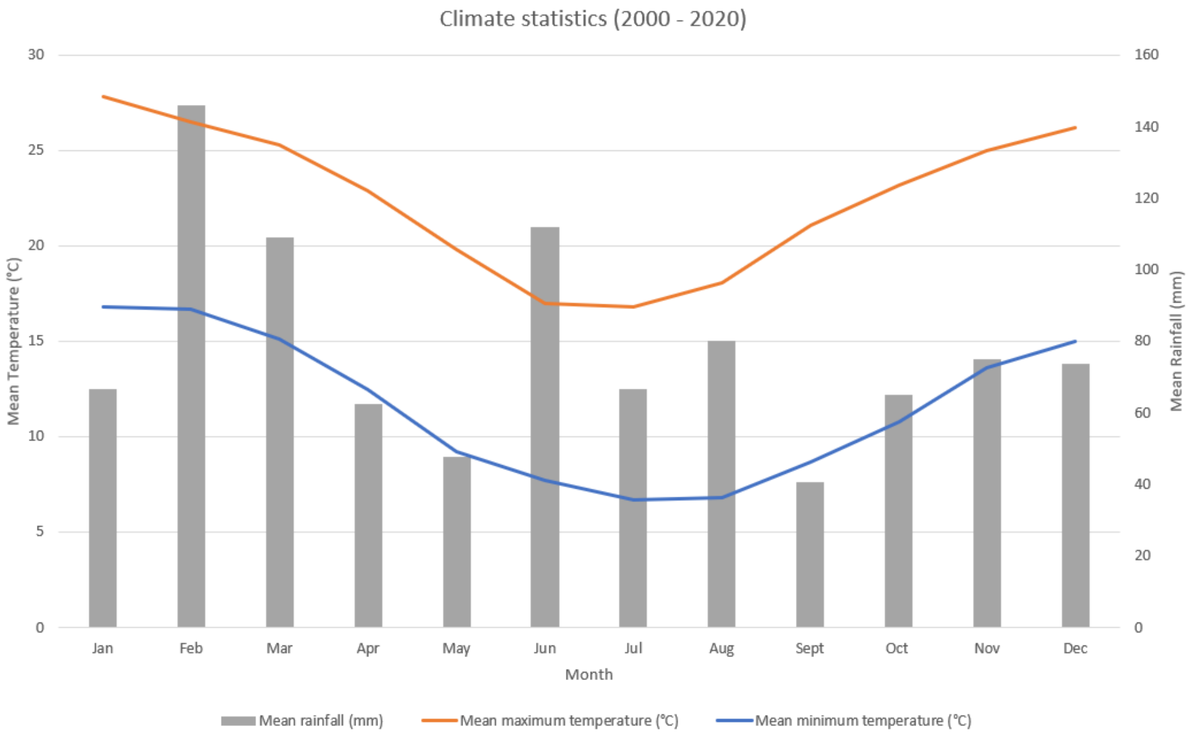


Figure 3-1 Climate statistics (Nowra RAN Air Station AWS 2000 – 2020)

3.3 Sensitive receptors

The Approved Methods defines sensitive receptors as locations where people are likely to work or reside and may include a dwelling, school, hospital, office or recreation areas.

The locations of the representative sensitive receptors relative to the site are presented in Table 3-2 with a description, address and approximate distance from site. The locations of representative sensitive receptors in the study area are shown in Figure 3-2.

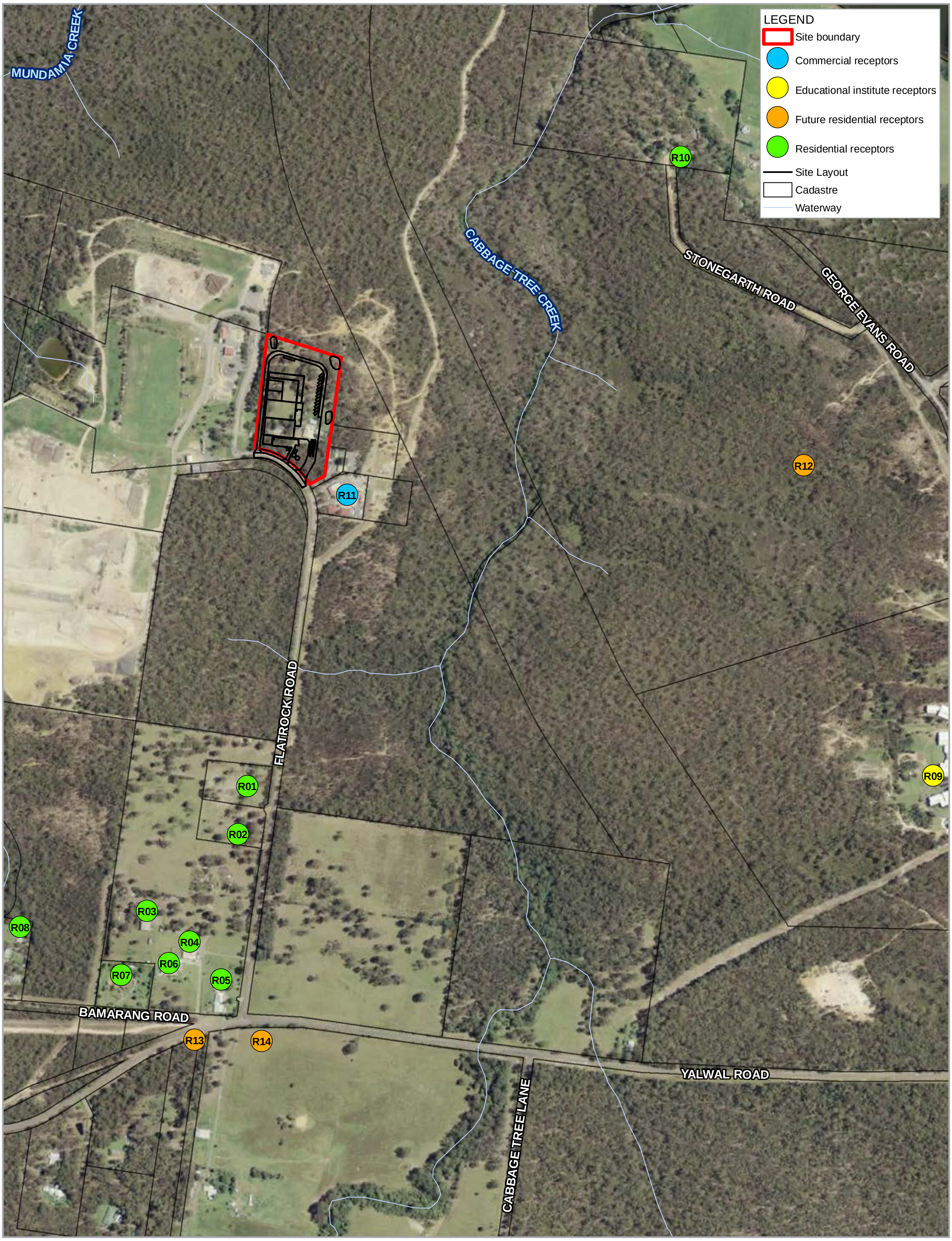
It should be noted that receptor nomenclature in this assessment was kept consistent with that presented in *West Nowra Recovery Park EIS Air Quality Assessment* (GHD, 2015). Therefore, a minor discrepancy in receptor nomenclature exists between this assessment and the recent air quality assessment undertaken by SLR (2019) and SLR (2020).

Table 3-2 Representative sensitive receptor locations

Receptor	Description	Address	Approximate distance from Site
R01	Residential dwelling	43 Flatrock Road, Mundamia	620 m south
R02	Residential dwelling	41 Flatrock Road, Mundamia	720 m south
R03	Residential dwelling	3 Flatrock Road, Mundamia	910 m south
R04	Residential dwelling	3 Flatrock Road, Mundamia	950 m south
R05	Residential dwelling	3 Flatrock Road, Mundamia	1000 m south
R06	Residential dwelling	3 Flatrock Road, Mundamia	1000 m south
R07	Residential dwelling	18 Bamarang Road, Mundamia	1050 m south
R08	Residential dwelling	Jim Da Silva Farm, 38A Old Bamarang Road, Mundamia	1060 m southwest
R09	University of Wollongong	George Evans Rd, West Nowra	1350 m east

Receptor	Description	Address	Approximate distance from Site
	Shoalhaven Campus		
R10	Residential dwelling	56 Stonegarth Road, Mundamia	800 m northeast
R11	OEH buildings	104 Flatrock Road, Mundamia	55 m southeast
R12[1]	Future residential	Mundamia Urban Release Area	930 m east
R13	Future residential	Cabbage Tree Lane Urban Release Area (west of Cabbage Tree Lane)	1170 m south
R14	Future residential	Cabbage Tree Lane Urban Release Area (east of Cabbage Tree Lane)	1170 m south

[1] R12 receptor was located at the worst-case location based on the planning zone. This is considered conservative as the proposed Mundamia development is located to the east of the R12.



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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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West Nowra Resource Recovery Park - Stage 2

Project No. 12536311
Revision No. 0
Date 11/05/2021

Project and sensitive receptor locations

FIGURE 3-2

\\ghdnet\ghd\AU\Sydney\Projects\21\12536311\GIS\Maps\Deliverables\12536311_Z013_AirLocation.mxd Data source: Aerial imagery - Google Earth 2021 (image date - 24/02/2016, image extracted - 25/08/2020) & Sixmaps 2021 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Borehole locations - ENRS. Created by: kpsroba

3.4 Ambient air quality

The existing landfill is a source of odour and particulate matter in the immediate area. To get an understanding of ambient air quality in the local area, GHD has reviewed available long term monitoring data.

The DPIE operate ambient air quality monitoring stations in selected areas around NSW. The nearest station to the site is the Albion Park South station which is located approximately 40 kilometres to the northeast of the project site and the Wollongong station which is located approximately 60 kilometres to the northeast of the project site. Use of data from the Albion Park South station was prioritised as it is located closer to the site. However, CO is not recorded at the Albion Park South station and therefore data from the Wollongong station was used.

No significant sources of emissions to air were identify in the area surrounding the project site. The prominent source of background dust would be areas subject to wind erosion and from urban activities. Pollen and vegetation derived dust would also be expected. Ambient pollutant concentrations for the 2019 calendar year are presented in Table 3-3.

Table 3-3 Ambient air quality data (01/01/2019 – 01/01/2020, µg/m^3)

Pollutant	Averaging period	NSW DPIE monitoring station	
		Albion Park South	Wollongong
PM_{10}	Maximum 24 hour	104.3	
	Maximum 24 hour (below assessment criteria)	47.0	
	70th percentile	21.3	
	Annual average	19.5	
NO_2	Maximum 1 hour	77.1	
	Annual average	7.2	
CO	Maximum 1 hour		5405.0
	Maximum 8 hour		2645.0

Elevated 24 hour averaged PM_{10} concentrations that exceed the assessment criteria (refer Section 4 assessment criteria) were identified. A time series of 24 hour average PM_{10} data is provide in Figure 3-3.

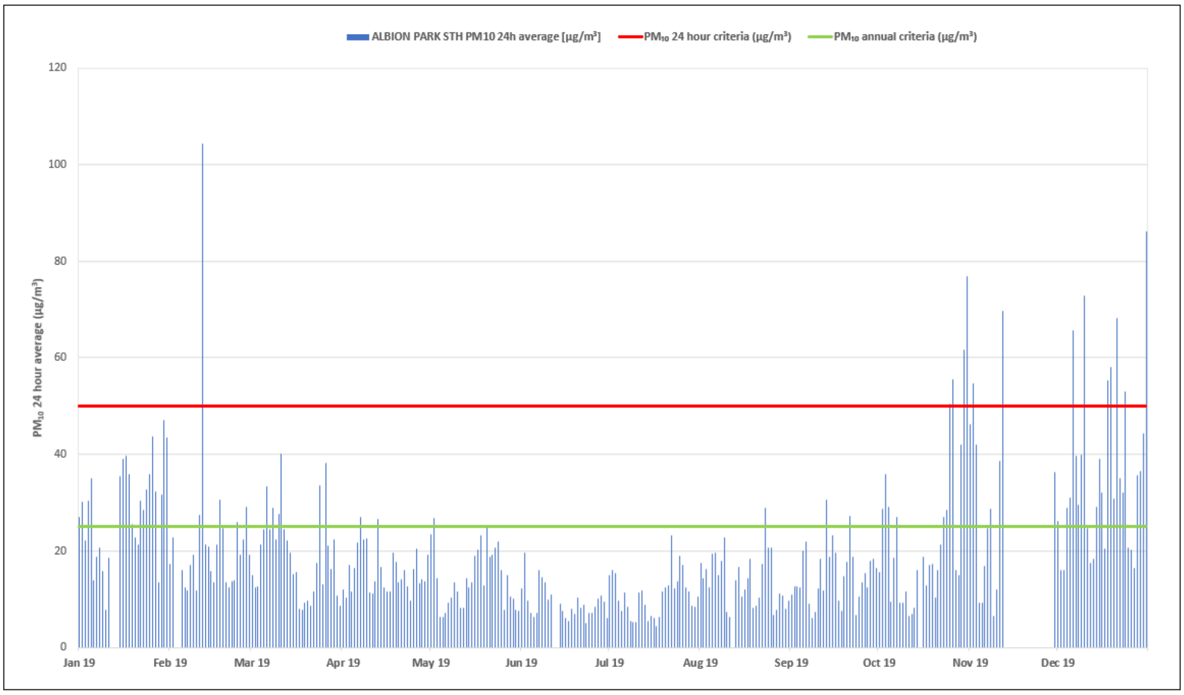


Figure 3-3 Time series PM_{10} data (Albion Park South, 01/01/2019 – 31/12/2019)

4. Air quality criteria

4.1 Legislative and policy context to the assessment

The relevant legislation and government guidance for the air quality assessment of the project are:

- NSW *Protection of the Environment Operations Act 1997* (POEO Act)
- NSW Protection of the Environment Operations (Clean Air) Regulation 2010 (the Clean Air Regulation)
- *Technical framework – Assessment and management of odour from stationary sources in NSW* (the Technical Framework), NSW Department of Environment and Conservation (DECC 2006)
- NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (2016) (the Approved Methods).

The POEO Act provides the statutory framework for managing pollution in NSW, including the procedures for issuing licences for environmental protection on aspects such as waste, air, water and noise pollution control. The POEO Act requires that no occupier of any premises causes air pollution (including odour) through a failure to maintain or operate equipment or deal with materials in a proper and efficient manner. The operator must also take all practicable means to minimise and prevent air pollution (sections 124, 125, 126 and 128 of the POEO Act). The POEO Act includes the concept of 'offensive odour' (section 129) and states it is an offence for scheduled activities to emit 'offensive odour'.

The Clean Air Regulation provides regulatory measures to control emissions from motor vehicles, fuels, and industry.

The Technical Framework provides a legislative context for the control of odour and presents odour assessment criteria guidelines. It provides a framework for different levels of odour assessment, strategies to mitigate odour, and guidance for performance monitoring, regulation and enforcement.

The Approved Methods lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in NSW. It considers the above-mentioned legislation and guidance to provide pollutant assessment criteria.

4.2 Project impact assessment criteria

4.2.1 Air quality assessment criteria

Assessment criteria has been taken from the Approved Methods. These criteria should be met at existing or future off-site sensitive receptors. The assessment criteria is provided as cumulative impacts, where the predicted impact of the project (incremental) is added to the existing levels (background) in order to assess the pollutants impacts. To determine the level of air quality impact, emissions from the project must be assessed against the assessment criteria as shown in Table 4-1 which are presented in micrograms per metre cubed ($\mu g/m^3$).

Table 4-1 Air quality impact assessment criteria

Pollutant	Averaging period	Percentile	Assessment criteria ($\mu g/m^3$) [2]
TSP (total suspended particulates)	Annual average	100th	90
PM_{10}	24 hour maximum	100th	50
	Annual average	100th	25
$PM_{2.5}$	24 hour maximum	100th	25
	Annual average	100th	8
CO	1 hour maximum	100th	30,000
	8 hour maximum	100th	10,000
NO_2	1 hour maximum	100th	246
	Annual average	100th	62
SO_2	1 hour maximum	100th	570
	24 hour maximum	100th	228
	Annual average	100th	60

4.2.2 Odour assessment criteria

The assessment criteria for odour are applied at the nearest existing or likely future off-site sensitive receptor. The Approved Methods defines odour assessment criteria (measured in odour units (OU))[3] and specifies how they should be applied in dispersion modelling to assess the likelihood of nuisance impact arising from the emission of odour.

Odour impact is a subjective experience and has been found to depend on many factors, the most important of which are:

- Frequency of the exposure
- Intensity of the odour
- Duration of the odour episodes
- Offensiveness of the odour
- Location of the source.

These factors are often referred to as the 'FIDOL' factors.

The odour assessment criteria are defined to take account of two of these factors (F is set at 99th percentile; I is set at between 2 to 7 OU). The choice of assessment criteria is also dependent on the population of the affected area, as shown in Table 4-2.

[2] CO assessment criteria was converted from milligrams per metre cubed (mg/m^3) to micrograms per metre cubed ($\mu g/m^3$) for consistency

[3] The number of odour units is the concentration of a sample divided by the odour threshold or the number of dilutions required for the sample to reach the threshold. This threshold is the numerical value equivalent to when 50 per cent of a testing panel correctly detect an odour

Table 4-2 Odour assessment criteria in the Approved Methods

Population of the affected community	Odour performance criteria (nose response odour certainty units at 99th percentile[4])
Single residence (≤ ~2)	7
~ 10	6
~ 30	5
~ 125	4
~ 500	3
Urban (≥~2,000)	2

The criteria assume that 7 OU at the 99th percentile would be acceptable to the average person, but as the number of exposed people increases, there is a chance that more sensitive individuals would be encountered. The criterion of 2 OU at the 99th percentile is considered to be acceptable for large populations (more than 2,000 people).

The criteria have also been specified at an averaging time of nominally one second. The choice of the short averaging time recognises that the human nose has a response time of less than one second, so that modelling of odour impact should allow for the short-term concentration fluctuations in an odour plume due to turbulence.

The site is surrounded primarily by vegetated land including the Bamarang Nature Reserve to the west. There are less than 10 houses within a 1 km radius of the site with an expected population of less than 30 people. Therefore an odour assessment criteria of 5 OU was adopted for all current receptors (R01 to R11).

It is understood that potential future residences are proposed in Mundamia and Bamarang areas (assessed as R12, R13 and R14). The proposed Mundamia development (R12 to the east of the project) consists of approximately 300 allotments. Therefore an odour assessment criteria of 3 OU was adopted for this future residential receptor (R12).

The proposed Bamarang development (R13 and R14 to the south of the project) does not have development consent and consequently lot plans and the number of future residents are not available at the time of this assessment, however it is understood that the lands are zoned general residential.

Therefore an odour assessment criteria of 5 OU was adopted for these future residential receptors (R13 to R14). It is recommended that the odour assessment criteria is confirmed for R13 and R14 once more detail regarding the number of proposed allotments within the development becomes available.

[4] This is a prediction of the odour level that may occur 99 per cent of the time, or that is below these criteria for 99 hours in every 100. Odour performance criteria are designed to be precautionary, so that impacts on sensitive receivers can be minimised.

5. Project air emissions

5.1 Overview

An overview of all sources of emissions to air from the project, mitigation measures and assumptions are provided in Table 5-1. Further detail and the basis for emission quantification is provided in the following sections.

Table 5-1 Air emission overview

Source location	Air quality emissions	Mitigation measures	Assumptions
Material reception hall	Odour and dust	The material reception hall is maintained under negative pressure to minimise fugitive emissions to air. Inlet louvres on the side of the building allow air in, while ventilation fans direct air to the odour and dust control stack. The control stack is fitted with an activated carbon filter (to treat odour) and a fabric filter (to reduce dust).	Odour is released via the stack (activated carbon filter achieves a 90% reduction) and via roller doors whilst open
Sterilization hall	Nil		The sterilization hall is an enclosed system with no emissions to air. Autoclave vapour is collected and condensed, prior to treatment in wastewater treatment plant.
Sorting hall	Dust and odour	Fitted with dust collector extraction system	A maximum finished product exposed surface area of 2000 square metres was assumed at any one time.
Boiler room	Products of combustion	Gas fired boiler (LPG)	Emission rates provided by Bioelektra
Wastewater treatment plant	Odour	Enclosed most sources to reduce odour.	Odour emissions would occur from the open top activated sludge reactor, all other components of wastewater treatment plant are enclosed.
Finished product holding bays and storage area (external)	Odour	Holding bays will consist of concrete slab, three walls and roof to minimise emissions to air.	A maximum finished product exposed surface area of 480 square metres was assumed at any one time.

5.2 Odour emissions

Odour emissions from the project are anticipated to occur from waste stored in the material reception hall (released primarily via the ventilation stack and minor fugitive emissions from the operable roller doors while open) and from the wastewater treatment plant activated sludge reactor.

Material reception hall

Odour emissions from the material reception hall was based on odour sampling undertaken at a comparable facility presented in *Banksmeadow Transfer Terminal Odour Emissions and Control (The Odour Unit, 2014)* attached as Appendix B. The Odour Unit (2014) conducted odour sampling from the building ventilation stack at Clyde Transfer Terminal (CTT).

At the time of odour sampling, CTT utilised a similar arrangement to the project consisting of a waste transfer area where municipal waste (same waste type as project) was placed on the floor and odour was managed using an odour control system consisting of a building ventilation system to collect odour and a stack to disperse it. Consequently, the odour sampling data presented in The Odour Unit (2014) is considered suitable for use in this air quality assessment.

A summary of The Odour Unit (2014) odour sampling is provided in Table 5-2.

Table 5-2 Summary of odour sampling results

Stack flowrate (m^3/s)	Waste tonnage on floor (t)	Odour concentration (OU)	Odour emission rate per tonnage ($OU.m^3/t/s$)	Notes
88.7	250	430	152.6	Stack flowrate and waste tonnage on floor at the time of the sampling was provided to The Odour Unit by Veolia Environmental Services. The maximum odour concentration (maximum of 4 samples) was used in this calculation

Therefore an odour emission rate of 152.6 $OU.m^3/t/s$ was adopted for receival hall stack emissions. Bioelektra advised that the reception hall will hold a maximum of four days stock equal to approximately 1,400 tonnes of waste (1,424.7 tonnes based a waste delivery rate of 15.6 tonnes per hour over three 7.6 hour shifts per day).

The material reception hall stack would be fitted with an activated carbon filter to manage odour emissions. It was assumed that the activated carbon filter achieves a 90% reduction of odour. This is considered conservative as activate carbon filters can readily achieve up to a 99% reduction of odour. The lower odour emission reduction factor was adopted to add a layer of conservatism to the assessment.

The receivals hall stack was modelled with the properties outlined in Table 5-3 provided by Bioelektra.

Table 5-3 Receivals hall stack properties

Parameter	Value	Units
Stack height	16	m
Stack diameter	0.9	m
Stack flowrate	40,000	m^3/h
Stack velocity	17.5	m/s
Exhaust temperature	298	K

Odour emissions from the operable roller doors were calculated based on the following assumptions:

- Internal waste has an odour concentration of 430 OU (refer Table 5-2)
- Total roller door area of 80 square metres
- The roller door would be open approximately 25% of the time and would only be opened during delivery hours (6 am to 6 pm)
- Air velocity out of the hall is approximately 0.1 metres per second while the roller door are open

Wastewater treatment plant

Odour emissions from the wastewater treatment plant would occur from the activated sludge reactor. All other tanks would be enclosed and would not release odour emissions. The wastewater treatment plant would be used to treat condensed vapour collected from the sterilization hall.

The Specific Odour Emission Rate (SOER) for the activated sludge reactor was adopted from odour sampling of an aerated leachate pond provided in *Odour Survey Lucas Heights Resource Recovery Park, Report No. 140107r* (Ektimo, 2014). The adopted SOER was 1.8 OU.$m^3/m^2/s$.

To account for potential material variability, the maximum measured odour concentration was adopted. The activated sludge reactor was modelled as a circular area source with a diameter of 12 metres.

Stabilisation and sorting hall

Odour emissions would occur from the stabilisation and sorting of finished product while it is inside the stabilisation and sorting halls. Odorous air inside the stabilisation and sorting halls would be ventilated via the sorting hall stack.

The odour emission rate for the stabilisation and sorting of finished product was adopted from odour sampling of similar finished product provided in Odour Concentration Test Report 2021 (Otto Engineering Polska Research Laboratory) attached as Appendix C.

To account for potential material variability, the maximum measured odour concentration was adopted. A maximum finished product exposed surface area of 2000 square metres was assumed at any one time.

Finished product storage area

Odour emissions would occur from finished product (primarily biomass) which is to be stored in the covered holding bays located along the eastern side of the site. The holding bays will consist of concrete slab, three walls and a roof to minimise emissions to air.

The odour emission rate for the storage of finished product was adopted from odour sampling of similar finished product provided in Odour Concentration Test Report 2021 (Otto Engineering Polska Research Laboratory) attached as Appendix C. A maximum finished product exposed surface area of 400 square metres was assumed at any one time.

5.2.1 Odour emissions inventory

The odour emissions inventory for the project is provided in Table 5-4.

Table 5-4 Odour emissions inventory

Odour source	Source type	Odour emission rate ($OU.m^3/s$)	Peak to mean factor	Modelled odour emission rate ($OU.m^3/s$)
Material reception hall (ventilation stack)	Stack (point source)	21,735	2.3 (Wake-affected point)	49,991
Sorting hall	Stack (point source)	1,274	2.3 (Wake-affected point)	2,930
Material reception hall (roller doors)	Volume	860	2.3 (Near field volume)	1,978
Wastewater treatment plant	Area	204	2.5 (Near field area)	509
Finished product storage area	Area	306	2.5 (Near field area)	764

5.3 Dust emissions

Particulate emissions would occur from the building ventilation systems in the receivals and sorting hall. Both stacks would be fitted with fabric filters to reduce emissions. Particulate emissions were estimated based on the proposed building ventilation air flowrate and fabric filter dust concentration performance factors provided by Bioelektra.

In lieu of specific PM_{10} emission factor, a PM_{10} to TSP ratio of 0.5 was assumed.

The dust emissions inventory for the project is provided in Table 5-5.

Table 5-5 Dust emissions inventory

Dust source	Source type	TSP emission rate (g/s)	PM_{10} emission rate (g/s)	Notes[5]
Material reception hall	Stack (point)	0.011	0.0056	Design flow rate 40,000 m^3/h Dust load estimate 1 mg/Am^3
Sorting hall (process air extraction)	Stack (point)	0.068	0.034	Total max flow 24,600 Am^3/h or 21,500 Nm^3/h Maximum residual dust 10 mg/Nm^3

The receivals hall stack was modelled in accordance with the properties outlined in Table 5-3 and the sorting hall stack was modelled with the properties outlined in Table 5-6 provided by Bioelektra.

Table 5-6 Sorting hall stack properties

Parameter	Value	Units
Stack height	17	m
Stack diameter	0.7	m
Stack flowrate	24,600	m^3/h
Stack velocity	17.8	m/s
Exhaust temperature	313	K

5.4 Boiler emissions

Combustion emissions would occur from combustion in the boiler and would be released via the flue gas stack. The boiler is used to provide heat for use in the autoclaves to pre-treat and sterilise the waste. Combustion pollutant exhaust concentrations (in parts per million (ppm)), flue gas flowrate (in kilograms per hour (kg/hr)) and temperature were provided by Bioelektra and are presented in Table 5-7.

It should be noted that Sulfur Dioxide (SO_2) exhaust concentrations were not provided by Bioelektra and are considered relatively minimal from gas fired boilers. A review of the *National Pollutant Inventory Emissions estimation technique manual for Combustion in boilers Version 3.6 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2011)* indicated that the emission factor for SO_2 (calculated by adopting the recommended Australian standard fuel sulfur content of 100 mg/kg[6]) is approximately 10% that

[5] Ventilation system flowrates and dust emission factors sourced from equipment supplier quotations provided by Bioelektra

[6] Emission factors for NO_x and SO_2 were sourced from Table 25: Emission factors for LPG (industrial propane) of *National Pollutant Inventory Emissions estimation technique manual for Combustion in boilers Version 3.6 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2011)*

of nitrogen oxides for gas fired boilers. Due to the relatively low emission rates expected, SO_2 emissions were considered negligible and not further included in the assessment.

Table 5-7 Boiler emissions

Parameter	Value	Units
NO_x exhaust concentration	100	ppm
CO exhaust concentration	50	ppm
SO_2 exhaust concentration	Considered negligible and not further assessed	N/A
Flue gas flow rate	12,000	kg/hr
Flue gas temperature	250	°C

Combustion pollutant emissions rates were calculated based on the following assumptions:

- Flue gas has a density of 0.698 kg/m^3 at the exhaust temperature of 250°C. Note that this assumption is based on ambient air at 25°C having a density of 1.225 kg/m^3
- Exhaust concentrations expressed in ppm were converted to milligrams per metre cubed (mg/m^3) based on the conversion factors supplied in the Approved Methods for 25°C. A conservative assessment of the oxidation of NO to NO_2 in the atmosphere has been undertaken as per Method 1:100% conversion of NO to NOx in the Approved Methods.

The calculated combustion emissions rates from the boiler are provided in Table 5-8.

Table 5-8 Combustion pollutant emission rate

Pollutant	Value	Units
NO_2	0.898	g/s
CO	0.275	g/s

The boiler flue gas stack was modelled with the properties outlined in Table 5-9 provided by Bioelektra.

Table 5-9 Boiler stack properties

Parameter	Value	Units
Stack height	15	m
Stack diameter	0.6	m
Stack flowrate	12,000	m^3/h
Stack velocity	16.9	m/s
Exhaust temperature	523	K

6. Air quality impact assessment

6.1 Overview

Dispersion modelling was undertaken to predict potential worst-case air quality impacts from the project in accordance with the methodology outlined in Section 2.

The averaging period and percentile presented for each air quality species was chosen to align with assessment criteria (refer Section 4) for that particular pollutant species. Predicted air quality concentration were presented at the identified sensitive receptors and as gridded contour plots.

6.2 Predicted pollutant concentrations

6.2.1 Odour

The predicted odour concentrations from the project and cumulative scenarios at each sensitive receptor are provided in Table 6-1.

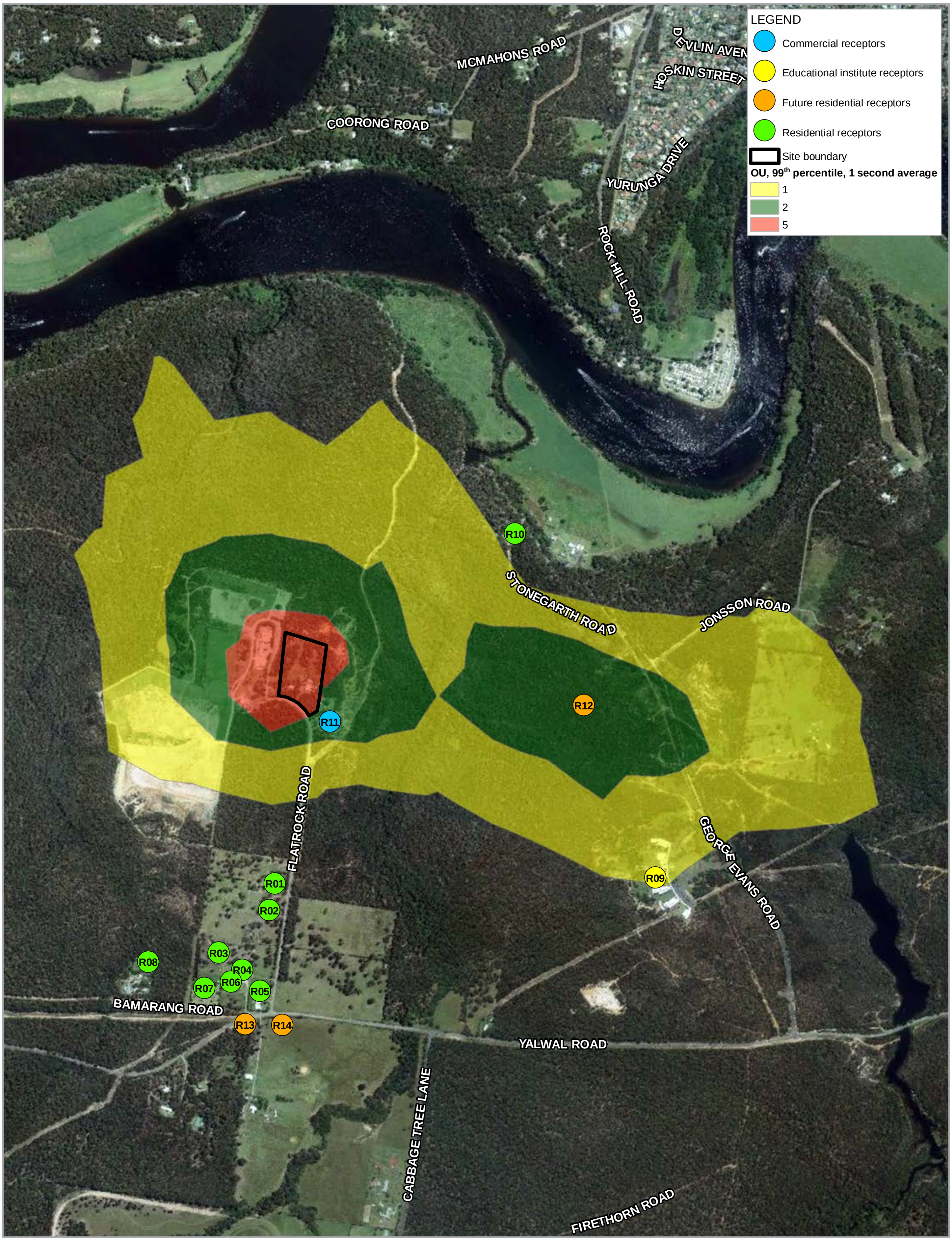
An odour contour plot depicting incremental odour concentration is shown on Figure 6-1 and cumulative odour contour plots for Bioelektra with current landfill operations and Bioelektra with proposed stage 4 Landfill Extension are shown on Figure 6-4 and Figure 6-6 respectively.

No exceedances of the odour assessment criteria were predicted.

Table 6-1 Predicted odour concentrations (OU)

Receptor	Odour assessment criteria (OU)	Predicted 99th percentile odour concentrations (1 second average, OU)		
		Incremental	Cumulative (Bioelektra + current landfill operations)	Cumulative (Bioelektra + proposed stage 4 Landfill Extension)
R01	5	0.4	0.9	1.3
R02	5	0.3	0.6	0.9
R03	5	0.2	0.4	0.5
R04	5	0.2	0.3	0.5
R05	5	0.2	0.3	0.4
R06	5	0.2	0.3	0.4
R07	5	0.2	0.3	0.4
R08	5	0.2	0.3	0.4
R09	5	1.1	1.1	1.2
R10	5	0.8	1.2	1.3
R11	5	2.9	3.1	3.3
R12	3	2.7	2.7	2.8

Receptor	Odour assessment criteria (OU)	Predicted 99th percentile odour concentrations (1 second average, OU)		
		Incremental	Cumulative (Bioelektra + current landfill operations)	Cumulative (Bioelektra + proposed stage 4 Landfill Extension)
R13	5	0.2	0.3	0.3
R14	5	0.2	0.2	0.3



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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park - Stage 2

Predicted incremental peak odour concentrations (99th percentile, 1 second average, OU)

Project No. 12536311
Revision No. 0
Date 11/05/2021

FIGURE 6-1

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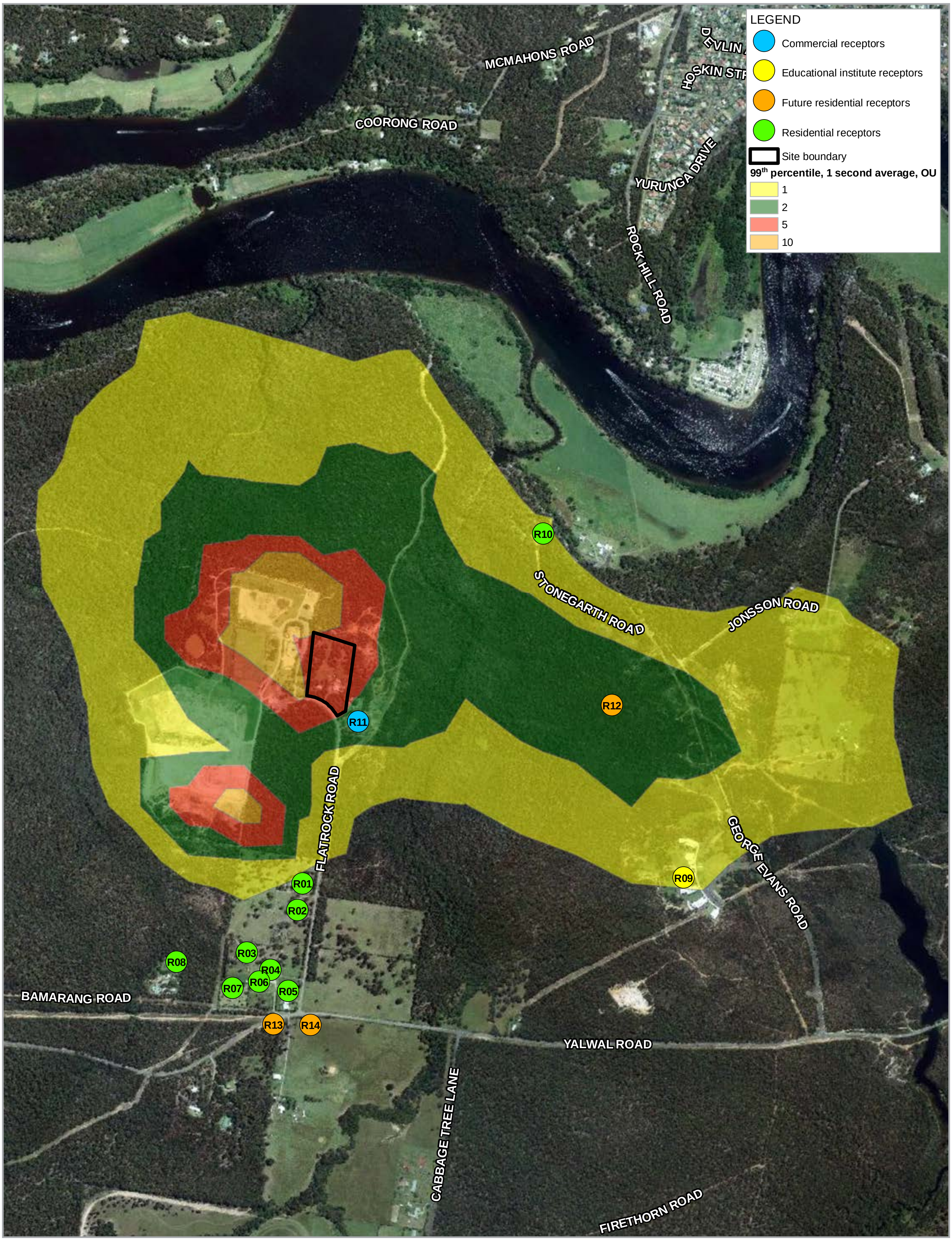
Data source: Aerial imagery - Google Earth 2021 (image date - 24/02/2016, image extracted - 25/08/2020) & Sixmaps 2021 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Borehole locations - ENRS. Created by: kpsroba



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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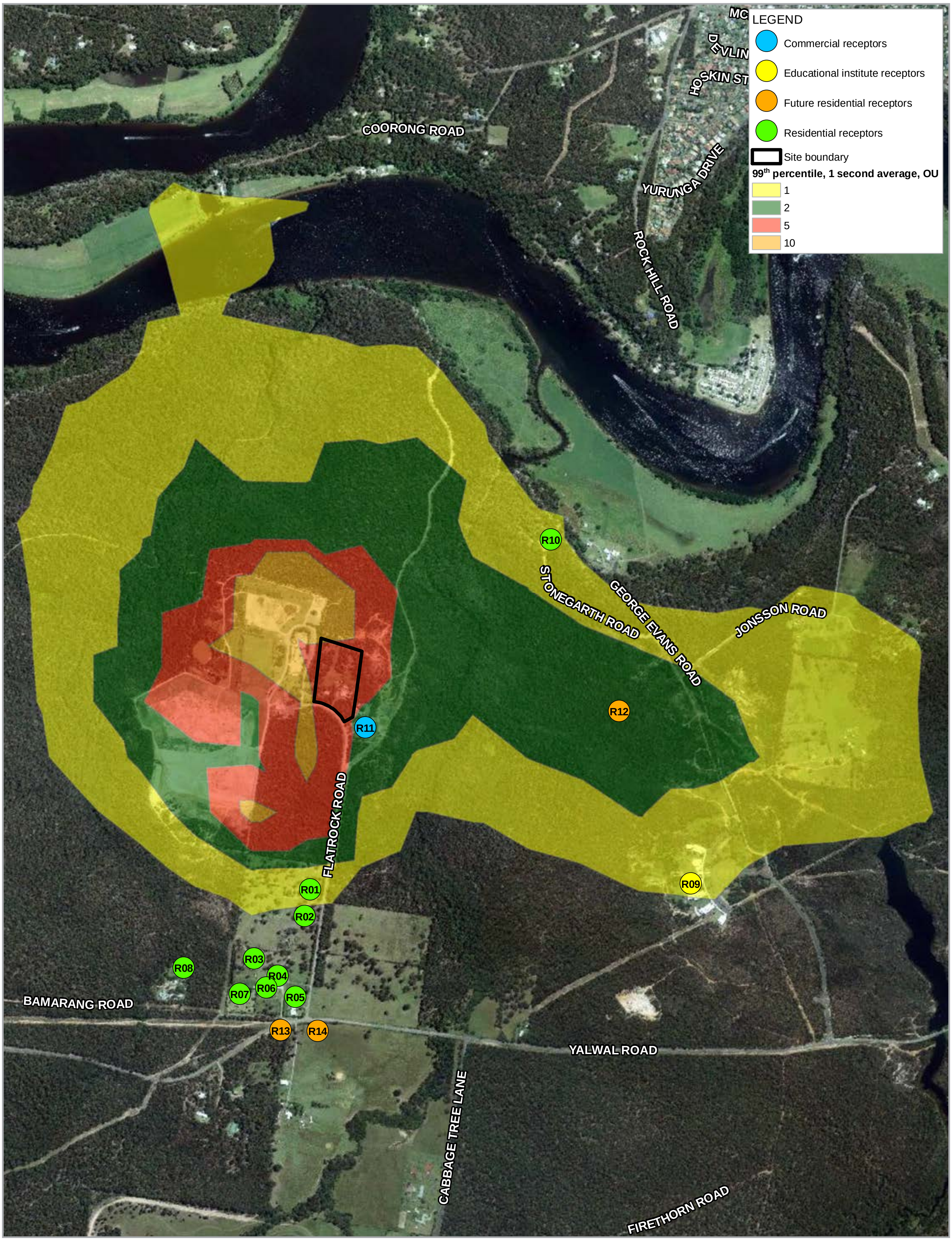
Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park - Stage 2

Predicted cumulative peak odour concentrations with current landfill operations
(99^{th} percentile, 1 second average, OU)

Project No. 12536311
Revision No. 0
Date 11/05/2021

FIGURE 6-2

\\ghdnet\ghd\AU\Sydney\Projects\21\12536311\GIS\Maps\Deliverables\12536311_Z017_PCumulativePeak.mxd Data source: Aerial imagery - Google Earth 2021 (image date - 24/02/2016, image extracted - 25/08/2020) & Sixmaps 2021 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Borehole locations - ENRS. Created by: kpsroba



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park - Stage 2

Predicted peak odour concentrations, cumulative with proposed stage 4 extension (99th percentile, 1 second average, OU)

Project No. 12536311
Revision No. 0
Date 11/05/2021

FIGURE 6-3

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Data source: Aerial imagery - Google Earth 2021 (image date - 24/02/2016, image extracted - 25/08/2020) & Sixmaps 2021 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Borehole locations - ENRS. Created by: kpsroba

6.2.2 Particulates

The predicted incremental particulate concentrations from the project at each sensitive receptor is provided in Table 6-2. Contour plot of incremental 24 hour averaged and annual averaged PM_{10} are shown on Figure 6-4 and Figure 6-6 respectively.

Predicted particulate concentrations from the project are low with the maximum 24 hour PM_{10} concentration in the year being 0.6 µg/m^3 at R11, and 0.3 µg/m^3 at a residential dwelling (approximately 1% of the assessment criteria). These incremental concentrations are minor in comparison to expected reductions in particulates from reduced landfill operations due to the project.

Cumulative particulate concentrations were calculated by adding predicted incremental concentrations to the maximum recorded background concentrations provided in Table 3-3 and are as follows:

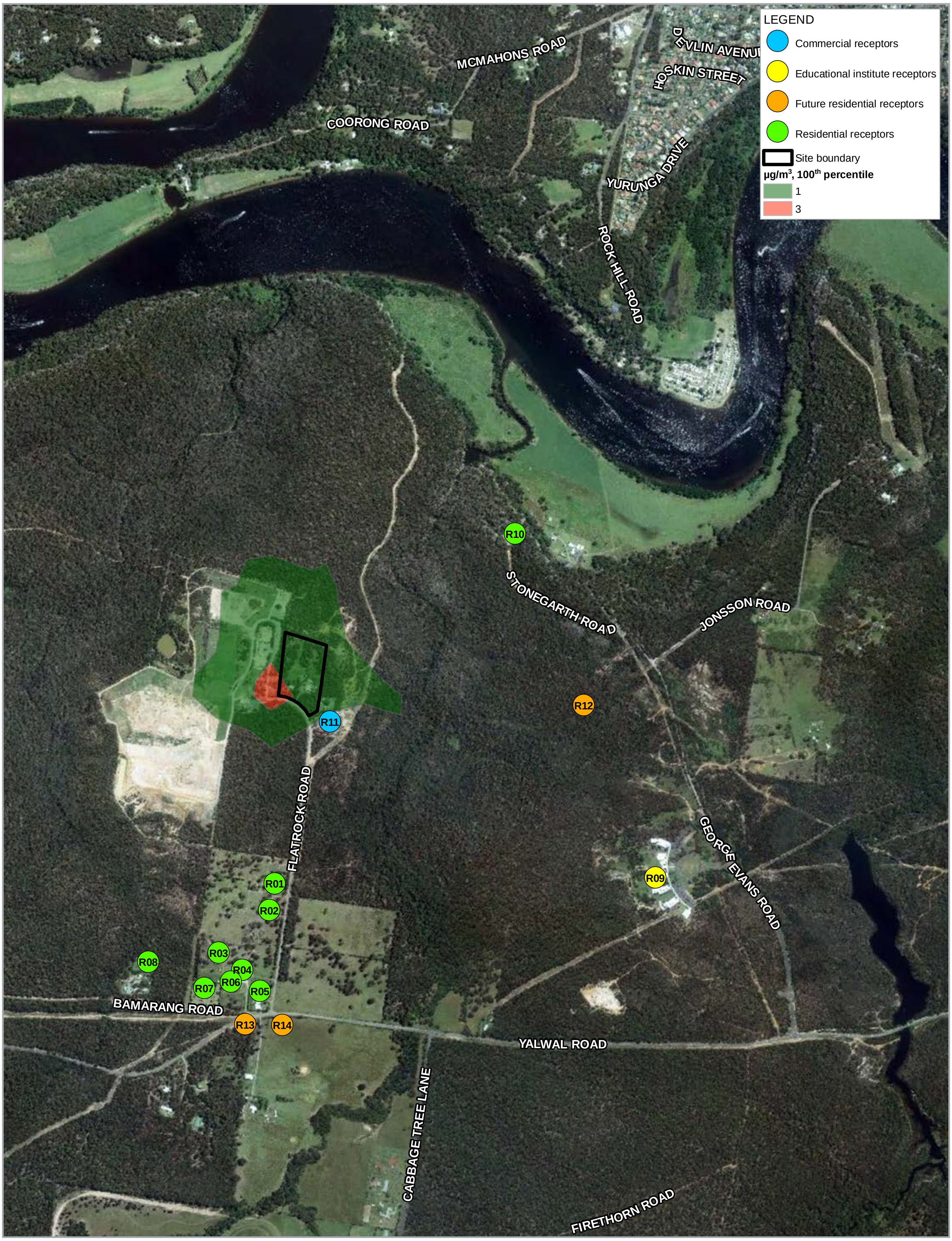
- A 24 hour PM_{10} concentration of 47.0 µg/m^3
- An annual PM_{10} concentration of 19.5 µg/m^3
- An annual TSP concentration of 39.0 µg/m^3 (assumed double the background annual PM_{10})

Cumulative 24 hour PM_{10} concentration presented in Figure 6-5 were calculated by adding predicted incremental concentrations to the 70th percentile background concentration (21.3 µg/m^3) as an indicative background concentration for the purpose of showing a cumulative 24 hour PM_{10} contour.

Table 6-2 Predicted incremental dust concentrations (µg/m^3)

Receptor	Predicted incremental dust concentration (µg/m^3)			Predicted cumulative dust concentration (µg/m^3)		
Pollutant	TSP	PM_{10}		TSP	PM_{10}	
Averaging period	Annual	24 hour	Annual	Annual	24 hour	Annual
Assessment criteria	90	50	25	90	50	25
R01	0.01	0.3	0.01	39.1	47.3	19.6
R02	0.01	0.2	0.01	39.1	47.2	19.6
R03	0.01	0.1	0.01	39.1	47.1	19.5
R04	0.01	0.1	0.01	39.1	47.1	19.5
R05	0.01	0.2	0.01	39.1	47.2	19.5
R06	0.01	0.1	0.01	39.1	47.1	19.5
R07	0.01	0.1	0.01	39.1	47.1	19.5
R08	0.01	0.1	0.01	39.1	47.1	19.5
R09	0.04	0.3	0.02	39.1	47.3	19.6
R10	0.03	0.2	0.02	39.1	47.2	19.6

Receptor	Predicted incremental dust concentration (µg/m³)			Predicted cumulative dust concentration (µg/m³)		
Pollutant	TSP	PM_{10}		TSP	PM_{10}	
Averaging period	Annual	24 hour	Annual	Annual	24 hour	Annual
R11	0.08	0.6	0.05	39.2	47.6	19.6
R12	0.14	0.5	0.09	39.2	47.5	19.6
R13	0.01	0.1	0.00	39.1	47.1	19.5
R14	0.01	0.1	0.00	39.1	47.1	19.5



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Grid: GDA 1994 MGA Zone 56

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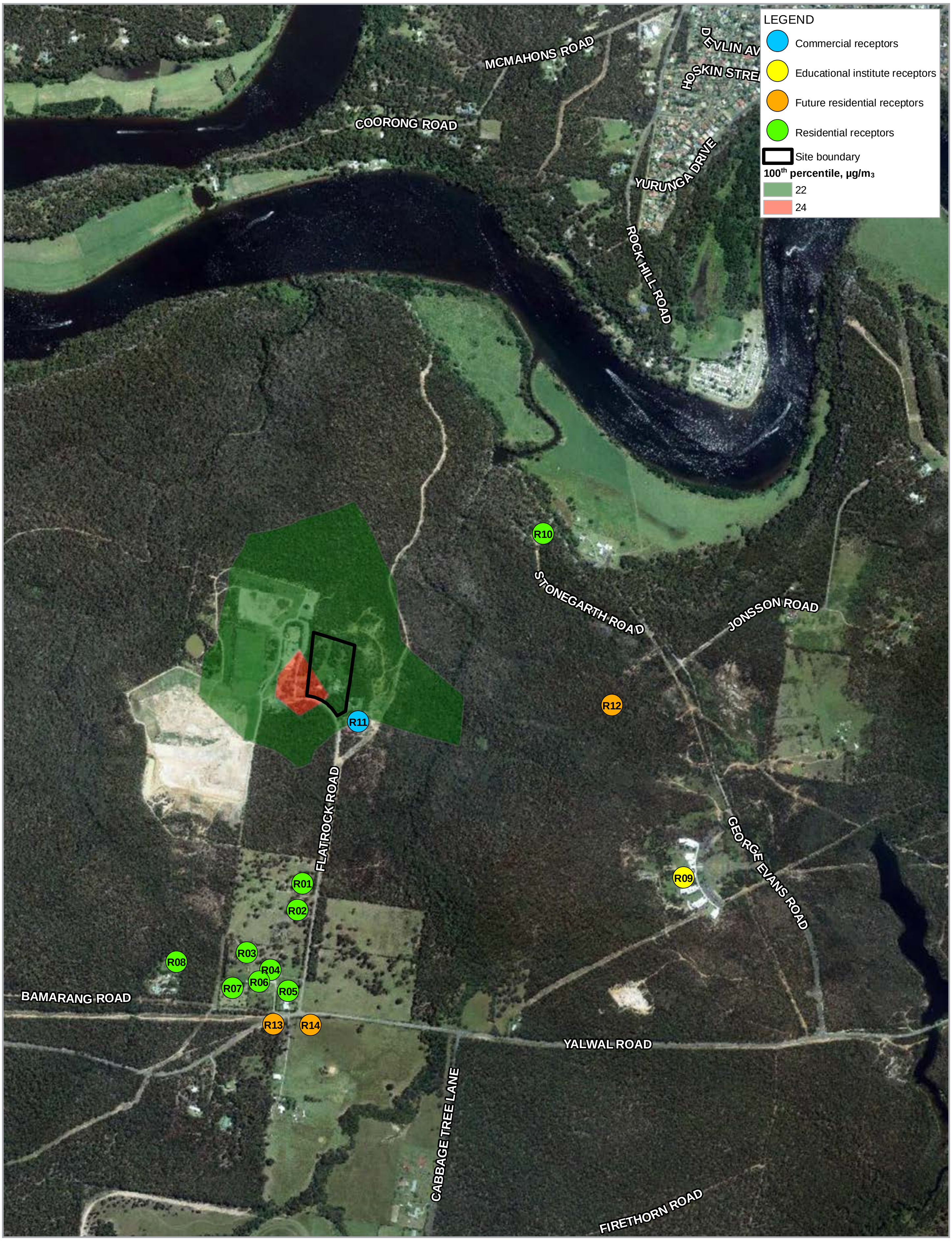
West Nowra Resource Recovery Park - Stage 2

Predicted incremental
24 hour averaged PM_{10} concentrations
(100th percentile, $\mu g/m^3$)

Project No. 12536311
Revision No. 0
Date 11/05/2021

FIGURE 6-4

\\ghdnet\ghd\AU\Sydney\Projects\21\12536311\GIS\Maps\Deliverables\12536311_Z015_PM24.mxd Data source: Aerial imagery - Google Earth 2021 (image date - 24/02/2016, image extracted - 25/08/2020) & Sixmaps 2021 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Borehole locations - ENRS. Created by: kpsroba



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Map Projection: Transverse Mercator
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Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park - Stage 2

Predicted cumulative
24 hour averaged PM_{10} concentrations
(100th percentile, $\mu g/m^3$)

Project No. 12536311
Revision No. 0
Date 11/05/2021

FIGURE 6-5

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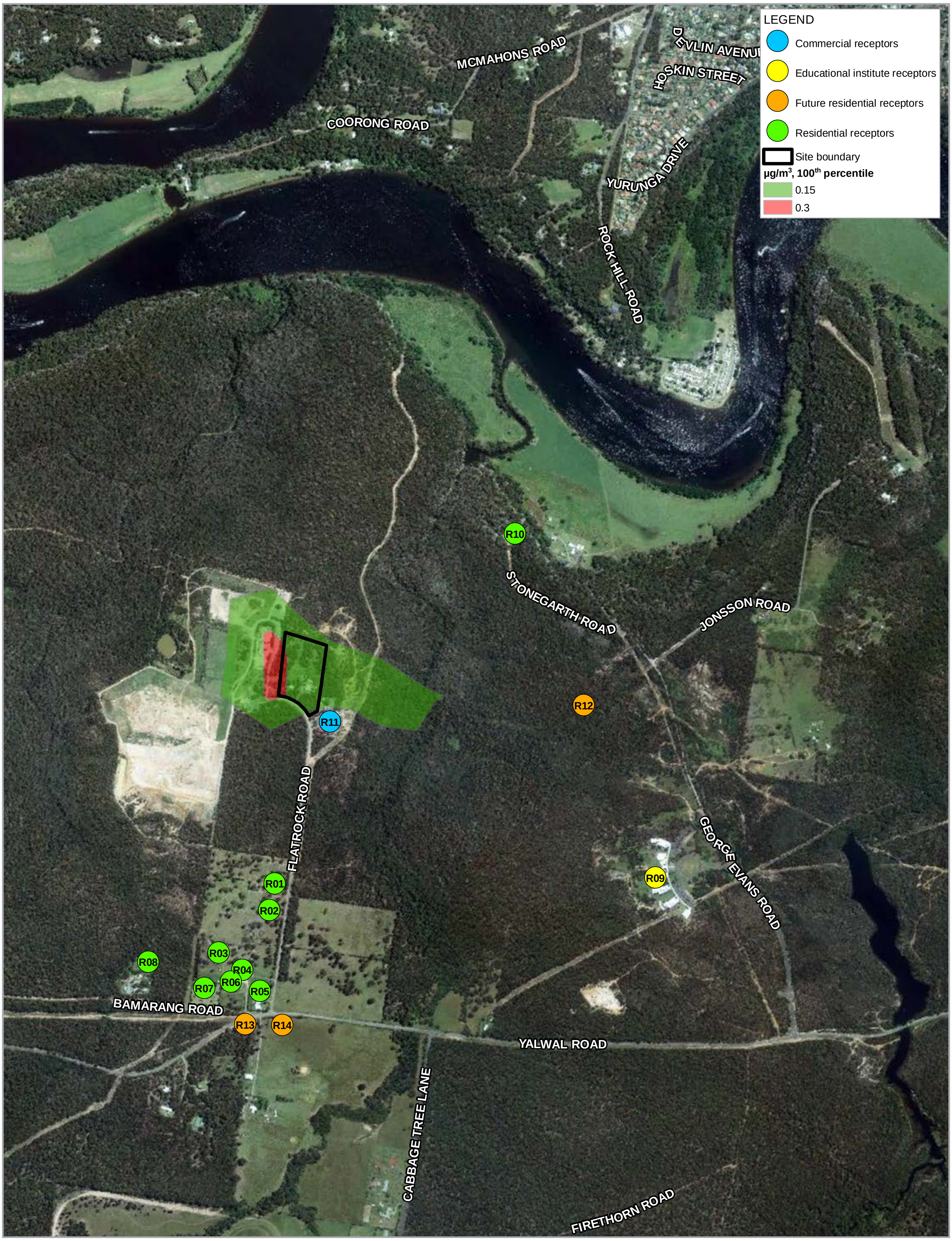
Data source: Aerial imagery - Google Earth 2021 (image date - 24/02/2016, image extracted - 25/08/2020) & Sixmaps 2021 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Borehole locations - ENRS. Created by: kpsroba



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Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park - Stage 2

Predicted incremental annual average PM_{10} concentrations (100th percentile, µg/m³)

Project No. 12536311
Revision No. 0
Date 11/05/2021

FIGURE 6-6

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6.2.3 Boiler emissions

Predicted incremental concentrations of boiler emissions are provided in Table 6-3. Predicted cumulative concentrations taking into account the background concentration presented in Table 3-3 are provided in Table 6-4.

No incremental or cumulative exceedances of the assessment criteria are predicted.

Table 6-3 Predicted incremental pollutant concentrations (µg/m³)

Receptor	Predicted incremental combustion pollutant concentrations (µg/m³)			
Pollutant	NO_2		CO	
Averaging period	1 hour	Annual	1 hour	8 hour
Assessment criteria	246	62	30,000	10,000
R01	30.5	0.1	9.4	3.7
R02	28.3	0.1	8.7	3.4
R03	15.2	0.1	4.7	1.3
R04	15.7	0.1	4.8	1.8
R05	21.1	0.1	6.5	2.7
R06	13.5	0.1	4.2	1.2
R07	11.4	0.1	3.5	1.0
R08	24.2	0.1	7.5	1.1
R09	34.0	0.4	10.4	3.0
R10	48.1	0.3	14.9	3.6
R11	49.9	0.4	15.4	5.6
R12	81.3	1.5	25.0	0.5
R13	10.7	0.1	3.3	0.0
R14	16.5	0.1	5.1	0.0

Table 6-4 Predicted cumulative pollutant concentrations (µg/m³)

Receptor	Predicted cumulative combustion pollutant concentrations (µg/m³)			
Pollutant	NO_2		CO	
Averaging period	1 hour	Annual	1 hour	8 hour
Assessment criteria	246	62	30,000	10,000
R01	107.6	7.3	5,414.4	2,648.7
R02	105.4	7.3	5,413.7	2,648.4

Receptor	Predicted cumulative combustion pollutant concentrations (µg/m^3)			
Pollutant	NO_2		CO	
Averaging period	1 hour	Annual	1 hour	8 hour
R03	92.3	7.3	5,409.7	2,646.3
R04	92.8	7.3	5,409.8	2,646.8
R05	98.2	7.3	5,411.5	2,647.7
R06	90.6	7.3	5,409.2	2,646.2
R07	88.5	7.3	5,408.5	2,646.0
R08	101.3	7.3	5,412.5	2,646.1
R09	111.1	7.6	5,415.4	2,648.0
R10	125.2	7.5	5,419.9	2,648.6
R11	127.0	7.6	5,420.4	2,650.6
R12	158.4	8.7	5,430.0	2,645.5
R13	87.8	7.3	5,408.3	2,645.0
R14	93.6	7.3	5,410.1	2,645.0

7. Recommended mitigation measures

7.1 Construction

A list of recommended mitigation measures to minimise potential air quality impacts during the construction of the project is provided below. This list incorporates management measures supplied in the *Local Government Air Quality Toolkit, Module 3, Part 3: Air quality guidance notes for Construction sites* (NSW EPA, 2017) and *in Guidance on the assessment of dust from demolition and construction version 1.1* (Institute of Air Quality Management, 2014).

The following mitigation measures are recommended for the construction of the project:

- The proposed selection of construction plant should be reviewed and equipment and dust reduction measures utilised where possible
- All spoil stockpiles should be covered where possible
- Particulate matter generated from construction activities is typically more prominent during dry and windy conditions. Water suppression should be used during these worst case conditions and when visible plumes of dust are observed to be dispersed from the construction of the project
- The frequency of water dust suppression should be increased during worst case dust dispersion meteorological conditions (dry and windy)
- The construction site should be maintained and kept clean
- Controlled site access should be maintained with use of cattle/shaker grids and wheel wash in order to reduce the tracking of mud off site.
- All vehicles transporting spoil or other dispersible material should be appropriately covered to prevent the escape of dust or other material while in transit
- A log of all dust complaints received should be compiled and any potential causes of the complaint noted. If a trend in complaints is identified, work methods should be adjusted accordingly to minimise the likelihood of any future complaints
- Construction plant and equipment should be properly operated and maintained to minimise excessive exhaust emissions
- Visual monitoring should be undertaken by site management to ensure that construction works do not generate unacceptably high quantities of dust
- Appropriate air quality mitigation measures (as provided above) should be included in the Construction Environment Management Plan

7.2 Operation

The following mitigation measures are recommended for the operation of the project:

Dust

- Regularly check, maintain and replace all building ventilation dust filters in accordance with manufacturer specifications
- Controlled site access should be maintained with vehicle wash down/clean down facilities (wheel wash if necessary) to be established to maintain access roads

Odour

- Regularly check, maintain and replace the activated carbon filter in accordance with manufacturer specifications
- Minimise the quantity of putrescible waste stored in the material reception hall
- Keep the material reception hall as clean as possible via regular sweeping and wash down to minimise unnecessary odour emissions
- Minimise the quantity of waste inside the material reception hall as much as practicable and prevent unnecessary build-up of waste
- Minimise unnecessary opening of the material reception hall door where possible
- Create an odour complaint register to record all occurrence of odour complaints
- Inform staff of the potential odour impacts from the operation of the project and educate them with appropriate mitigation measures (as outlined above)

8. Conclusion

GHD conducted an air quality assessment for the construction and operation of the proposed integrated resource recovery facility at West Nowra.

Construction of the project was assessed via a qualitative approach. Construction mitigation measures were supplied to minimise any potential dust emissions during construction efforts. No dust impacts are anticipated during the construction of the project.

Operation of the project was assessed via a quantitative approach that utilised air quality dispersion modelling. An emissions inventory was prepared for odour, particulates and combustion products. Odour emissions were based on sampling data obtained from a similar reference facility. Particulate emissions were based on manufacturer specified emissions limits. Boiler combustion emissions were based on stack concentrations provided by Bioelektra.

Background air quality was reviewed and incorporated into the assessment where possible based on the previous assessments at the site undertaken by SLR (2019), SLR (2020) and ambient concentrations recorded from the Albion Park South monitoring station.

A cumulative air quality assessment has been undertaken to determine the cumulative odour impact from the resource recovery park and the adjacent landfill for Bioelektra with current landfill operations and Bioelektra with proposed stage 4 extension operations. The cumulative odour dispersion modelling predicted compliance with the odour assessment criteria.

No exceedances of the assessment criteria for any pollutant were predicted and based on assumptions in the report no impacts are expected during the operation of the project.

Recommended dust and odour mitigation measures have been provided to assist with management onsite during operation of the project.

9. References

The following documentation were referenced and relied upon in this report:

- Australian Government Department of Sustainability, Environment, Water, Population and Communities (2011) *National Pollutant Inventory Emissions Estimation Technique Manual for Combustion in boilers (Version 3.6)*
- Australian Government Department of Sustainability, Environment, Water, Population and Communities (2012). *National Pollutant Inventory (NPI) Emissions Estimation Technique Manual for Mining (Version 3.1)*
- Ektimo (2014). Odour Survey Lucas Heights Resource Recovery Park, Report No. 140107r
- GHD (2015). West Nowra Recovery Park EIS Air Quality Assessment
- Institute of Air Quality Management (2014). Guidance on the assessment of dust from demolition and construction version 1.1
- NSW EPA (2017). Local Government Air Quality Toolkit, Module 3, Part 3: Air quality guidance notes for Construction sites
- NSW EPA. (2016). *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. NSW Government Gazette of 26 August 2005, minor revisions Novemeber 2016*. Sydney, NSW: Department of Environment and Conservation NSW (DEC).
- OEH NSW. (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'.* Sydney: NSW Office of Environment and Heritage
- Otto Engineering Polsk (2021). Odour Concentration test report No. LB/007/02/21
- SLR Consulting (2019). *West Nowra Recycling & Waste Facility Proposed Stage 4 Landfill Extension Air Quality Impact Assessment*
- SLR Consulting (2020). *Additional Air Quality Modelling and Assessment*
- The Odour Unit (2014). Banksmeadow Transfer Terminal Odour Emissions and Control

Appendices

Appendix A – Meteorology modelling methodology

A.1 Overview

This appendix outlines the methodology used to synthesise meteorology for the project site. The meteorology is used in CALPUFF to drive the dispersion model.

Local meteorology, including long term wind speed and direction as well as atmospheric stability, can influence how pollutants are dispersed into the local environment.

Site specific meteorology for the project was produced using a model called CALMET. The CALMET simulation produced a 3D wind field for the modelled year. Prognostic TAPM data was used alongside observations taken at one NSW Bureau of Meteorology (BoM) site as inputs into the CALMET model. Details of the procedure undertaken to produce the site specific meteorology is outlined in the following sections.

A.2 Methodology

The characterisation of local wind patterns generally requires accurate site-representative hourly recordings of wind direction and speed over a period of at least a year.

In order to produce a representative site-specific meteorological data set encompassing the meteorological data from the observational site, the following methodology was carried out:

- Producing a 3D gridded dataset with the prognostic model TAPM
- Using the TAPM 3D gridded dataset as an initial guess field for the CALMET meteorological model
- Using data from the observation site (Nowra RAN Air Station AWS) for surface level observations.

A.2.1 Representative year selection

A review of nearby BoM station is provided in Table A-1.

Table A-1 Nearby BoM station review

BoM station	Approximate distance from Site	Availability of meteorological data	BoM station setting
Nowra RAN Air Station AWS (BoM ID: 68072)	7.5 km southwest of the Site	Began operation in December 2000. All desired meteorological parameters available.	Located in flat rural lands
Jervis Bay (Point Perpendicular AWS) (BoM ID: 68151)	32.5 km southeast of the Site	Began operation in December 2003. All desired meteorological parameters available.	Located on coast

The Nowra RAN Air Station AWS is located on similar terrain to the project and is significantly closer to the project than the Jervis Bay station. in addition, the Jervis Bay station is located on the coast and is likely to experience meteorology generated by the land-sea interface. Consequently the Nowra RAN Air Station AWS was selected as station most representation of project meteorological conditions.

Therefore the representative year analysis utilised a 5 year dataset (01/01/2015 – 31/12/2019) from Nowra RAN Air Station AWS. Probability density function plots for wind speed, wind direction and temperature are provided in Figure A1, Figure A2 and Figure A3 respectively.

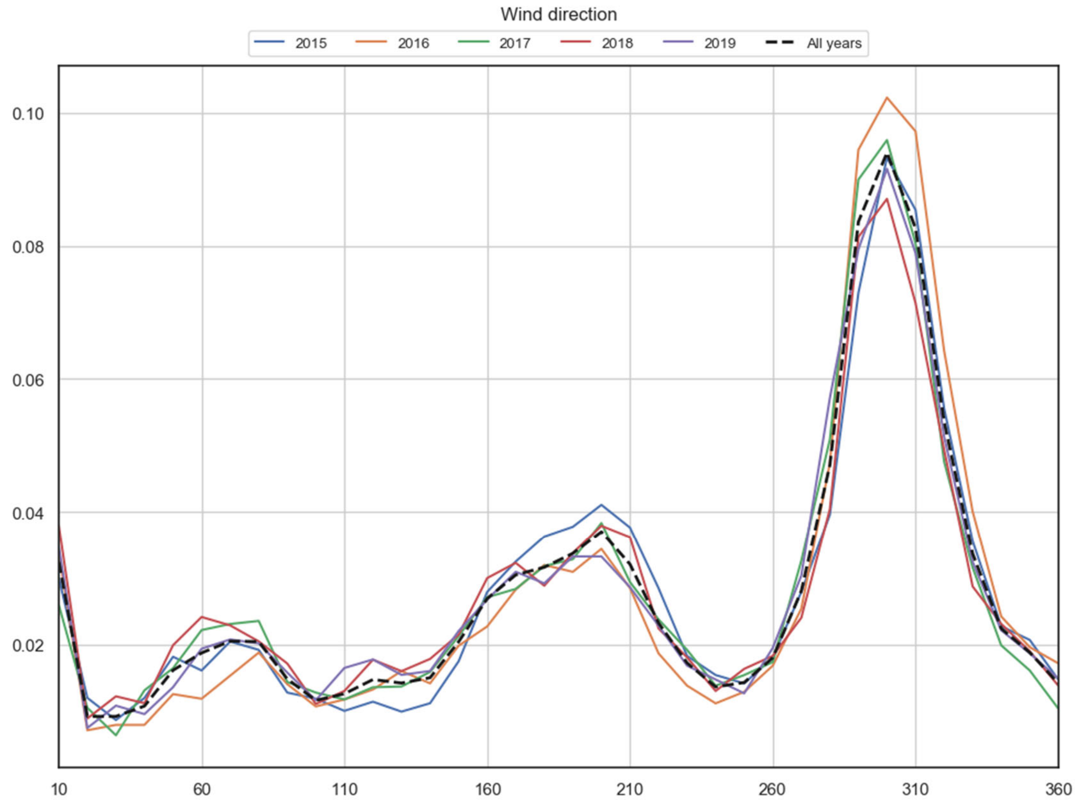

Figure A1 Wind direction plot (Nowra RAN Air Station AWS , 2015 – 2019)

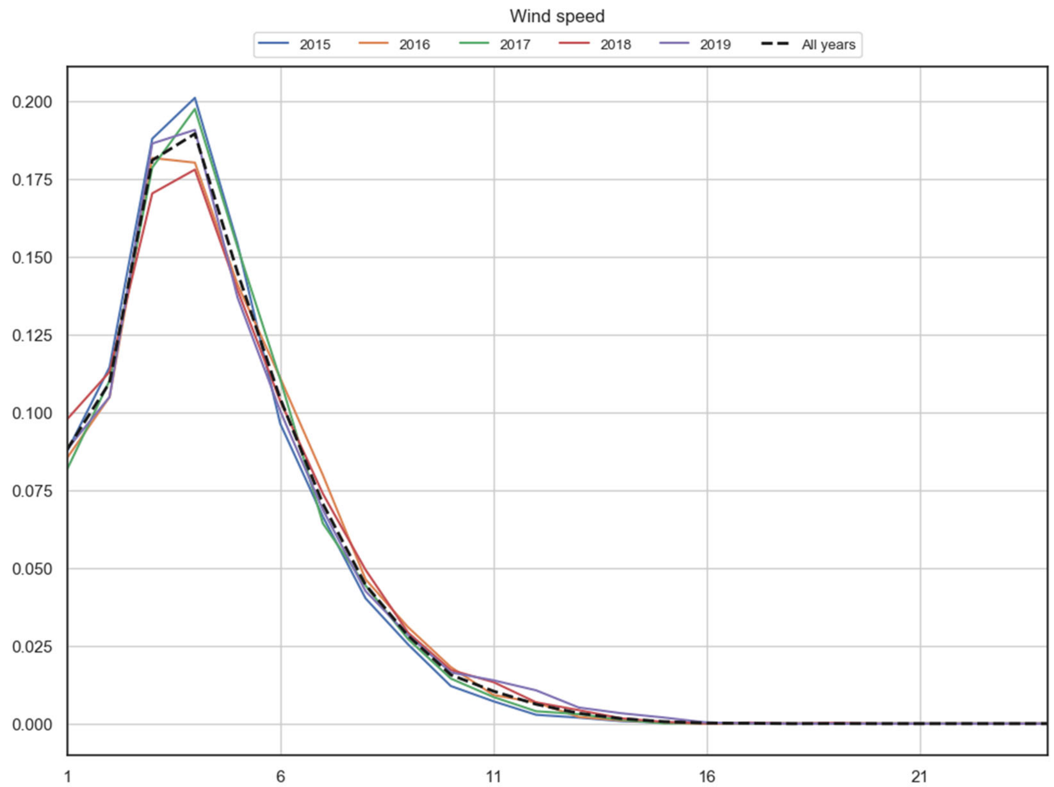

Figure A2 Wind speed plot (Nowra RAN Air Station AWS , 2015 – 2019)

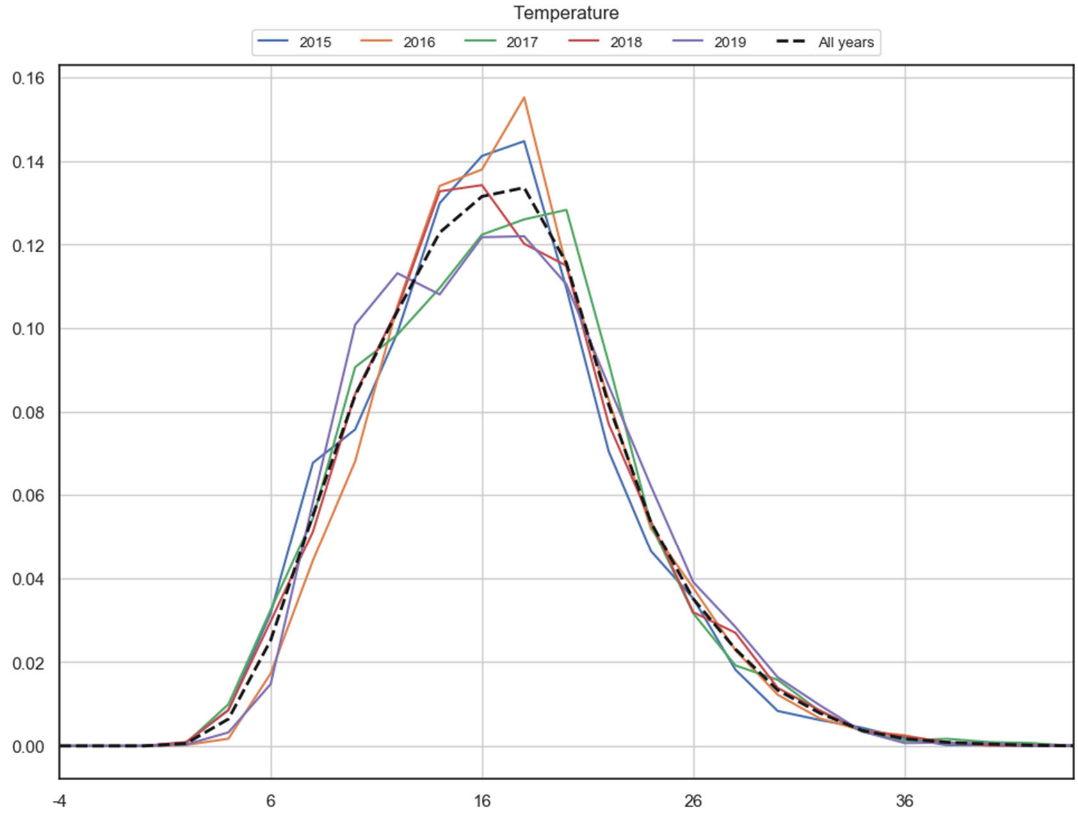

Figure A3 Temperature plot (Nowra RAN Air Station AWS , 2015 – 2019)

Based on the representative year analysis, the year with greatest overall correlation to average conditions was identified to be 2019.

A.2.2 Prognostic meteorology

The TAPM prognostic model was run to obtain a coarse meteorological 3D gridded dataset for the site for the selected year (2019). This dataset is based on synoptic observations, local terrain and land use information with a resolution of 1,000 metres. The TAPM model parameters are summarised in Table A1 and were selected in accordance with the Approved Methods.

Table A1 TAPM model parameters

Parameter	Value
Modelled period	1 December 2018 to 1 January 2020
Domain centre	UTM: 56H 276,000 mE, 6,137,000 mS
	Latitude = -34° 53'
	Longitude = 150° 33'
Number of vertical levels	25
Number of easting grid points	41
Number of northing grid points	41
Outer grid spacing	30,000 m x 30,000 m
Number of grid levels	4
Grid level horizontal resolution	Level 2 – 10,000 m Level 3 – 3,000 m Level 4 – 1,000 m

A.3 CALMET modelling

CALMET (Version 7) was used to resolve the wind field around the subject site to 200 metres spatial resolution. The application of CALMET for this purpose is an approved modelling approach in NSW as per the Approved Methods with model guidance documentation provided.

Upon completion of the broad scale TAPM modelling runs, a CALMET simulation was set up to run for the model period using the three dimensional gridded data output from the TAPM model as an initial guess field. This approach is consistent with guidance documentation.

CALMET was run using the ‘Hybrid’ mode. All model settings were selected based on the recommendations provided in the *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia* (J Barclay and J Scire, Atmospheric Studies Group TRC Environmental Corporation, 2011) except for MDISP which the default value was used.

The southwest corner of the CALMET domain, or the origin, was located at UTM Zone 56 coordinates 257 kilometres east and 6118 kilometres north. The CALMET domain extended 38 kilometres to the east and north. The CALMET domain consisted of 190 grids in both the east and north directions, with a grid resolution of 0.2 kilometre.

CALMET settings were selected as per the model guidance document for ‘Hybrid’ mode. The TERRAD variable were set to the values presented in Table A2 based on an inspection of the terrain elevations in the immediate vicinity of the subject site, based on model guidance. The CALMET model parameters are summarised in Table A2.

Terrain and land use data used for the CALMET modelling are presented in Figure A5 and Figure A6.

Table A2 Summary of CALMET model parameters

Parameter	Value
Modelled period	1 January 2019 to 31 December 2019
Mode	Hybrid (NOOBS = 1)
UTM zone	56
Domain origin (south-west corner)	Easting: 257 km Northing: 6118 km
Domain size	190 x 190 at 0.2 km resolution (38.0 km x 38.0 km)
Number of vertical levels	11
Vertical levels (m)	20, 40, 60, 90, 120, 180, 250, 500, 1000, 2000, 3000
CALMET settings for hybrid mode Settings selected in accordance with (OEH, 2011)	TERRAD = 5.0 km R = 6.0 km Rmax = 10.0 km
Initial guess field	TAPM .m3d file used as an initial guess field for CALMET
Surface data	Surface data from Nowra RAN Air Station AWS (BoM ID: 69072)
Upper air data	No site specific upper air data is used. Upper air data is included within the TAPM .m3d initial guess field.
Land use and terrain data	Land use data was manually developed through assessment of aerial imagery to accurately reflect the land use in the area. High-resolution terrain data was sourced from the STRM 1-second (~30 m) database.

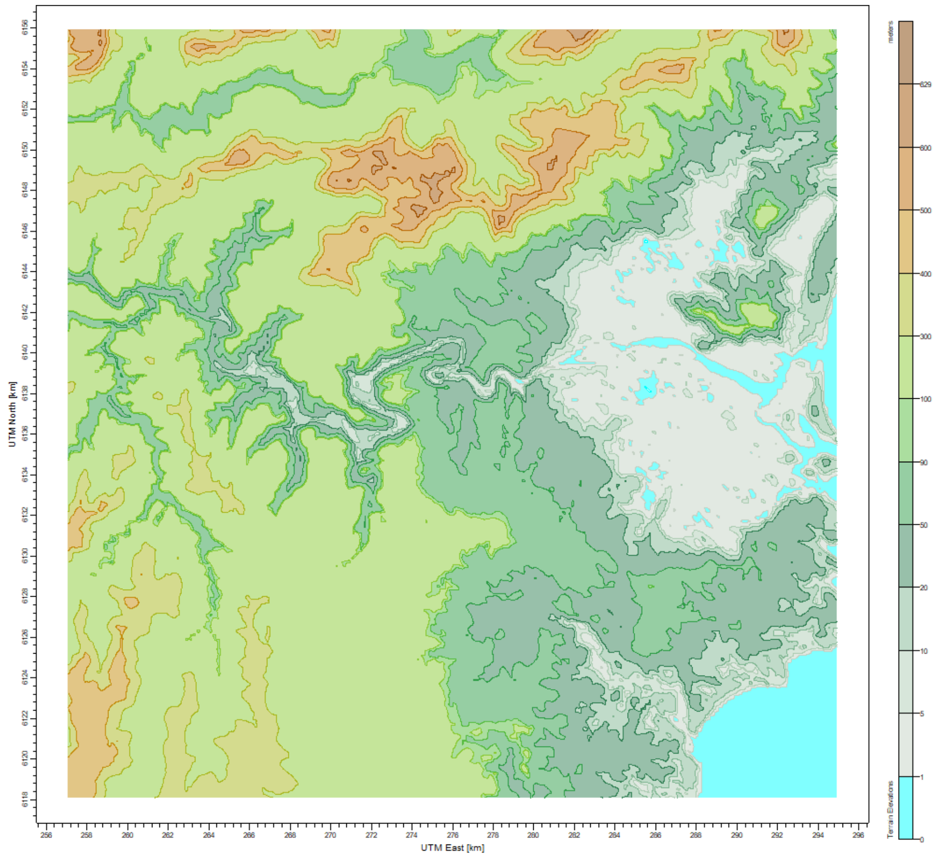

Figure A5 Terrain data used for CALMET modelling

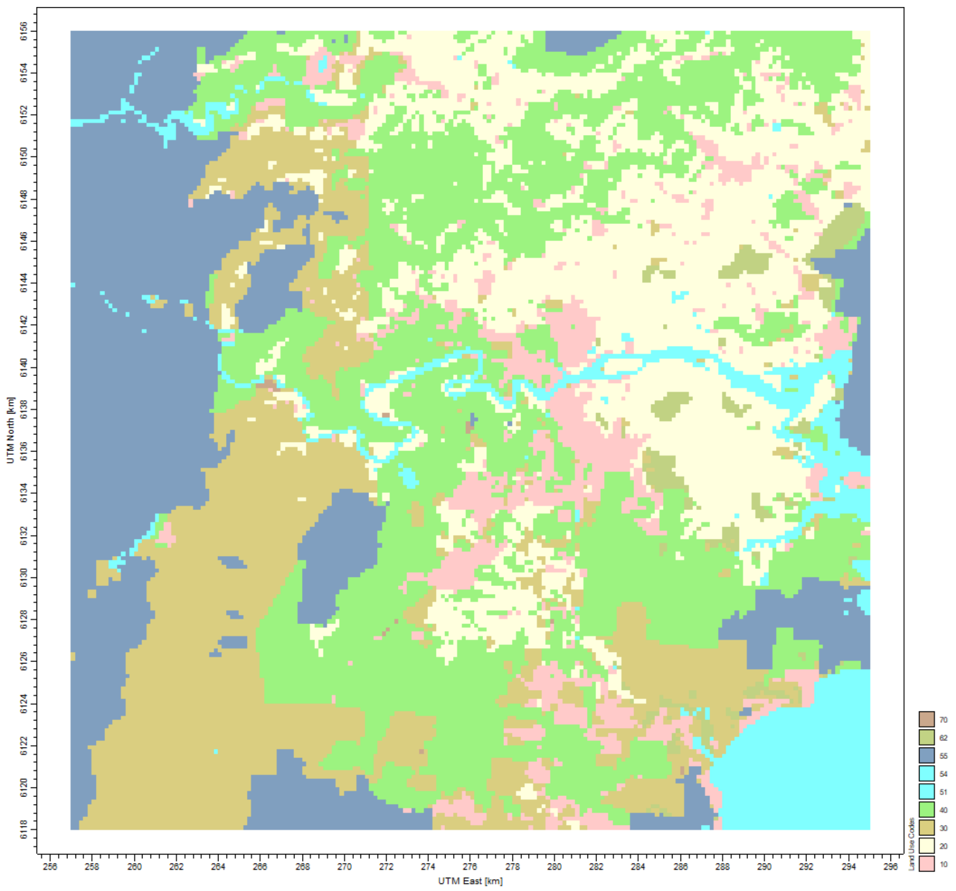

Figure A6 Land use data used for CALMET modelling

The local meteorology largely determines the pattern of off-site air quality impact on receptors (houses, businesses and industry). The effect of wind on dispersion patterns can be examined using the wind and stability class distributions at the site from the dataset that is produced by CALMET. The winds at the site are most readily displayed by means of wind rose plots, giving the distribution of winds and the wind speeds from these directions.

The features of particular interest in this assessment are (i) the dominant wind directions and (ii) the relative incidence of stable light wind conditions that yield minimal mixing (defines peak impacts from ground-based sources).

A.3.1 Annual wind patterns

The wind rose for the entire data period taken at the project site is shown in Figure A7 and shows the following features:

- The predominant annual average wind directions are from the west
- The majority of lower wind speeds (1 – 3 m/s) are from the west and south
- The average wind speed measured was 2.28 metres per second
- Calm conditions (wind speeds less than 0.5 m/s) occurred 5.11 per cent of the time.

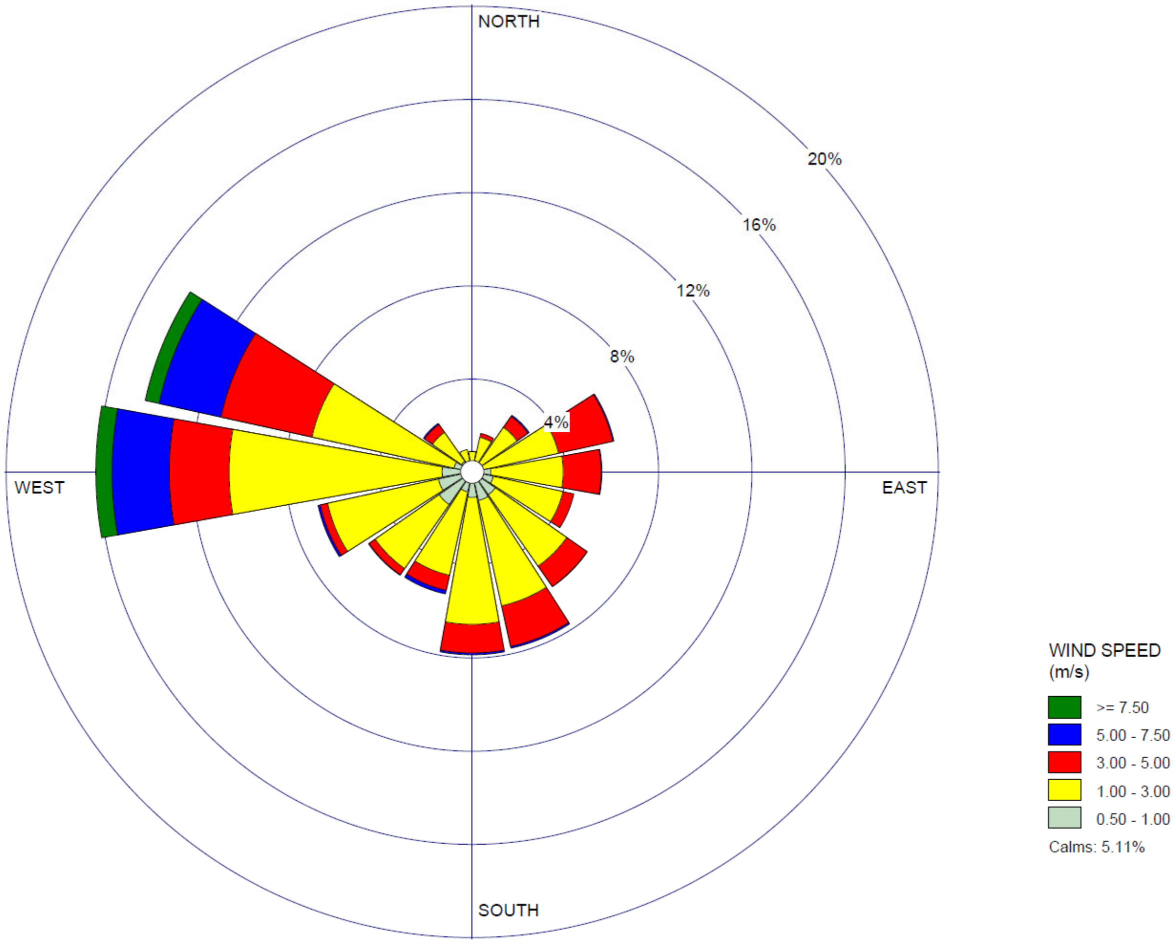

Figure A7 Wind rose at site from CALMET (2019)

A.4 Pattern of atmospheric stability

Atmospheric stability substantially affects the capacity of a pollutant such as gas, particulate matter or odour to disperse into the surrounding atmosphere upon discharge and is a measure of the amount of turbulent energy in the atmosphere.

There are six Pasquill-Gifford classes (A-F) used to describe atmospheric stability, and these classes are grouped into three stability categories; stable (classes E-F), neutral (class D), and unstable (classes A-C). The climate parameters of wind speed, cloud cover and insolation (solar radiation) are used to define the stability category as shown in Table A3. As these parameters vary from day to night, there is a corresponding variation in the occurrence of each stability category.

Stability is most readily displayed by means of stability rose plots, giving the frequency of winds from different directions for various stability classes A to F.

Table A3 Stability category relationship to wind speed and stability characteristics

Stability category	Wind speed range (m/s)[a]	Stability characteristics
A	0 – 2.8	Extremely unstable atmospheric conditions, occurring near the middle of day, with very light winds, no significant cloud
B	2.9 – 4.8	Moderately unstable atmospheric conditions occurring during mid-morning/mid-afternoon with light winds or very light winds with significant cloud
C	4.9 – 5.9	Slightly unstable atmospheric conditions occurring during early morning/late afternoon with moderate winds or lighter winds with significant cloud
D	≥6	Neutral atmospheric conditions. These occur during the day or night with stronger winds, during periods of total cloud cover or during the twilight period
E	3.4 – 5.4 b	Slightly stable atmospheric conditions occurring during the night-time with significant cloud and/or moderate winds
F	0 – 3.3 [b]	Moderately stable atmospheric conditions occurring during the night-time with no significant cloud and light winds

Note: a Data sourced from the Turner's Key to the P-G Stability Categories, assuming a Net Radiation Index of +4 for daytime conditions (between 10:00 am and 6:00 pm) and –2 for night-time conditions (between 6:00 pm and 10:00 am)

b Assumed to only occur at night, during Net Radiation Index categories of –2.

Figure A8 shows the frequency of stability class for all hours of the model generated dataset. The following observations were made:

- Stable conditions (classes E and F) are the dominant stability state of the atmosphere occurring 48 per cent of the time
- Neutral atmosphere conditions (class D) occur 15 per cent of the time
- Unstable atmospheres (classes A, B and C) occur about 37 per cent of the time.

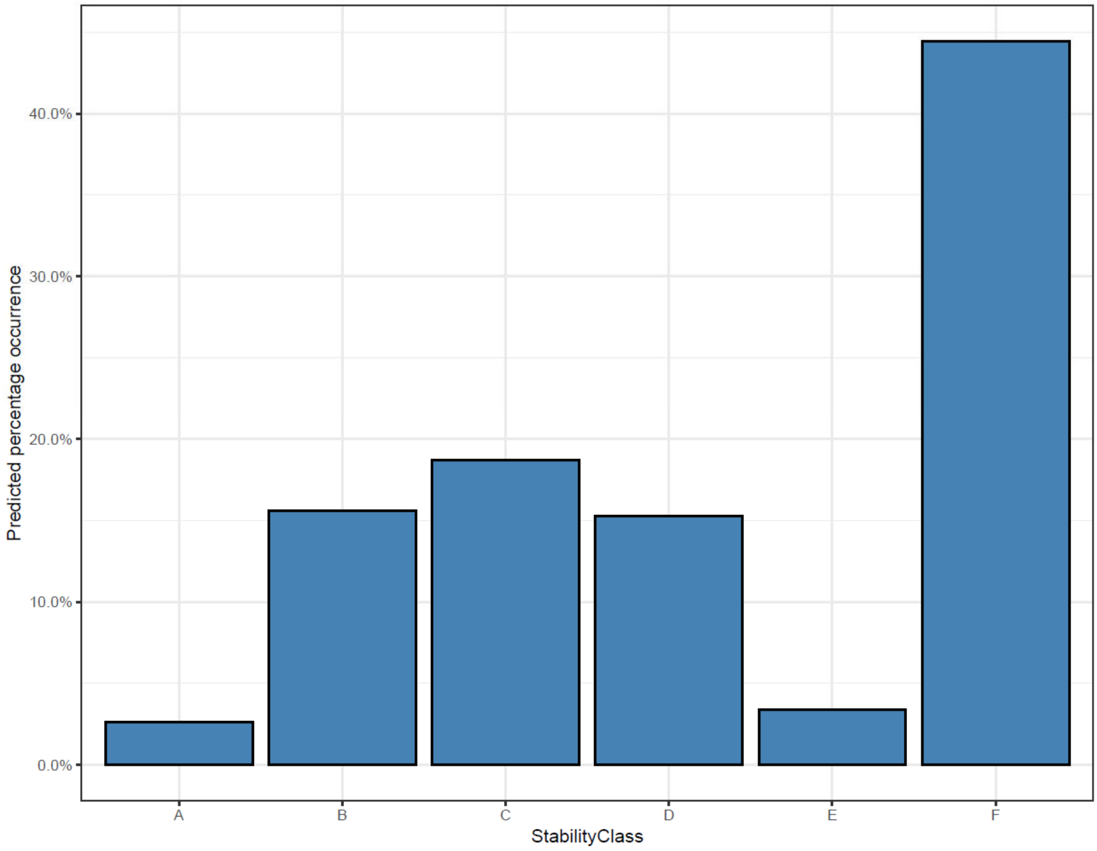

Figure A8 Distribution of stability class for the model period

Figure A9 shows the predicted mixing height for each hour of the day. The highest mixing heights were predicted to occur during late morning and early afternoon periods between 11am to 4pm. The lowest mixing heights were predicted to occur during night and early morning periods between 7pm to 5am.

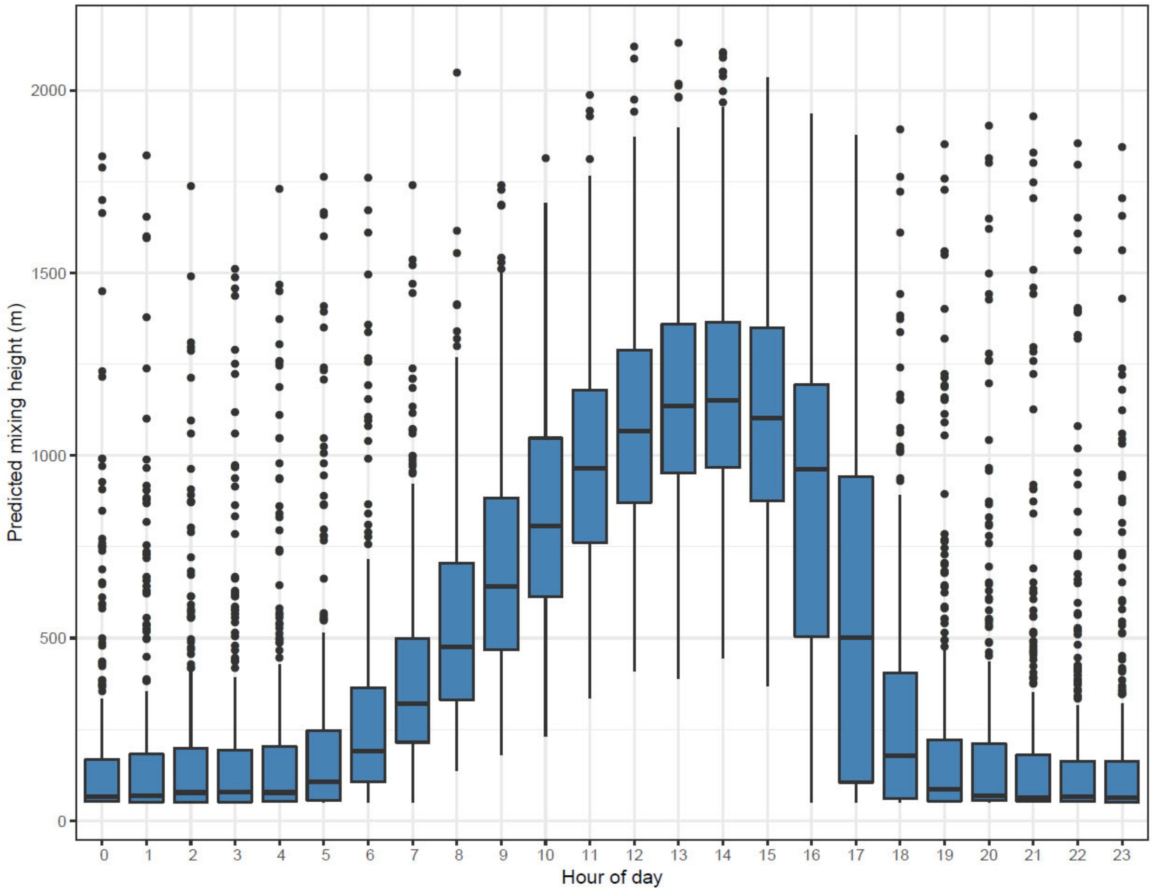

Figure A9 Distribution of stability class for the model period

Appendix B – Banksmeadow Transfer Terminal Odour Emissions and Control (The Odour Unit, 2014)

VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA)

Banksmeadow Transfer Terminal

Odour Emissions and Control

Banksmeadow NSW

Final Report

February 2014

THE ODOUR UNIT PTY LIMITED

ABN 53 091 165 061
ACN 091 165 061
Australian Technology Park,
Locomotive Workshop,
Suite 16012, 2 Locomotive Street,
EVELEIGH NSW, 2015

Project Number: N1906R.06

Report Revision		
Report Version	**Date**	**Description**
0.1 (Draft)	17/09/13	Draft report for comment.
1.0 (Final)	20/09/13	Final Report.
2.0	20/02/14	Scope reduced to odour emissions and control.
2.1	24/02/14	Incorporating further feedback. Specification increased to 3 significant figures.
2.2 (Final)	25/02/14	Final Report.
Report Preparation		
Report Prepared By: S. Hayes		Approved By: T. Schulz
Report Title: Veolia Environmental Services - Banksmeadow Transfer Terminal Odour Emissions and Control		

TABLE OF CONTENTS

APPENDICES

1 INTRODUCTION

The Odour Unit Pty. Ltd. (TOU) has been commissioned by Veolia Environmental Services (Australia) Pty. Ltd. (VES) to determine the odour emissions and provide analysis regarding the building ventilation system of the proposed municipal solid waste transfer terminal located at Banksmeadow NSW. The building ventilation system is based upon a system installed at an existing VES transfer terminal at Clyde NSW.

The primary objectives of this report are to discuss the effectiveness of the building ventilation system design in the dispersion of odour once discharged, supply calculations and test reports for the odour emissions factor based on waste mass on floor of tipping areas and to address some issues raised by the Environment Protection Authority (EPA) review of the Draft Environmental Impact Statement (SSD 13-5855) by providing further information on the calculation of emission rates and the development of the design of the ventilation system for the Banksmeadow Transfer Terminal proposal.

2 PROPOSED BUILDING VENTILATION SYSTEM

2.1 SITE PLAN

The Banksmeadow Transfer Terminal (BTT) is proposed to be located at McPherson Street, Banksmeadow NSW. The site operational area has been highlighted in yellow in **Figure 2.1.1**. The nearest sensitive places to the proposed BTT location are the residential and commercial zones within the suburbs of Hillsdale and Matraville on the eastern sides of Beauchamp Road and Denison Street. The topography immediately surrounding the site could be described as simple, low lying and flat.

The terminal structure containing the non-putrescible and putrescible tipping floors and compactor areas is planned to be constructed in the south-western sector of the site. The proposed location of the building ventilation system stack is on the north-east corner of the putrescible area shown in **Figure 2.2.2** (extracted from **Hyder Consulting Drawing No. A001-B**).

Figure 2.1.1: BTT site location

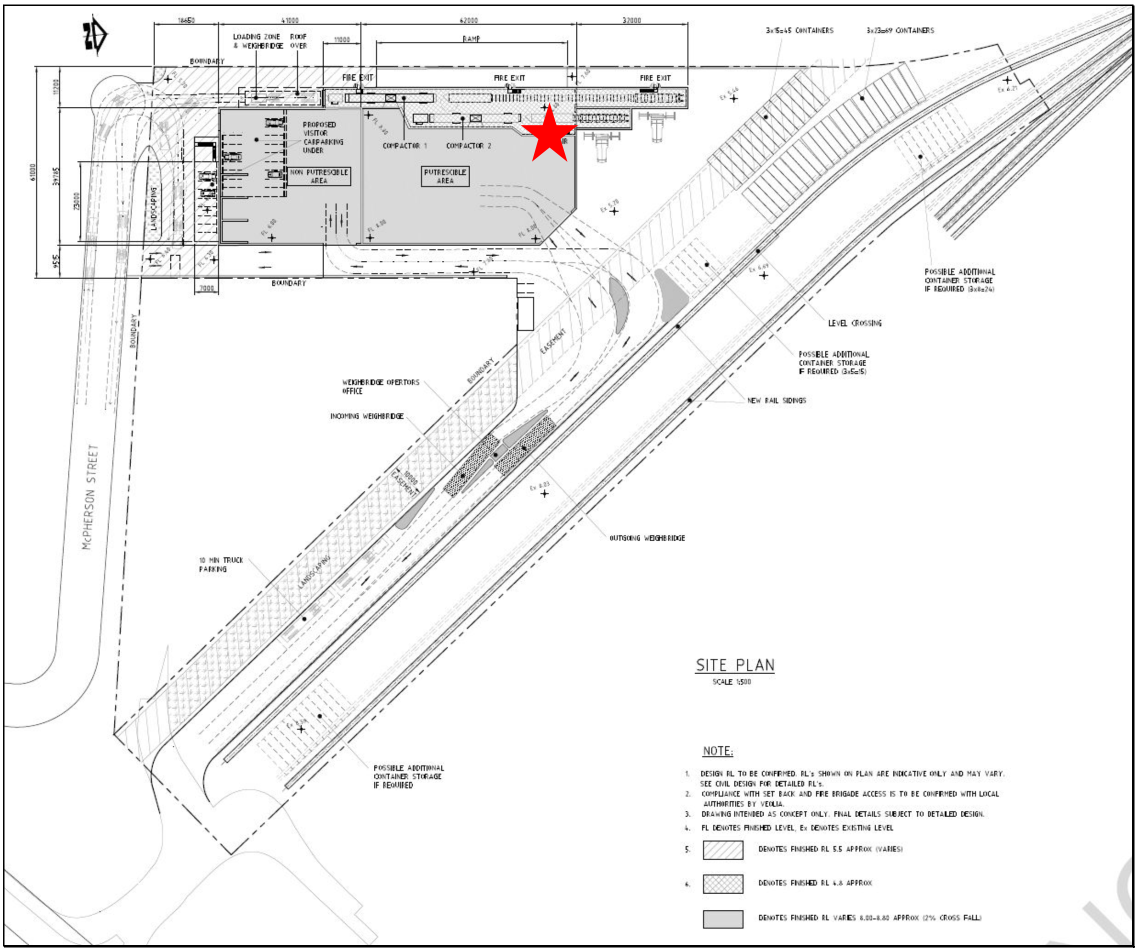

Figure 2.1.2: Site layout and approximate building ventilation stack location (image Hyder Consulting Drawing No. A001-B).

2.2 SPECIFICATION

The building ventilation system proposed for BTT is to be based on the same parameters as the stack at Clyde Transfer Terminal (CTT). The design parameters (3 significant figures) of the stack are:

- 21.0 m stack height above ground level.
- Stack diameter of 2.64 m (gives a);
- Stack cross-sectional area of 5.47 m^2 (multiplied by);
- 20.0 m/s design stack exit velocity (equals);
- 394,000 m^3/h (109 m^3/s) stack flow discharge rate;
    - Therefore, 394,000 m^3/h building ventilation rate (divided by an);
- Approximate building volume 43,800 m^3 (gives an);
- Approximate air exchange rate of nine air changes per hour;

This system is designed to ventilate the building, as well as capture and disperse odour emissions from all significant odour sources within the structure including the putrescible area and from compactors and containers. The bulk air exchange rate is proposed to achieve approximately nine air changes per hour based on a building volume of approximately 43,800 m^3.

The building ventilation system captures ventilation air from the putrescible tipping floors and compactor area to capture significant odour source emissions. The waste compaction units are housed within the fully enclosed compactor area, which is extracted by the building ventilation system and discharged and dispersed via the proposed stack.

Once waste has been loaded into the containers, the containers remain completely sealed and odour is controlled through activated carbon filtration packs fitted to the air exhaust vent in each container.

2.3 BEST AVAILABLE ODOUR CONTROL TECHNOLOGY

In the application of Waste Transfer Terminals and paired with best management practices, it is TOU's view that stack dispersion of building odour emissions offers the most practicable, affordable and proven odour control technology. A working demonstration of the proposed building system is already in operation at the VES operated CTT.

In August 2005, TOU completed a review for Collex (now VES) of the odour control system design and performance that it was operating at CTT. The transfer building was configured as a naturally ventilated system through breezeways in the walls and a large open doorway. It had an odour control system based upon six individual dust and carbon filter units discharging treated air through short stacks located along the roof of the building. A design bulk air exchange rate of seven air changes per hour was possible, excluding any air changes through the doorway and breezeways, equivalent to a stack velocities of 17.7 m/s (TOU, 2005).

It was found that the flow rate of air from the stacks was highly dependent on the condition of the dust and carbon filters. The air flow rates from the stacks were highly variable, due to excessive pressure losses across blocked dust and carbon filters. In the worst-case the total flow rate with six dirty dust filters reduced the bulk air exchange rate to just one air change per hour (TOU, 2005).

The activated carbon system was atypical of those commonly used in industrial odour control. In such applications, activated carbon filters were most commonly used for medium to high concentrations of odour in foul air streams having low air flow rates. In these cases granular activated carbon was used in vertical filter vessels. Such systems are typically designed with sufficient carbon capacity to ensure a reasonable filter life before carbon replacement. Granular activated carbon filter systems for very large airflows require a large capital investment and a very large and ongoing operating cost (TOU, 2005).

Following on from this review, TOU completed an odour mitigation study of CTT in December 2005. This study involved an odour emissions survey and a dispersion modelling study. A range of stack configurations were modelled, including a single external ventilation stack (TOU, 2005). In July 2006, a more refined modelling scenario found that a single external with stack height of 21 m, diameter of 2.64 m and stack exit velocity of 20 m/s, was the optimum design for CTT and met the EPA odour impact assessment criteria (TOU, 2006). The sealing of building breezeways and installation of plastic strips on the open truck doorway was also carried out. This design was accepted and successfully implemented and still under effective operation by VES at CTT.

It is TOU's view that it would be appropriate for VES to use of the design of the successful building ventilation system at CTT as a working model of the best available odour control technology that is practicable for waste transfer stations.

2.4 FUGITIVE EMISSIONS

The building would be sealed except for the open truck entrances to the non-putrescible tipping floor and putrescible tipping floors. A minor release of fugitive emissions may occur primarily out of the open truck entrances.

TOU has experienced other industries where large-volume buildings are fitted with fast-acting doors in the truck receival areas as a means of minimising fugitive odour releases. However when considering this approach for waste transfer terminals it is quickly evident that the large volume of truck traffic would not be suitable for a fast-acting door system. Plastic strips are proposed to be installed to help contain odour within the building whilst practicably allowing the high rate of truck movements into and out of the tipping areas. These strips would cover the upper one-third of the opening area. They have been shown by smoke testing at CTT to decrease air movement through the doorway.

There would also be a brief opening of doors to the compactor area to enable changeover of waste containers. TOU's recent audit of existing VES operations at the Crisps Creek Intermodal Facility, as part of Woodlawn Bioreactor Expansion Project, had found that the current measures used for the waste transport operations were very effective at mitigating any odour emissions. The low flow and carbon filtered odour emission from the containers had a very small, if not insignificant, odour emission potential. There was very little evidence of any waste-based odour being generated. The Audit determined that facility was very unlikely to generate problematical odour emissions. This was provided that the waste containers used in the process continue to be adequately maintained and remain fully sealed during waste transportation (TOU, 2014).

TOU recommend that a nominal average fugitive release of 5% of total odour emissions is a sensible and conservative assumption.

3 ODOUR EMISSION SCENARIOS

3.1 ODOUR EMISSION FACTOR

On 20th August 2008, TOU took airflow and temperature measurements and collected four air samples from the single stack system at CTT. The sampling was carried out by the methods of AS/NZS 4323.3:2001. Analysis of the air samples for odour concentration was carried out the following day by dynamic olfactometry to Australian Standard AS/NZS 4323.3:2001. The mean result of the odour testing and air flow measurements was used to calculate an odour emission factor (odour units per tonne on floor per second – ou.m^3/t.s) based on the amount of waste on the floor in the terminal building as advised at the time by VES (250 tonnes). A summary of the measurements and odour testing results has been provided in **Table 3.1.1**. The odour concentration test report has been provided in **Appendix A**.

Table 3.1.1: Summary of stack measurements and odour testing results.

Mean Odour Conc^n (ou)	Stack Diameter (m)	Mean Stack Gas Temp (^{0}C)	Mean Stack Gas Exit Velocity (m/s)	Mean Stack Gas Flowrate @ 25^{0}C (m^3/s)	Tonnes of garbage inside transfer building (Tonnes)	Odour emission factor per tonne of waste (ou.m^3/t.s)
320	2.64	21.4	16.0	88.7	250	113.5

It should be noted that the odour emissions were measured directly from within the extraction stack in preference to collection from stockpiles using an Isolation Flux Chamber. The Isolation Flux Chamber method is an EPA approved method but is known to inherently give significantly lower emission rate values compared with more direct measurement techniques.

3.2 VARIABLE ODOUR EMISSIONS SCENARIOS

The OER per tonne factor (113.5 ou.m^3/t.s) was used to calculate hourly variable emissions over a typical operating day shown in **Table 3.2.2**. The hourly 'waste on floor' data was provided by VES as representative snapshot of daily waste levels at CTT. It is also expected to represent the peak levels for BTT.

Table 3.2.1: CTT hourly variable emissions profile				
TIME	Tonnage on floor (t)	Odour Emission Rate (ou.m^3/s)	Hour of Day	Main Stack by Hour with P/M60
0000-0059	46.82	5,314	1	12,222
0100-0159	53.74	6,099	2	14,029
0200-0259	96.24	10,923	3	25,123
0300-0359	184.48	20,938	4	48,159
0400-0459	188.721	21,420	5	49,266
0500-0559	164.73	18,697	6	43,003
0600-0659	137.34	15,588	7	35,853
0700-0759	34.16	3,877	8	8,917
0800-0859	28.62	3,248	9	7,471
0900-0959	71.17	8,078	10	18,579
1000-1059	15.59	1,769	11	4,070
1100-1159	46	5,221	12	12,008
1200-1259	41.35	4,693	13	10,794
1300-1359	90.323	10,252	14	23,579
1400-1459	109.316	12,407	15	28,537
1500-1559	15.364	1,744	16	4,011
1600-1659	0	0	17	0
1700-1759	4.74	538	18	1,237
1800-1859	1.5	170	19	392
1900-1959	4.04	459	20	1,055
2000-2059	12.16	1,380	21	3,174
2100-2159	21.1	2,395	22	5,508
2200-2259	64.38	7,307	23	16,806
2300-2359	91.66	10,403	24	23,928

The use of this CTT data could be considered as refined and realistic simulations of potential odour impacts as a result of odour emissions from the BTT site.

3.3 CONSTANT ODOUR EMISSIONS SCENARIO – SENSITIVITY TEST

TOU believes that it is a reasonable approach to consider a sensitivity test with use of a constant emission rate out the stack and truck doorway at double the maximum odour emission hour given in **Table 3.2.1**. The results of this sensitivity test could be interpreted as an extremely unlikely upset condition simulation where the waste on floor has accumulated well above expectations for every hour of every day of the entire year.

The findings from this sensitivity test should be viewed in terms of the large extent of safety margin allowed for in the design of the waste transfer terminal.

4 REFERENCES

- AS/NZS 4323.3:2001, *Determination of odour concentration by dynamic olfactometry,* Jointly published by Standards Australia International Ltd, Sydney and Standards New Zealand, Wellington

- The Odour Unit, 2005, *Collex Waste Transfer Terminal – Odour Control System Design and Performance Review*, Eveleigh.

- The Odour Unit, 2005, *Collex Pty Limited – Clyde Waste Transfer Terminal - Odour Mitigation Study*, Eveleigh.

- The Odour Unit, 2006, *Collex Pty Limited – Clyde Waste Transfer Terminal - Odour Mitigation Study – Addendum to Final Report*, Eveleigh.

- The Odour Unit, 2014, *Veolia Environmental Services (Australia) Pty Limited Woodlawn Bioreactor Expansion Project – Independent Environmental Audit #2*, Eveleigh.

Appendix A: Odour Concentration Test Reports

THE ODOUR UNIT PTY LIMITED

THE ODOUR UNIT

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Eveleigh
NSW 1430

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ABN: 53 091 165 061

Form 06 - Sydney Laboratory
Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Veolia Environmental Services	Telephone	(02) 9841 2927
Contact	S.Hambly, R. Bachu	Facsimile	(02) 9841 2992
Sampling Site	Clyde Waste Transfer Terminal	Email	Steven.Hambly@veolia.com.au; Ramona.Bachu@veolia.com.au
Sampling Method	Drum and pump	Sampling Team	TOU

Order details:

Order requested by	T. Muddle	Order accepted by	S. Hayes
Date of order	18/08/2008	TOU Project #	1230
Order number	CT45-884468	Project Manager	T. Schulz
Signed by	S. Lawrence	Testing operator	J. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. Odour character is also assessed, however, this assessment is not covered by AS4323.3:2001.
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 Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. 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 $2^2 \le \chi \le 2^{18}$ 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 between 22°C and 25°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V02
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \le 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $r = 0.1217$ (19/20 March, 2008) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \le 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $A =$ 0.1282 (19/20 March, 2008) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 23 ou (blank bag odour concentration)
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. 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.

Date: Friday, 22 August 2008

Report Number / Panel Roster Number: SYD20080821_075

T. Schulz
Principal and Managing Director

J. Schulz
Authorised Signatory

THE ODOUR UNIT PTY LIMITED

Odour Sample Measurement Results

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Odour Character
Stack - Sample 1	SC80295	20/08/2008 1420	21/08/2008 1128	4	8	No Dilution	No Dilution	430	430	Garbage.
Stack - Sample 2	SC80296	20/08/2008 1138	21/08/2008 1208	4	8	No Dilution	No Dilution	332	332	Garbage.
Stack - Sample 3	SC80297	20/08/2008 1450	21/08/2008 1243	4	8	No Dilution	No Dilution	304	304	Garbage.
Stack - Sample 4	SC80298	20/08/2008 1505	21/08/2008 1326	4	8	No Dilution	No Dilution	215	215	Garbage.

THE ODOUR UNIT PTY LIMITED

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/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20080821_075	49,600	$20 \leq \chi \leq 80$	861	58	Yes

Comments None.

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Limited for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Limited relinquishes The Odour Unit Pty Limited from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

Note This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Limited.

END OF DOCUMENT

Appendix C – Odour Concentration test report No. LB/007/02/21 (Otto Engineering Polsk, 2021)

PCA
POLSKIE CENTRUM AKREDYTACJI
BADANIA
AB 1426

OTTO ENGINEERING POLSKA Sp. z o.o.

Research Laboratory

Rzeszów, 05.02.2021

Order ref.: LB 20-2021-008

ODOUR CONCENTRATION

Test Report

No. LB/007/02/21

Customer:

Bioelektra Australia Pty Ltd
31/287 Victoria Ave
Rydalmere NSW 2116

ul. Połonińska15
35-082 Rzeszów

Tel.: +48 (17) 249 00 43
+48 (17) 249 00 30
Fax: +48 (17) 249 00 39

e-mail:
laboratorium@ottoindustries.com.pl

Place of measurement:

Bioelektra Group – sorting plant
Różanki 12
14-240 Różanki

Report prepared by:

05.02.2021 Szylic Paweł
Date and signature

Report authorised by:

mgr inż. Wojciech Kołcz
Date and signature
KIEROWNIK TECHNICZNY
LABORATORIUM
tel. 510 253 221

The Customer is entitled to complain within 14 days of the date of receiving the report.
Without a written consent of the OTTO Research Laboratory, the report cannot be reproduced otherwise than in whole. The results refer solely to the tested structures on the date of the measurement.
The document consists of 6 pages and appendices.

TABLE OF CONTENTS

1. Object of the test

- Odour concentration measurement in the samples of air taken from the biomass heap placed for measurement purposes at the Bioelektra Group waste sorting plant in Różanki.

2. Basis of the report

2.1. Formal basis

- Customer order recorded under ref. LB 20-2021-008
- Measurement plan of 1 February 2021
- Protocol from site inspection of 1 February 2021

2.2. Legal basis

- Not applicable.

3. Test method

- PN-EN 13725:2007 Air quality – Determination of odour concentration by dynamic olfactometry
- VDI 3880:2011 Olfactometry Static sampling
- PN-Z-04030-7:1994 Air purity protection – Tests for dust content – Measurement of concentration and mass flow rate of particulate matter in waste gases by gravimetric method

4. Purpose of measurement

Determination of odor concentrations in sampled air emitted from the biomass sample.

5. Measuring equipment

Equipment	Serial/registration number	Date of calibration Certificate No.	Calibration validity date
Temperature recorder LB-516T	LBO/PK/068 1948	22-24.11.2017 53227/2017	21.11.2021
DAVIS Vantage VUE 6250EU weather station barometer	LBO/PK/039 ME130827049	19.02.2020 97/42/LA/P/2020	18.02.2023
DAVIS Vantage VUE 6250EU weather station hytherograph	LBO/PK/039 ME130827049	16, 17, 25, 26.02.2020 507/100/LA/TH/2020	15.02.2023
TESTO multifunctional test device, model 435-4 Vane term anemometer No. 5412983	LBO/PK/024 02386449	13.02.2019 84/A/19	12.02.2021
KIMO MP 120 micropressure gauge	LBO/PK/069 1P161143241	19.12.2019 133/P/19	18.12.2021
Rotronic HygroPalm HP22-A hytherograph	LBO/PK/034 0060974673	17-19.06.2019; 19.06.2019 147/6/619; 148/6/19	16.06.2023
TO8 olfactometer	LBO/AB/076	9.10.2020 K/4392/20/00	08.10.2021

6. Additional information

The area is not regulated by law.

7. Measuring conditions, results discussion

7.1. Date of air samples taking

- 02.02.2021

7.2. Date of measurement (odour concentration assessment)

- 03.02.2021

7.3. Measuring team

Full name	Position/task	Signature
Wojciech Kołcz	Technical Manager/ sample taking	Wojciech Kołcz
Paweł Wójcik	Measurement Specialist / Sample taking, TO8 operator	Wójcik Paweł

7.4. Group of persons assessing the odour

For the purpose of ensuring good measurement quality, the persons assessing the odour had been tested for n-butanol perception with the use of TO8 device.
The team of the persons assessing the odour (persons identifiable based on the acronyms).

Odour assessing person 1 – CZM
Odour assessing person 2 – PEW
Odour assessing person 3 – RYS
Odour assessing person 4 – KAZ

Results of team selection measurements based on n-butanol sensing prior to the 03.02.2021 measurements

Stand number	Odour assessing person	1st criterion of the team selection – antilogarithm $0,0200 \leq 10^{y_{ITE}} \leq 0,0800$	2nd criterion of the team selection $10^{s_{ITE}} \leq 2,300$
1	CZM	**0,0546**	**1,6220**
2	PEW	**0,0568**	**1,3997**
3	RYS	**0,0568**	**1,5095**
4	KAZ	**0,0358**	**1,7017**

Value of the antilogarithm $10^{y_{ITE}}$ should fulfil the condition of $0,0200 \leq 10^{y_{ITE}} \leq 0,0800$, whereas $10^{s_{ITE}} \leq 2,300$.
Both criteria must be fulfilled at the same time.

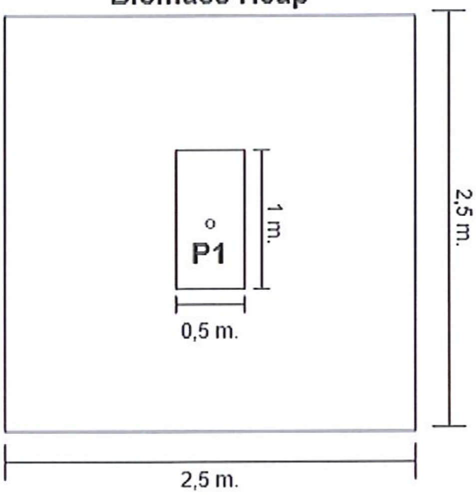
7.5. System description

A heap of biomass, originating from the mechanical and thermal processing of waste, piled up for measurement purposes with dimensions of 2.5 x 2.5 m and 0,2 m height, was subject to measurement. The biomass was measured after a period of about 24 hours from the end of the sterilization process.

7.6. Description of the place of air samples taking

Air samples for olfactometric studies were collected from the surface of the biomass heap, using a ventilated cap with an area of $0.5 m^2$ ending in an emitter with a diameter of 100 mm. Samples were collected at a central point located on the surface of the heap.

Simplified measurement scheme::



7.7. Summary of measurement results

7.7.1. Gas parameters

Temperature, humidity and velocity of the waste gas

Point	Mark of the samples	Time of sampling	Ventilation duct dimension	Waste gas		
			[mm]	Temp. [°C]	Hum. [%]	Velocity [m/s]
P1 – Surface of the biomass heap	O/BIO/21/02/OF/01	8:35-8:40	100	17,9	45,3	1,08
	O/BIO/21/02/OF/02	8:49-8:54		17,5	48,6	0,95
	O/BIO/21/02/OF/03	9:02-9:07		16,9	40,6	1,01
	O/BIO/21/02/OF/04	9:15-9:20		16,8	41,6	1,03
	O/BIO/21/02/OF/05	9:28-9:33		16,8	43,9	0,99
	O/BIO/21/02/OF/06	9:41-9:46		16,4	45,6	1,02

7.7.2. Odour concentration

Results of olfactometric measurements of tested gas samples

Point	Mark of the samples	Time of measurement	Odour concentration c_{OD} [ou$_E$/m^3]	Lower bound c^- [ou$_E$/m^3]	Upper bound c^+ [ou$_E$/m^3]
P1 – Surface of the biomass heap	O/BIO/21/02/OF/01	7:50	38	-	-
	O/BIO/21/02/OF/02	7:41	25	-	-
	O/BIO/21/02/OF/03	7:59	23	-	-
	O/BIO/21/02/OF/04	7:31	40	-	-
	O/BIO/21/02/OF/05	8:11	21	-	-
	O/BIO/21/02/OF/06	8:19	21	-	-
	Geometric mean	-	***27,0***	*19,5*	*37,3*

Uncertainty expression:
Extended uncertainty of the measurement, i.e. 95% confidence interval, is calculated as:

Lower bond

$$\log(c^{-}) = \log(c_{OD}) - t * \frac{s_r}{\sqrt{n}}$$

Upper bond

$$\log(c^{+}) = \log(c_{OD}) + t * \frac{s_r}{\sqrt{n}}$$

Where c^- is the lower limit of the confidence interval and c^+ is the upper limit of the confidence interval, t is the t-Student coefficient (for the quantity of $n=\infty$ it is $t = 2,0$), s_r is the standard deviation for the repeatability limit criterion $s_r = 0,1721$.

7.7.3. Results of odour stream estimation

Mark of the samples	Odour concentration c_{OD} [ou$_E$/m^3]	Flow rate under standard conditions [m^3/m^2*h]*	Odour stream [ou$_E$/m^2*s]*
P1 – Surface of the biomass heap			
O/BIO/21/02/OF/01	38	59,9	0,632
O/BIO/21/02/OF/02	25	52,8	0,366
O/BIO/21/02/OF/03	23	56,2	0,359
O/BIO/21/02/OF/04	40	57,3	0,637
O/BIO/21/02/OF/05	21	55,1	0,322
O/BIO/21/02/OF/06	21	56,9	0,332
Average value	*27,0*	*56,4*	***0,422***

* - values are given for one square meter of biomass surface

7.8. Summary / Conclusions

The measurements made it possible to determine the odour concentration in the air samples taken from the measurement point located on the surface of a heap of biomass. The values of odour concentration are presented in the table in Section 7.7.2. Section 7.7.3 presents the results of odour stream estimation.

8. Appendices

- Not applicable

****** END OF REPORT ******

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Revision	Author	Reviewer		Approved for Issue		
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