Putta Bucca Rd Pump Station

Odour Assessment

Mid-Western Regional Council

21 February 2022

GHD Pty Ltd | ABN 39 008 488 373
133 Castlereagh Street, Level 15
Sydney, New South Wales 2000, Australia
T +61 2 9239 7100 | **F** +61 2 9239 7199 | **E** sydmail@ghd.com | **ghd.com**

Printed date	21/02/2022 9:19:00 AM
Last saved date	21 February 2022
File name	https://projectsportal.ghd.com/sites/pp01_04/acousticandodourasse/ProjectDocs/12564732-REP-0_Putta Bucca Rd Pump Station Odour Assessment.docx
Author	Julia Potgieter
Project manager	Danny Craggs
Client name	Mid-Western Regional Council
Project name	Odour assessments Putta Bucca
Document title	Putta Bucca Rd Pump Station | Odour Assessment
Revision version	Rev 0
Project number	12564732

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	A	E.Smith	D.Craggs		D.Mees		04/02/22
S4	0	E.Smith	D.Craggs		D.Mees		21/02/22

Contents

Table index

Figure index

Appendices

1. Introduction

1.1 Purpose of this report

Mid-Western Regional Council (MWRC) has engaged GHD to conduct an odour assessment for the proposed sports training and accommodation facility to be constructed on land described as Lot 2 DP1252505 on Putta Bucca Road, Mudgee. The site is located within the Mid-Western Council Local Government Area (LGA).

An odour assessment is required in order to determine any potential odour impacts from the existing Putta Bucca Pump Station on the surrounding environment including on Lot 2 DP1252505.

1.2 Scope and limitations

This report documents the assessment of potential odour impacts associated with the operation of the pump station and potential impacts on future users of the proposed sports training and accommodation facility. The scope of the assessment included:

A Level 3 odour assessment has been carried out as per the *Technical Framework: Assessment and management of odour from stationary sources in NSW* (DEC NSW, 2006)The assessment method is described below:

- Desktop assessment, including a review of all relevant documents, site layout, pumpstation location and sensitive receiver locations
- Engagement of odour sampling subcontractor to undertake odour sampling at the pumping station during times of peak flows
- Local meteorology assessment using data from the nearby BoM Mudgee AWS. Local meteorology has the potential to influence dispersion of odour.
- Preparation of a meteorological file for use in dispersion modelling.
- Preparation of a dispersion model for the pumping station using AERMOD, an EPA approved model.
- Assessment to determine potential odour impacts from the pumping station on the development and assess its suitability in terms of odour.

Preparation of a report in accordance with the Technical framework: Assessment and management of odour from stationary sources in NSW (DEC NSW, 2006)and Approved methods for the modelling and assessment of air pollutants in NSW (Approved Methods) (NSW EPA, 2016)*This report: has been prepared by GHD for Mid-Western Regional Council and may only be used and relied on by Mid-Western Regional Council for the purpose agreed between GHD and Mid-Western Regional Council as set out in section 1.2 of this report.*

GHD otherwise disclaims responsibility to any person other than Mid-Western Regional Council 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(s) 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

1.3 Assumptions

The following assumptions apply to the assessment:

- Odour sampling was undertaken by Ektimo Pty Ltd (Ektimo) of the main pump station stack (3 m high stack that discharges air from the odour extraction fan). At the time of sampling, there was no air flow through the second, naturally ventilated stack (6m). Given the forced ventilation from the main pump station stack, it is assumed that this is the major source of odour and the second naturally ventilated 6 m high vent stack is not a significant source of odour.
- Odour sampling was undertaken at a time which represents the morning peak, as advised by Council. It is assumed that odour samples reflect a typical worst case from the pump station.
- Modelling was undertaken assuming the worst-case odour emissions occur 24 hours a day which is highly conservative.
- Modelling assumes meteorological data from the BoM Mudgee Airport AWS is representative of the project site.
- The assessment has been carried out for conditions as measured on the day of sampling and does not consider changed odour risk associated with any modifications to the sewer network, changes to pump station flows, or upset scenarios.

2. Description of the proposal

2.1 Proposed development

The proposed training camp includes two accommodation blocks (Block A and B) and one multipurpose building (Block C) with dining, lounge, lecture room and gymnasium.

The proposed infrastructure covers an area of approximately 6300 m^2, on Lot 2 of DP1252505 and the location is provided in Figure 2.1.

While it is not known the maximum number of occupants at any one time, there are 28 separate units in Block A and B. Building A is nearest to the Putta Bucca pump station, which is located about 150 metres to the northwest.

2.2 Pump station

The Putta Bucca pump station (PBPS) is located on Putta Bucca Road, south of the Putta Bucca wetlands. The station was upgraded in 2012 by TWS Evolution, which increased the capacity to transfer 500 litres per second at 1000 kPa to the sewage treatment plant (TWS Evolution, 2014).

The location of the PBPS with respect to the proposed development is shown in Figure 2.1 and a schematic is shown in Figure 2.2.

Legend

- Putta Bucca House
- Buildings
- Development
- Site boundary (indicative)
- Putta Bucca Pump Station

Paper Size ANSI A

0 50 100 m

N

Map Projection: Mercator Auxillary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxillary

GHD

MID-WESTERN REGIONAL COUNCIL
PUTTA BUCCA RD
PUMP STATION

GENERAL LAYOUT

Project No. **12564732**
Revision No. **0**
Date. **18/02/2022**

FIGURE 2.1

Document Path: C:\Users\jpotgieter2\Desktop\Putta Bucca\QGIS\Patta Bucca.qgz

Print Date: 18/02/2022

Data Source: Development and buildings - GHD 2022 / World imagery: GoogleEarthSatellite

Created By: Julia Potgieter

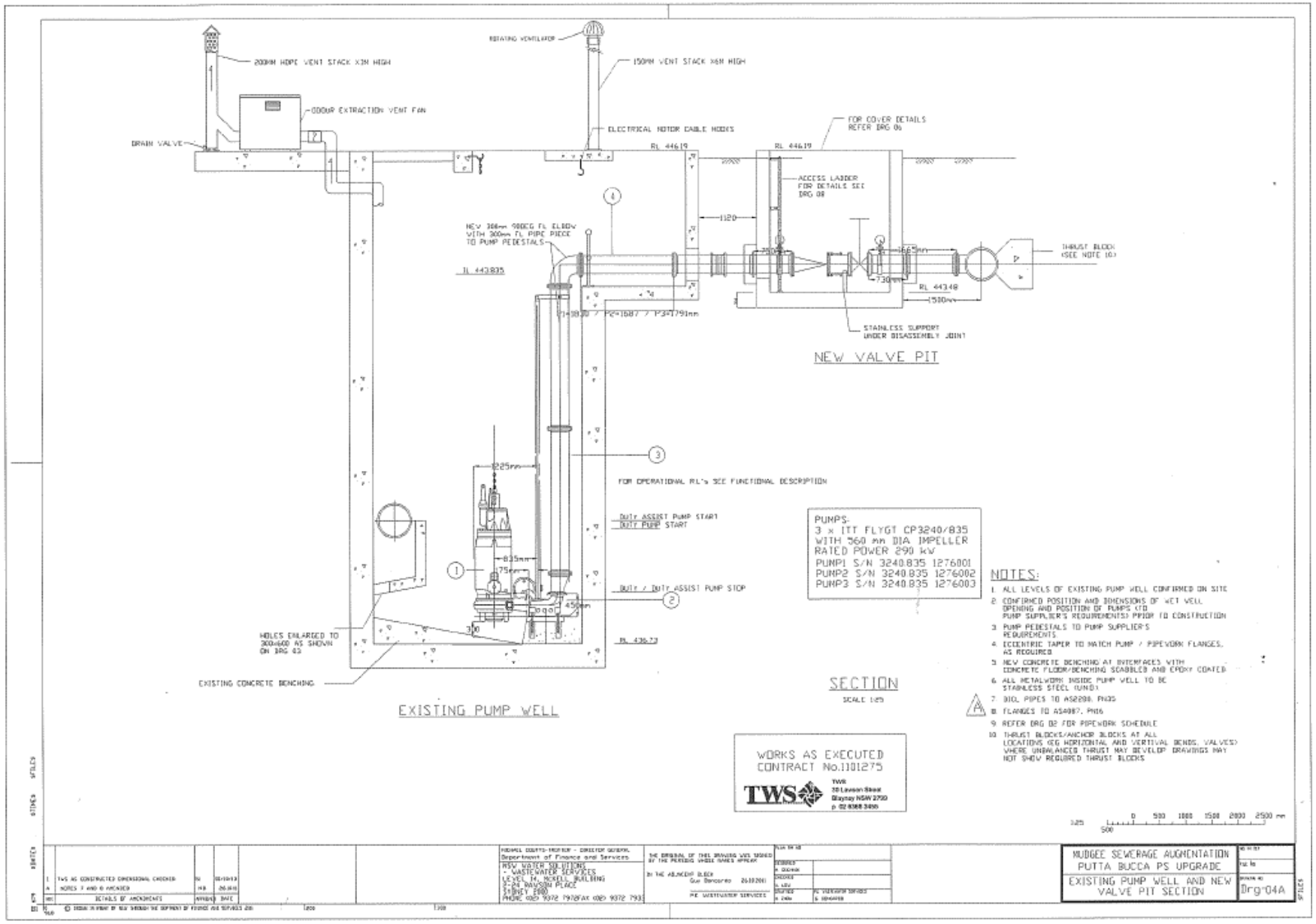


Figure 2.2 PBPS schematic (TWS, 2013)

3. Environmental setting

3.1 Sensitive receptors

The Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales ('the Approved Methods') (EPA, 2016) defines sensitive receptors as locations where people are likely to work or reside and may include a dwelling, school, hospital, office or recreation area.

Whilst the assessment focusses on potential odour impacts at the proposal location only, existing residential premises are included in the assessment to provide context. The nearest built-up residential area is approximately 580 metres to the south of the PBPS. A single, isolated residence is located approximately 370 metres to the southwest. Nearer to the PBPS includes industrial (concrete batching plant), commercial (Putta Bucca House) and open space/recreational areas (Putta Bucca Wetlands). These are shown on Figure 3.1.

Legend

- Concrete batching plant
- Residential area
- Putta Bucca House
- Putta Bucca Wetlands
- Nearest residence
- Buildings
- Development
- Site boundary (indicative)
- Putta Bucca Pump Station

Paper Size ANSI A

0 100 200 m

N

Map Projection: Mercator Auxillary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxillary

GHD

MID-WESTERN REGIONAL COUNCIL
PUTTA BUCCA RD
PUMP STATION

SENSITIVE RECEPTORS AROUND THE PUMP STATION

Project No. **12564732**
Revision No. **0**
Date. **18/02/2022**

FIGURE 3.1

Document Path: C:\Users\jpotgieter2\Desktop\Putta Bucca\QGIS\Patta Bucca.qgz

Print Date: 18/02/2022

Data Source: World imagery - GoogleEarthSatellite

Created By: Julia Potgieter

3.2 Meteorology

The Bureau of Meteorology (BoM) operates Automatic Weather Stations (AWS) at various locations around Australia. The nearest station to the project site is Mudgee Airport AWS, approximately 4.1 km northwest of the PBPS. Due to the surrounding terrain features, it has been determined that the conditions at Mudgee Airport are likely to be suitably representative of the wind conditions at the PBPS. Five years (2016-2020) of meteorological data from Mudgee Airport AWS has been analysed for this assessment and annual and seasonal wind roses are presented below in Figure 3.2 and Figure 3.3. Cloud cover data from this station has also been analysed to determine atmospheric stability.

3.2.1 Annual Wind Patterns

Figure 3.2 shows the 5-year (2016-2020) annual average wind rose at Mudgee Airport AWS, and the following features can be seen:

- Annual average wind speed of 3.1 m/s.
- Winds are most prevalent from the northeast and southeast.
- Winds are least prevalent from the west.
- Light winds (<3 m/s) occur predominantly from the east.
- High wind speeds (>5 m/s) occur predominantly from the west.
- Calm conditions (wind speeds <0.5 m/s) occurred 7.5% of the time.

Calm and light winds are often associated with poor odour dispersion.

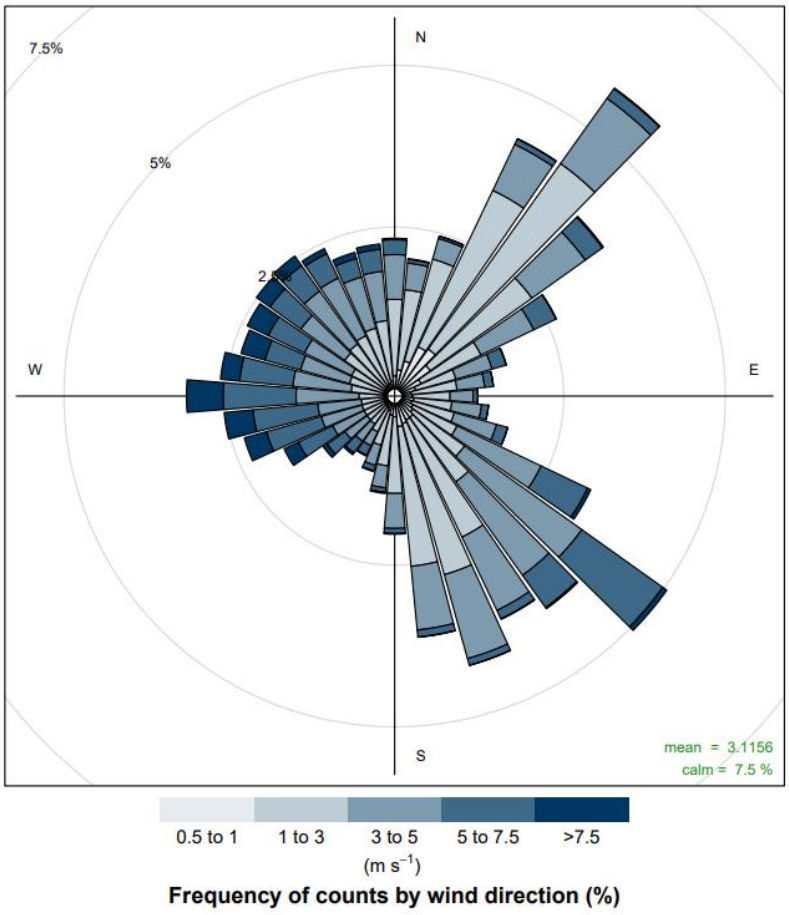


Figure 3.2 Annual average wind rose at Mudgee Airport AWS for 2016-2020

3.2.2 Seasonal variation in wind patterns

The 5-year seasonal wind roses are presented in Figure 3.3 and show that:

- Across all seasons there is wind from the northeast approximately 10% of the time.
- During summer and autumn, the predominant wind direction is from the southeast.
- Winter has the greatest proportion of calm conditions (wind speeds <0.5 m/s).
- Spring and summer have higher mean wind speeds of 3.4 and 3.5 m/s respectively.
- Autumn and winter have lower mean wind speeds of 2.8 m/s.

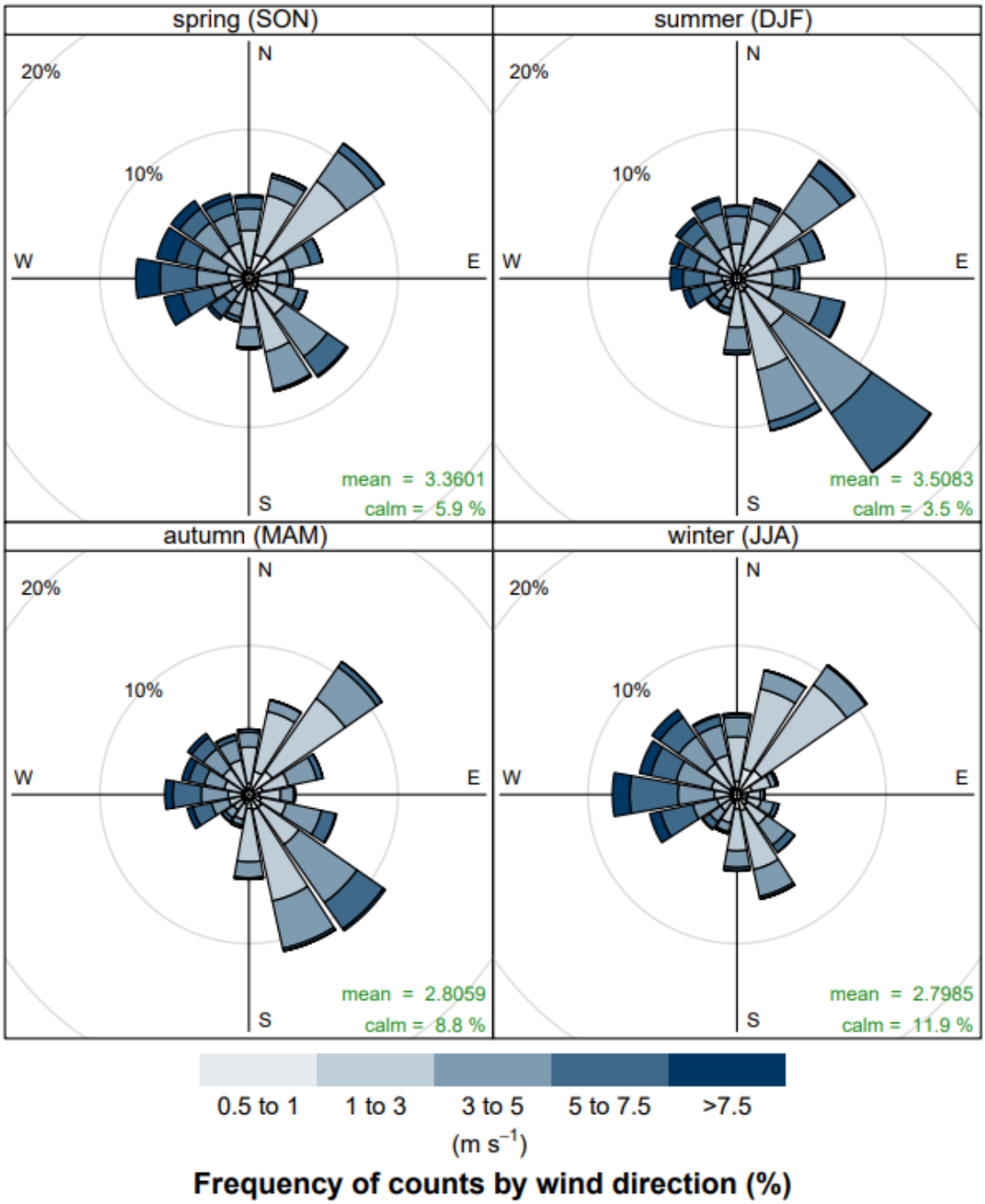


Figure 3.3 Average seasonal wind roses at Mudgee Airport AWS from 2016-2020

3.2.3 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 are used to define the stability category.

The 5-year average annual atmospheric stability is presented in Figure 3.4 and shows that:

- Stable atmospheres (E and F) occur for an average of 43.5% of the year.
- Unstable atmospheres (A, B and C) occur for an average of 28.8% of the year.
- Neutral conditions (D) occur for an average of 27.6% of the year.
- The dominant state of the atmosphere is stable (E and F).

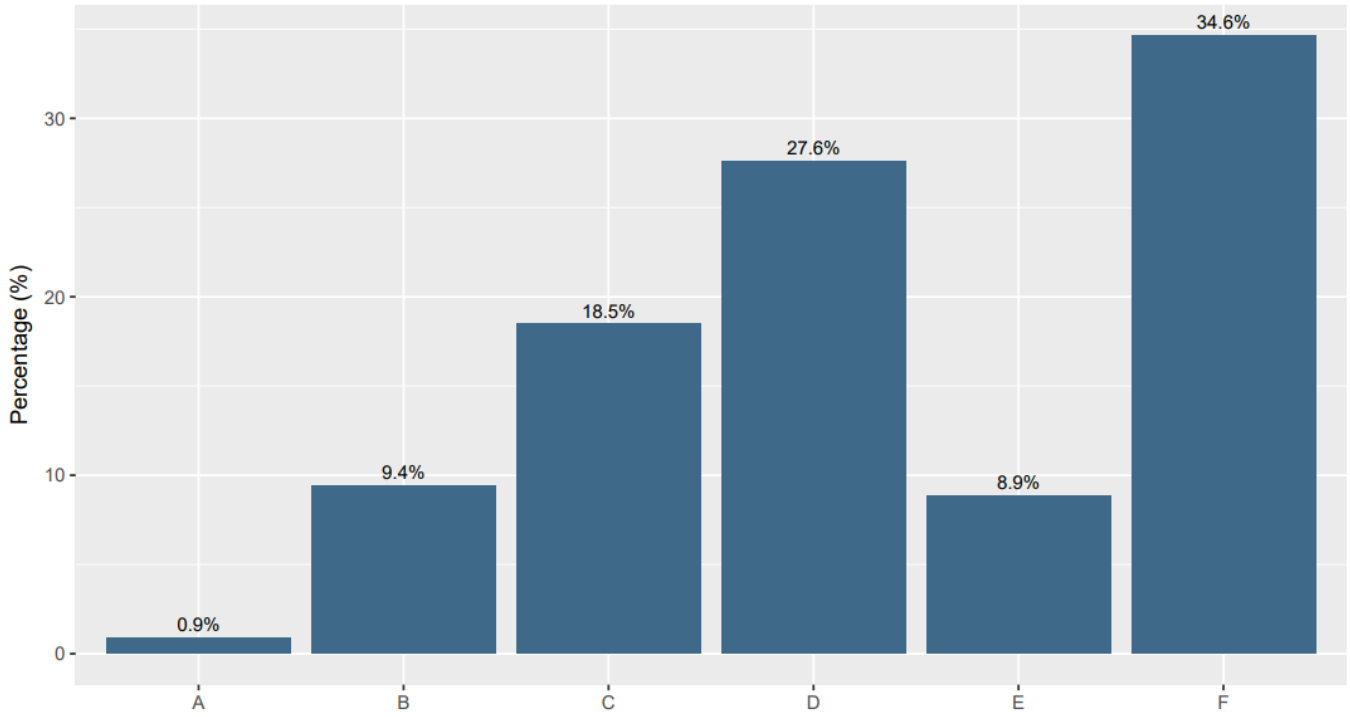


Figure 3.4 Annual average atmospheric stability at Mudgee Airport AWS from 2016-2020

3.3 Odour complaint history

MWRC provided GHD with complaint history for the PBPS. The PBPS received one odour complaint on 14 January 2009, and no further complaints were made. Upgrades of the PBPS commenced in July 2012 and no complaints have been received since the upgrade.

4. Odour assessment

4.1 Methodology

The following methodology was used to assess odour impacts from the PBPS.

– Odour sampling was conducted at the PBPS main stack.
– Odour emissions from the stack were calculated based on the odour sampling result.
– Meteorological modelling was undertaken following appropriate regulatory guidance (refer Appendix A)
– Dispersion modelling was undertaken following NSW EPA guidance (refer Appendix A for more detailed summary)
– Impact assessment was undertaken with predicted odour concentrations compared with the NSW EPA guidance

4.2 Odour sampling

Ektimo conducted odour sampling of the pump station on the morning of 21 January 2022. The samples were taken during the time of morning pump station peak flows, which would likely correspond with the highest odour emissions.

The PBPS has two stacks, one is a 200 mm (measured 170 mm internal diameter) HDPE 3 m high vent stack which discharges air from the odour extraction fan vent. Based on the site odour sampling, this was the main source of air and odour. The second is a 150 mm vent stack 6 m high with rotating ventilator which Did not have any flow at the time of sampling. Given that there is forced ventilation of the PBPS through the main stack, it is assumed that the flow and therefore odour emissions from the second stack would not be significant unless under upset conditions where the main stack ventilation fan fails.

Odour sampling has been conducted of the main vent stack only, the results of which are shown in Table 4.1. A total of four odour samples were taken over two time periods during peak morning sewage flow (test 1 at 8:02-8:22 and test 2 8:30-8:50).

The odour sampling report is provided in Appendix B.

Table 4.1 Summary of sampling results

Test	Odour concentration (OU)	Flow rate (m^3/min)	Velocity (m/s)	Odour emission rate (OU.m^3/min)	Temperature (C)
Test 1A	3300	41.4	34	140,000	24
Test 1B	3900	41.4	34	160,000	24
Test 2A	4200	40.2	33	170,000	24
Test 2B	3600	40.2	33	140,000	24
The sampling report noted that the main stack had a rain cap.					

4.3 Emissions inventory

Based on the results of odour sampling and the supplied pump station design information, an emissions inventory has been prepared for use in dispersion modelling. The average of all four odour samples has been used and based on the time of the sampling, represents a typical worst-case odour from the pump station. Subsequent modelling (refer Appendix A for methodology) has conservatively assumed this same odour emission rate occurs 24 hours a day, although odours would drop considerably during times of lower pump station flows.

A peak to mean (P/M) scaling factor of 2.3 has been used to scale up the odour emission rate used in modelling, to account for the estimation of short or peak odour concentrations on a time scale of one second or less. This

factor assumes a wake affected point source due to stack being only 3 metres tall with a rain cap and small odour extraction building adjacent (refer Table 6.1, Approved Methods).

The odour and stack parameters used in the assessment and modelling are provided below in Table 4.2.

Table 4.2 Modelled source parameters

Test	Height (m)	Diameter (mm)	Flow rate (m^3/min)	Velocity (m/s)	Temperature (C)	Odour emission rate (OU.m^3/min)	Modelled odour emission rate (OU.m^3/min)
Test 1A	3	170	41.4	34	24	140,000	322,000
Test 1B	3	170	41.4	34	24	160,000	368,000
Test 2A	3	170	40.2	33	24	170,000	391,000
Test 2B	3	170	40.2	33	24	140,000	322,000
Average				33.5	24	152,500	350,750

4.4 Assessment of predicted impacts

4.4.1 Establishment of project specific objective

For a Level 3 odour assessment, the Technical Framework outlines recommended assessment objective based on the type of facility being assessed (new, existing, upgrading/expanding). For existing facilities, the benchmark for the facility is whether the emission of odour is:

- 'offensive' (for schedules activities), or
- Being prevented or minimised using best management practices (for scheduled and non-scheduled activities).

Comparison of the sites predicted performance against impact assessment criteria outlined in the Technical Framework is a valuable tool in understanding the spatial variation in potential off-site impacts, expected level of risk as well as providing a baseline for future plant modifications or future developments surrounding the source of odour. The odour criteria range from 2 odour units (OU) for densely populated areas up to 7 OU for single isolated residences and can be seen in Table 4.3.

Table 4.3 Odour assessment criteria

Population of affected community	Odour performance criteria (OU) (nose response odour certainty units at 99th percentile[1])
Single Residence (≤ ~2)	7
~ 10	6
~ 30	5
~ 125	4
~ 500	3
Urban (≥~2,000)	2

Note 1: This is a prediction of the odour level that may occur 1% of the time, or one hour in one hundred. Odour performance criteria are designed to be precautionary, so that impacts on sensitive receivers can be minimised

The nearest proposed facility to the PBPS is the training camp made up of three buildings which include 28 accommodation units and general facilities, located approximately 150 metres southeast of the PBPS. This is assumed to accommodate less than 125 people at any one time and as such an odour criteria of 4 OU would be most appropriate to determine the potential impact from the PBPS on this development.

4.4.2 Predicted impacts

The results of the odour modelling and assessment are provided below in Table 4.4. All results are the 99th percentile peak odour concentration as per the Technical Framework guidance.

The results show that predicted odour from the PBPS is well below the assumed criteria at the proposed development site of the training camp.

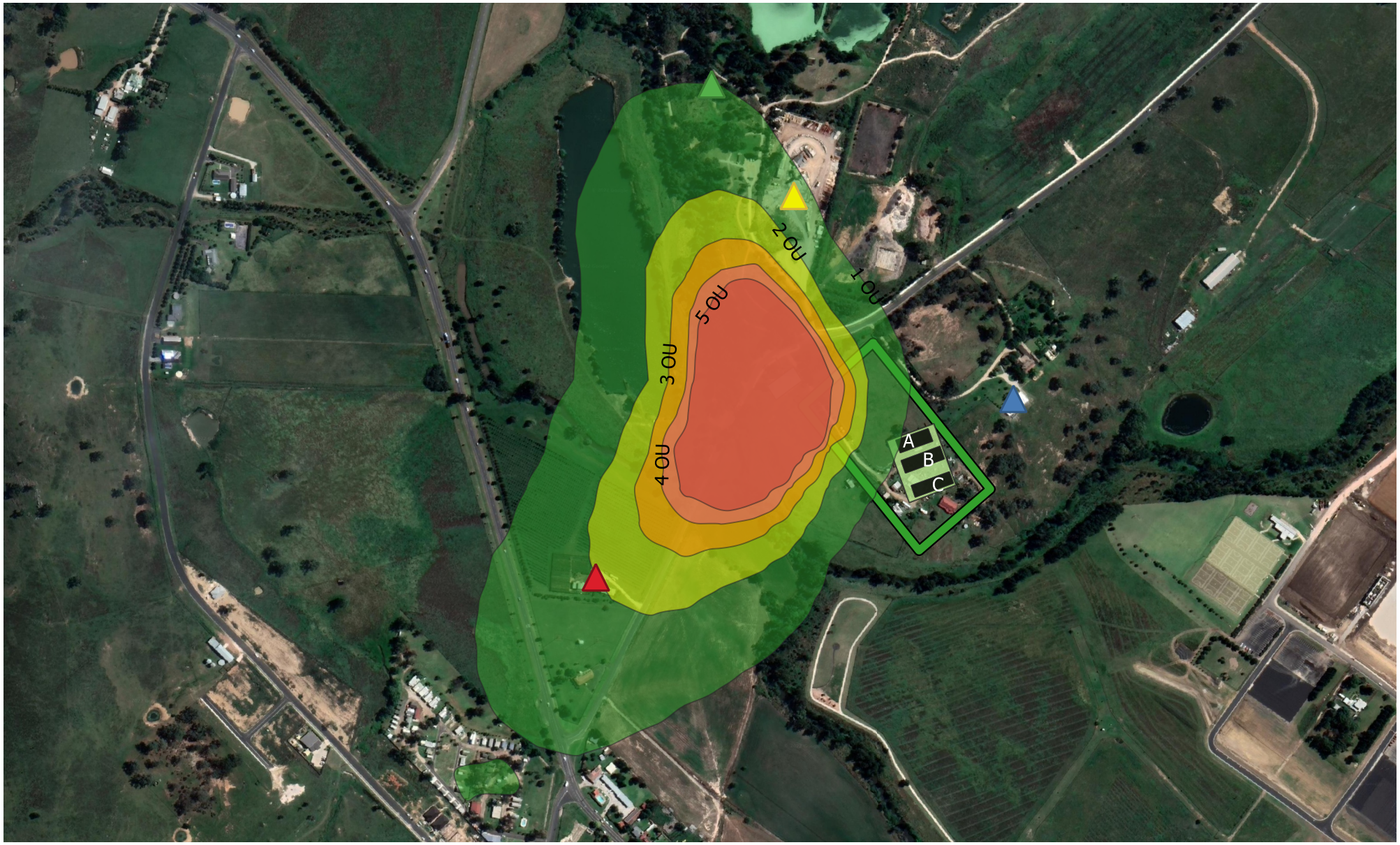
Table 4.4 Predicted odour concentration at sensitive receptors

Sensitive receptor	Predicted odour concentration (OU)	Odour concentration criteria (OU)
Proposed development site	0.9	4
Putta Bucca House	0.3	4
Nearest residence (21 Putta Bucca Rd)	1.9	4
Putta Bucca wetlands	1.3	4

A contour plot for the predicted peak 99th percentile odour concentration is shown in Figure 4.1 below. The following observations are made:

- The predicted plume dispersion extends further to the north and south rather than to the east and west of the PBPS, most likely due to meteorological effects.
- The 4 OU criteria is not exceeded at the development site, nor is the more stringent 2 OU criteria for densely populated areas.

The peak 99th percentile concentration predicted within a residential land use is approximately 1.9 OU, at an isolated dwelling at 21 Putta Bucca Road. As no recent complaints (none in the last 10 years) have been lodged, it is assumed odour at this location is not offensive. The predicted odour concentration at the development site is lower than that at this residence.



Legend

- Concrete batching plant
- Putta Bucca House
- Putta Bucca Wetlands
- Nearest residence
- Buildings
- Development
- Site boundary (indicative)

Paper Size ANSI A

0 100 200 m

N

Map Projection: Mercator Auxillary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxillary

GHD

MID-WESTERN REGIONAL COUNCIL
PATTA BUCCA RD
PUMP STATION

PREDICTED PEAK ODOUR CONCENTRATION FROM PBPS (1hour 99th percentile)

Project No. **12564732**
Revision No. **0**
Date. **18/02/2022**

FIGURE 4.1

Document Path: C:\Users\jpotgieter2\Desktop\Putta Bucca\QGIS\Patta Bucca.qgz

Print Date: 18/02/2022

Data Source: World imagery - GoogleEarthSatellite

Created By: Julia Potgieter

5. Conclusion

An odour assessment has been completed to assess the impact of the PBPS on the proposed training camp located at Lot 2 DP1252505 Putta Bucca Road, Mudgee. A Level 3 odour assessment has been completed in accordance with the 'Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW' (DEC, 2006).

Odour emission data and discharge parameters for the stack source were sampled by Ektimo during the morning peak pump station flow which would correspond with higher odours.

A conservative odour emissions inventory was developed which assumes sampled odours occur 24 hours a day and was used in conjunction with a site-representative meteorological file to complete odour dispersion modelling.

Based on the assessment completed in this report, the following are concluded:

- An analysis of complaints history has shown a single instance where a lodged complaint may be attributed to odorous emissions from the PBPS and no further complaints have been lodged since equipment upgrades have been completed in 2012. As such it is concluded that the existing facility is not contributing to a significant loss of amenity at off-site receptors due to emission of odours.
- Dispersion modelling predictions for PBPS do not exceed the peak 99th percentile 4 OU impact assessment criteria at any existing receptors nor at the proposed development site to the southeast. The maximum predicted odour concentration at a residential land use is approximately 2 OU.

Based on the findings of this assessment, odour from the pump station is not expected cause significant odour impacts on the training camp and the site would be considered suitable from an odour perspective.

6. References

DEC NSW. (2006, November). Technical Framework Assessment and management of odour from stationary sources in NSW. Sydney: Department of Environment and Conservation NSW.

NSW EPA. (2016, November). Approved Methods for the Modelling and Assessment of AIr Pollutants in New South Wales. *NSW Government Gazette of 26 August 2005, minor revisions November 2016*. Sydney.

TWS. (2013). Drg-04A Existing Pump Well and New Valve Pit Section. *Mudgee Sewerage Augementation Putta Bucca PS Upgrade*.

Appendix A

Modelling Methodology

A-1 Meteorological modelling

A-1-1 Model configuration

Key meteorological input data for the assessment was from the Mudgee Airport AWS operated by BoM approximately 4.1 kilometres northeast of the PBPS.

The AERMET model was used to develop the meteorological grid for subsequent use in dispersion modelling. The model was run over 5 years from 01 January 2016 to 31 December 2020. Surface characteristics were constant for all sectors. Details of albedo, bowen ratio and surface roughness are presented in Table 6.1.

Table 6.1 Surface characteristics around the PBPS

	Albedo	Bowen Ratio	Surface Roughness
January	0.171	0.725	0.14
February	0.171	0.725	0.14
March	0.171	0.985	0.14
April	0.171	0.985	0.14
May	0.171	0.985	0.14
June	0.188	0.985	0.14
July	0.188	0.985	0.14
August	0.188	0.985	0.14
September	0.171	0.505	0.14
October	0.171	0.505	0.14
November	0.171	0.505	0.14
December	0.171	0.725	0.14

1-1-1 Local wind field

The local meteorology largely determines the pattern of off-site air quality impacts on receptors. The effect of wind on dispersion patterns can be examined using the wind distributions at the subject site. The winds at a site are most readily displayed by means of a wind rose. Figure 3.2 shows the annual average wind rose for the site for the years 2016-2020.

A-2 Dispersion modelling

The air quality dispersion modelling was conducted in accordance with the Approved methods for modelling and assessment of air pollutants in NSW (EPA, 2016), using the US EPA regulatory Gaussian air dispersion model, AERMOD. Details of the model configuration are outlined below:

- Model: AERMOD Version 9.8.3
- The years 2016-2020 were modelled.
- A Cartesian receptor grid was modelled with 50 grids in each direction, 50 metre grid resolution.
- The modelled source was located at an easting of 741,617.5 metres and a northing of 6,392,461.0 metres, and a base elevation of 446.1 metres (WGS 84 UTM Zone 55)
- Emission rates were modelled as constant throughout the model period to capture worst-case emission rates through the period.
- Modelling was completed for a 1-hour timestep. To assess against peak (nose-response time) concentrations, a peak-to-mean ratio of 2.3 was applied.
- A rain-cap was modelled at the main stack, effectively reducing plume exit velocity to 0 m/s
- The 99th percentile value was extracted at each receptor location for assessment against the relevant criteria. The 99th percentile represents the level where the presented odour concentration is exceeded for 1% of the model duration, and as such represents the assessment of reasonably worst-case impacts from the PBPS.

Appendix B

Odour Sampling Report

Ektimo

GHD Pty Ltd

Odour Testing Report

Mudgee Putta Bucca SPS Main Stack

Report Number R011907

Document Information

Template Version 211117

Client Name:	GHD Pty Ltd
Report Number:	R011907
Date of Issue:	3 February 2022
Attention:	Danny Craggs
Address:	380 Lonsdale Street SYDNEY NSW 3000
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Aaron Davis
Senior Air Monitoring Consultant

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation. This does not include comments, conclusions or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 Executive Summary

1.1 Background

Ektimo was engaged by GHD Pty Ltd to perform odour emission testing at the Mudgee Putta Bucca SPS facility.

1.2 Project Objective

The objective of the project was to quantify odour emissions from 1 discharge point on two occasions (in duplicate) during morning peak sewage flow.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
Mudgee Putta Bucca SPS Main Stack	21 January 2022	Odour (Test 1 of 2 in duplicate) Odour (Test 2 of 2 in duplicate)

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP (except odour wet – STP).

2 Results Summary

A summary of results can be seen below.

Mudgee Putta Bucca SPS Main Stack. 21 January 2022						
	Average		T 1		T 2	
	Odour Concentration ou	Odourant Flow Rate oum³/min	Odour Concentration ou	Odourant Flow Rate oum³/min	Odour Concentration ou	Odourant Flow Rate oum³/min
Test 1 (0802 - 0822)	**3,600**	**150,000**	3,300	140,000	3,900	160,000
Test 2 (0830 - 0850)	**3,900**	**160,000**	4,200	170,000	3,600	140,000

3 Results

3.1 Mudgee Putta Bucca SPS Main Stack (Test 1)

Date	21/01/2022	**Client**	GHD Pty Ltd (NSW)
Report	R011907	**Stack ID**	Mudgee Putta Bucca SPS Main Stack
Licence No.	-	**Location**	Mudgee
Ektimo Staff	Scott Woods	**State**	NSW
Process Conditions	Sampling conducted during morning peak flow		*220120*

Sampling Plane Details	
Sampling plane dimensions	170 mm
Sampling plane area	0.0227 m²
Sampling port size, number	2" BSP (x1)
Access & height of ports	Ground level 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 5 D
Upstream disturbance	Junction 6 D
No. traverses & points sampled	1 1
Sample plane conformance to AS4323.1 (2021)	Conforming but non-ideal

Comments
Test 1 of 2
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.14	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0800 & 0825	
Temperature, °C	24	
Temperature, K	297	
Velocity at sampling plane, m/s	34	
Volumetric flow rate, actual, m³/s	0.78	
Volumetric flow rate (wet STP), m³/s	0.69	
Volumetric flow rate (dry STP), m³/s	0.67	
Mass flow rate (wet basis), kg/hour	3200	

Odour	Average		Test 1		Test 2	
Sampling time			0802 - 0822		0802 - 0822	
	Concentration ou	Odourant Flow Rate oum³/min	Concentration ou	Odourant Flow Rate oum³/min	Concentration ou	Odourant Flow Rate oum³/min
Results	3600	150000	3300	140000	3900	160000
Lower uncertainty limit	2800		2400		2800	
Upper uncertainty limit	4600		4600		5500	
Analysis date & time			21/01/22, 1502-1555		21/01/22, 1502-1555	
Holding time			7 hours		7 hours	
Dilution factor			1		1	
Bag material			Nalophan		Nalophan	
Butanol threshold (ppb)	49					
Laboratory temp (°C)	21					
Last calibration date	October 2021					

3.2 Mudgee Putta Bucca SPS Main Stack (Test 2)

Date	21/01/2022	**Client**	GHD Pty Ltd (NSW)
Report	R011907	**Stack ID**	Mudgee Putta Bucca SPS Main Stack
Licence No.	-	**Location**	Mudgee
Ektimo Staff	Scott Woods	**State**	NSW
Process Conditions	Sampling conducted during morning peak flow		220120

Sampling Plane Details	
Sampling plane dimensions	170 mm
Sampling plane area	0.0227 m²
Sampling port size, number	2" BSP (x1)
Access & height of ports	Ground level 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 5 D
Upstream disturbance	Junction 6 D
No. traverses & points sampled	1 1
Sample plane conformance to AS4323.1 (2021)	Conforming but non-ideal

Comments
Test 2 of 2
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.14	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0825 & 0855	
Temperature, °C	24	
Temperature, K	297	
Velocity at sampling plane, m/s	33	
Volumetric flow rate, actual, m³/s	0.76	
Volumetric flow rate (wet STP), m³/s	0.67	
Volumetric flow rate (dry STP), m³/s	0.66	
Mass flow rate (wet basis), kg/hour	3100	

Odour	Average		Test 1		Test 2	
Sampling time			0830 - 0850		0830 - 0850	
	Concentration ou	Odourant Flow Rate oum³/min	Concentration ou	Odourant Flow Rate oum³/min	Concentration ou	Odourant Flow Rate oum³/min
Results	3900	160000	4200	170000	3600	140000
Lower uncertainty limit	3100		3000		2600	
Upper uncertainty limit	5000		5900		5000	
Analysis date & time			21/01/22, 1502-1555		21/01/22, 1502-1555	
Holding time			6 hours		6 hours	
Dilution factor			1		1	
Bag material			Nalophan		Nalophan	
Butanol threshold (ppb)	49					
Laboratory temp (°C)	21					
Last calibration date	October 2021					

4 Plant Operating Conditions

See Mudgee Putta Bucca SPS records for complete process conditions.

5 Test Methods

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sampling points - Selection	NSW EPA TM-1	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW EPA TM-2	NSW EPA TM-2	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22	NSW EPA TM-22	8%	✓	✓
Molecular weight	NA	NSW EPA TM-23	not specified	NA	✓
Dry gas density	NA	NSW EPA TM-23	not specified	NA	✓
Odour	NSW EPA OM-7	NSW EPA OM-7	refer to results	✓	✓¥
Odour characterisation	NA	direct observation	NA	NA	×

211208

* Uncertainties cited in this table are estimated using typical values and are calculated at the 95% confidence level (coverage factor = 2).

¥ Odour analysis conducted at the Unanderra, NSW laboratory by forced choice olfactometry, NATA accreditation number 14601. Results were reported on 21 January 2022 in report ON-00116

5.1 Deviations to Test Methods

Deviation from analytical method: Due to COVID-19 social distancing requirements, the minimum number of panellists stipulated in AS4323.3 of four (4) cannot be adhered to. Three (3) panellists were used and the number of dilution series for each sample was increased to achieve comparable calculated uncertainty and meet the minimum ITE requirement (8) of the method.

6 Quality Assurance/Quality Control Information

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APAC (Asia Pacific Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through mutual recognition arrangements with these organisations, NATA accreditation is recognised worldwide.

7 Definitions

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American Public Health Association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM/CEMS	Continuous Emission Monitoring/Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone is defined as the particle diameter at which the cyclone achieves a 50% collection efficiency i.e. half of the particles are retained by the cyclone and half pass through it. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety Committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
ITE	Individual threshold estimate
Lower bound	When an analyte is not present above the detection limit, the result is assumed to be equal to zero.
Medium bound	When an analyte is not present above the detection limit, the result is assumed to be equal to half of the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	Odour unit. One OU is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis. PSA provides a distribution of geometric diameters, for a given sample, determined using laser diffraction.
RATA	Relative accuracy test audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration is determined by matching the area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test method
TOC	The sum of all compounds of carbon which contain at least one carbon-to-carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity difference	The percentage difference between the average of initial flows and after flows.
Vic EPA	Victorian Environment Protection Authority
VOC	Volatile organic compound. A carbon-based chemical compound with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the given conditions of use. VOCs may contain oxygen, nitrogen and other elements. VOCs do not include carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray diffractometry
Upper bound	When an analyte is not present above the detection limit, the result is assumed to be equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

8 Appendix 1: Site Location Photo

Mudgee Putta Bucca SPS Main Stack

Ektimo

ektimo.com.au
1300 364 005

MELBOURNE (Head Office)
26 Redland Drive
Mitcham
VIC 3132
AUSTRALIA

SYDNEY
6/78 Reserve Road,
Artarmon
NSW 2064
AUSTRALIA

WOLLONGONG
1/251 Princes Highway
Unanderra
NSW 2526
AUSTRALIA

PERTH
52 Cooper Road
Cockburn Central
WA 6164
AUSTRALIA

BRISBANE
3/109 Riverside Place
Morningside
QLD 4170
AUSTRALIA

ghd.com

The Power of Commitment