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Shoalhaven Starches, Independent Odour Audit (2021-2022)

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Quality Control

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ODOUR AUDIT EVIDENCE	Final	GCG	MD	GCG
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Report Status

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Final Authority

This report must by regarded as draft until the above study components have been each marked as final, and the document has been signed and dated below.

G. Graham **20 October 2022**

Contents

1. INTRODUCTION ... 6
1.1. Auditing Period ... 6
1.2. Consultation ... 7
1.2.1. Environment Protection Authority (EPA) ... 7
1.2.2. Department of Planning and Environment (DPE) ... 8
1.3. Site Inspection ... 8
1.4. Field Ambient Odour Assessment ... 9
2. ODOUR AUDIT REQUIREMENTS ... 10
2.1. Audit Procedure ... 10
2.2. Audit Compliance Status Descriptors ... 10
2.3. Audit Recommendations ... 11
2.4. Consolidated Odour Conditions and Summary of Compliance ... 11
3. ODOUR AUDIT EVIDENCE ... 12
3.1. Review of Management Plans ... 12
3.1.1. Odour Management Plan ... 12
3.1.2. Pollution Incident Response Management Plan (Updated 2021) ... 13
3.2. Odour Complaints ... 14
3.3. Review of Production Data ... 14
3.4. Independent Environmental Audit ... 15
3.5. Biofilter Capacity and Condition Assessments ... 16
3.6. Odour Monitoring Results ... 17
3.6.1. Process Conditions during the Monitoring ... 17
3.6.2. Summary of Measurements – Annual Testing ... 17
3.6.3. Summary of Measurements – Quarterly Testing ... 18
3.6.4. Variability of Measurements ... 21
3.7. Odour Modelling ... 24
4. ODOUR AUDIT FINDINGS ... 34
5. SUMMARY ... 45

5.1. Identified Non-Compliances 45

5.2. Recommendations 45

Appendices

Appendix A – Director General's Letter of Appointment

Appendix B – Biofilter Photographs

Appendix C – DDG Biofilter & Capacity & Condition Assessment Reports

Appendix D – Annual and Quarterly Odour Emission Surveys

Appendix E – Odour Modelling Assessment

Appendix F – Odour Complaint Records

Tables

Table 1	Odour audit compliance criteria	11
Table 2	Odour complaints	14
Table 3	Odour monitoring and production rates	15
Table 4	Biofilter capacity and condition report (#25) – operating parameters	16
Table 5	Biofilter capacity and condition reports – odour measurements	16
Table 6	Summary of annual odour monitoring results	18
Table 7	Summary of quarterly odour monitoring results	19
Table 8	Observed variability in the measured odour emission rate (by quarter)	21
Table 9	Observed variability in the measured odour emission rate (by audit year)	22
Table 10	Observed variability in the measured odour concentration and volumetric discharge rate	23
Table 11	Summary of odour modelling results (MOD 21) (99th percentile 1-second OU)	28
Table 12	Summary of odour modelling results (MOD 23) (99th percentile 1-second OU)	29
Table 13	Consolidated odour conditions and summary of compliance (MOD 16, Schedule 3)	35
Table 14	Independent odour audit non-compliances	45
Table 15	Independent odour audit recommendations	45

Figures

Figure 1	Data sources audited in this audit period	7
Figure 2	Variation in measured emission rates (range and mean)S	22
Figure 3	Comparison of measured and modelled odour emission rates	28
Figure 4	Ground level odour predictions (MOD 21) (GHD, Nov 2021)	31
Figure 5	Ground level odour predictions (MOD 23) (GHD, Jan 2022)	33

Units Used in the Report

All units presented in the report follow the International System of Units (SI) conventions, unless derived from references using non-SI units. In this report, units formed by the division of SI and non-SI units are expressed as a negative exponent, and do not use the solidus (/) symbol.

For example, 20 odour units cubic metres per second would be presented as 20 $OU \cdot m^3 \cdot s^{-1}$ and not 20 $OU \cdot m^3/s$.

1. INTRODUCTION

Shoalhaven Starches Pty Ltd (on behalf of the Manildra Group) has engaged Gary Graham, Director of Northstar Air Quality Pty Ltd (Northstar) to perform the independent odour audit (2021-2022) of the Shoalhaven Starches Facility (the facility) which operates at Bolong Road, Bomaderry, NSW.

As stipulated in the NSW Government (May 2020) *Independent Audit – Post Approval Requirements* (DPIE, 2020) I, Gary Graham, confirm that I am independent of Shoalhaven Starches as determined under Section 3.1.1 of the above guidance.

I have completed an Independent Audit Declaration Form, and this is attached in **Appendix A** of this report.

The requirement for an Independent Odour Audit is prescribed within Schedule 3 of the consolidated conditions of Project Approval 06_0228. For clarity, the consolidated conditions are reproduced in their entity in **Table 13** (**Section 4**), with a reference to the sections of the report that provide evidence and commentary on the compliance (or otherwise) with each condition related to odour.

1.1. Auditing Period

This odour audit covers the period from Q1 2021/22 to Q4 2021/22, aligned to the EPL reporting period. With reference to the NSW Environment Protection Authority (EPA) website[1], it is noted that anniversary date for EPL 883 is stated as 30 April. Correspondingly, this report covers the period from 1 May 2021 to 30 April 2022.

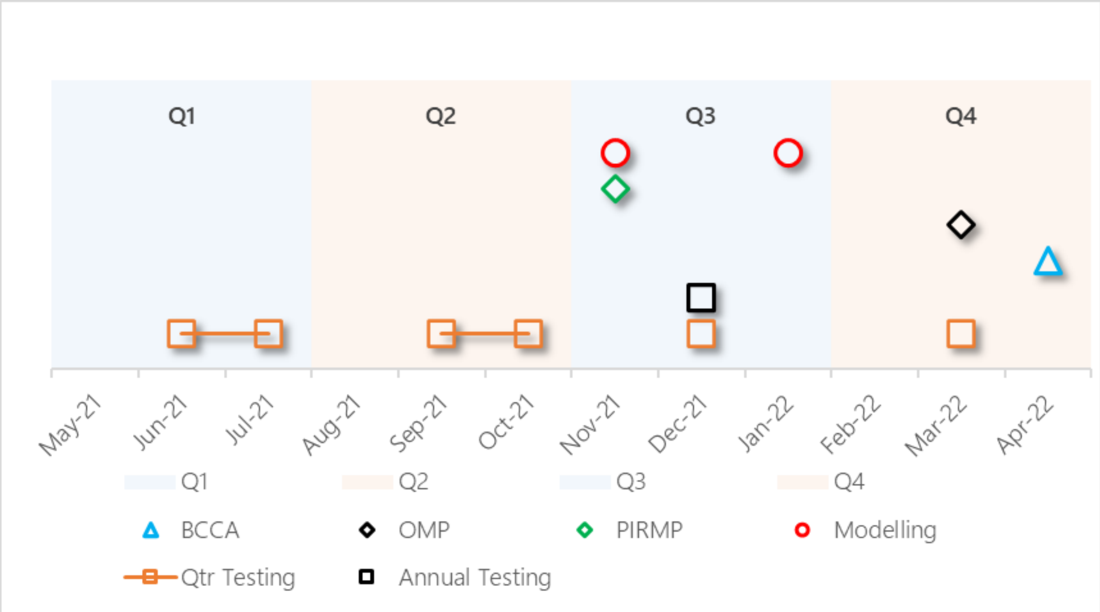
The quarters of the reporting year covered by this audit are therefore:

- Quarter 1 (Q1): May 2021 to July 2021;
- Quarter 2 (Q2): August 2021 to October 2021;
- Quarter 3 (Q3): November 2021 to January 2022; and
- Quarter 4 (Q4): February 2022 to April 2022.

The various reports relating to plant performance and odour emissions (including the quarterly and annual odour emissions test, biofilter capacity and condition assessments, management plans and modelling assessments) are discussed in the relevant sections of this audit report, and for ease of understanding how these data sources relate to the audit period, a summary has been provided in **Figure 1**.

[1] http://www.epa.nsw.gov.au/prpoeoapp/

Figure 1 Data sources audited in this audit period



Notes: BCCA – Biofilter Capacity and Condition report, Qtr Testing – Quarterly odour source monitoring, OMP – Odour Management Plan, Annual testing – Annual odour source monitoring, PIRMP – Pollution Incident and Response Management Plan, Modelling – Odour modelling

1.2. Consultation

As required under Condition 5, consultation with the relevant regulatory bodies (EPA and NSW Department of Planning and Environment [DPE]) was performed as part of this odour audit.

1.2.1. Environment Protection Authority (EPA)

The EPA was contacted by email on 13 October 2022 and a telephone conversation was held on 19 October 2022. Confirmation of that discussion was received from Amanda Fletcher on 19 October 2022, which is reproduced below:

> *"Thanks for your time today. As discussed, the EPA has the following comments.*
>
> - *The purpose of the odour PRP on the licence is for Shoalhaven Starches to provide an update on the odour controls at the premises and provide a baseline which will assist with assessing future modifications. The PRP comes from EPA's assessment of Modification 21, where EPA identified several deficiencies in the AQIA. It was decided, in consultation with Shoalhaven Starches, that some of EPA's comments would be addressed outside of the planning process as the PRP.*

- *The EPA has received three odour complaints from surrounding neighbours regarding odour from the WWTP. These odour complaints related to offensive odour detected by the various complainants on 25 July, 2 August and 5 August 2022. Following discussion with Shoalhaven Starches, the EPA understands that the odour source was excess biogas that was being produced at the WWTP due to the fluctuation in quality of the effluent. The EPA further understands that Shoalhaven Starches are looking into ways to address the excessive biogas production."*

On 27 July 2022, (i.e. outside of the odour audit period), NSW EPA issued Notice 1619775 to vary EPL 883 to include Condition U2: Odour Pollution Reduction Study (Stage 1), the "PRP" discussed above by EPA. The performance of the PRP will be addressed in the 2022-23 independent odour audit. Reference should also be made to the performance of an independent field ambient odour assessment as discussed in **Section 1.4**, and reported separately in Northstar report 22.1126.FR2V1.

The odour complaint dates provided by NSW EPA will also be captured in the 2022-23 independent audit period.

1.2.2. Department of Planning and Environment (DPE)

DPE was contacted by email on 13 October 2022 and provided a response on 19 October 2022, including the following comment:

> *"The Department has no new issues to raise regarding the odour audit for the Shoalhaven Starches facility.*
>
> *However, the Department notes past issues with the site regarding elevated odour emissions levels and the continued development and upgrades of the site which the Department recommends scrutinising further in the Odour Audit."*

The odour performance of the site is determined by the results of the quarterly and annual odour emissions testing, which are discussed in **Section 3.6**. The variability of the odour emissions results is presented in **Section 3.6.4**.

1.3. Site Inspection

A site inspection was performed on 1 August 2022. The site inspection was facilitated by John Studdert (Manildra) and attended by Gary Graham and Nick Phillips-Glyde (Northstar). The purpose of Nick Phillips-Glyde participation in the site visit was to gain familiarity with the different characteristics of odour emissions from the various processes performed across the site, and facilitate off-site odour observations as part of a field ambient odour assessment (FAOA) (see **Section 1.4**).

1.4. Field Ambient Odour Assessment

On 27 July 2022, (i.e. outside of the odour audit period), NSW EPA issued Notice 1619775 to vary EPL 883 to include Condition U2: Odour Pollution Reduction Study (Stage 1).

Condition U2.2 required the following:

> *"The licensee must engage a suitably qualified independent person to undertake a minimum of (3) field odour surveys, at least one week apart. These must at a minimum:*
>
> *a) Characterise the frequency, intensity, duration, offensiveness, location and extent of any off-site odours.*
>
> *b) Be undertaken during hours when poor dispersion and/or peak odour emissions are expected.*
>
> *Findings and conclusions from the odour survey must be presented in the context of the activities being undertaken at the time the odour survey was conducted."*

Simultaneously with the performance of this annual odour audit, Northstar was commissioned to perform a series of four (4) independent field ambient odour surveys. This has been performed independently and in accordance with the requirements specified in EPL 883 Condition U2.2. This stand-alone component has been reported under separate cover to this audit report (ref: 22.1126.FR2V1) (Northstar, 2022).

2. ODOUR AUDIT REQUIREMENTS

2.1. Audit Procedure

The procedure followed during the audit was derived from NSW Department of Planning and Environment (2020) Independent Audit – Post Approval Requirements (PAR) (DPIE, 2020). The requirements for an audit are prescribed in Appendix B of the PAR:

> *"The Audit Table must set out the following information for each requirement to be complied with (compliance requirement):*
>
> 1. *condition of consent number;*
> 2. *the exact wording of the compliance requirement;*
> 3. *a blank column to record the evidence used to assess and determine whether each requirement has been complied with;*
> 4. *a blank column for commentary on findings and recommendations;*
> 5. *a blank column for recording the status of compliance, and*
> 6. *a unique identification non compliance number."*

The methodology adopted in this audit has followed this guidance. An additional column 'recommendations / actions' has been included to discuss remedial actions and/or recommendations where necessary, as required under Section 4.2.4 of the guidance.

For each **non-compliance,** a unique identification number (UIN) has been assigned as required under the PAR (DPIE, 2020). As this odour audit is against the conditions presented in Schedule 3 of the Consolidated Conditions of Project Approval (MOD 19), each UIN has been labelled as **21/22-NC-n** where *n* is the Condition Number derived from MOD 21 and replicated in the first column of **Table 13**. Reference to UINs in previous odour audit reports will adopt the same nomenclature as previously reported (as sequential numbers rather than condition numbers) to avoid any confusion.

2.2. Audit Compliance Status Descriptors

As presented in NSW Government (DPIE, 2020) *Independent Audit – Post Approval Requirements*, the criteria outlined in **Table 1** have been adopted for the independent odour audit:

Table 1 Odour audit compliance criteria

Status	Description
Compliant	The auditor has collected sufficient verifiable evidence to demonstrate that all elements of the requirement have been complied with within the scope of the audit.
Non-compliant	The auditor has determined that one or more specific elements of the conditions or requirements have not been complied with within the scope of the audit.
Not triggered	A requirement has an activation or timing trigger that has not been met during the temporal scope of the audit being undertaken (may be a retrospective or future requirement), therefore an assessment of compliance is not relevant.

The following is also noted:

> *"The terms partial compliance, partial non-compliance, not verified or administrative non-compliance or other similar terms must not be used.*
>
> *As part of the Audit evaluation, the auditor may make observations, including identifying any opportunities for improvement in relation to any compliance requirement or any other aspect of the project. Any observations or notes are in addition to the compliance status descriptor assigned to each compliance requirement, limited to the descriptors listed in Table 2* (as reproduced in **Table 1**).

2.3. Audit Recommendations

Where recommendations are noted, these are expressed in **Section 3** and are not replicated in **Section 4** which relates to the compliance with the Consolidated Conditions of Project Approval only. These are designated identifiers as **21/22-REC-x** (where x is a sequential letter designator) and do not carry the Condition reference to avoid compliance issues. Recommendations are provided for any observed opportunity for improved odour performance and are not solely related to compliance with the Consolidated Conditions of Project Approval.

2.4. Consolidated Odour Conditions and Summary of Compliance

Section 4 and **Table 13** below presents a list of odour conditions, as prescribed in Schedule 3 of the Consolidated Conditions of Project Approval.

These conditions have been repeated *verbatim* and are accompanied with a summary of the sections of this report that provide additional evidence and commentary, and a summary of compliance (or otherwise) with that specific condition.

3. ODOUR AUDIT EVIDENCE

3.1. Review of Management Plans

As required to comply with Condition 5d of PA 06_0228, the odour management plan has been reviewed, including:

- Shoalhaven Starches (2019) Shoalhaven Starches Ethanol Upgrade Odour Management Plan (ref: EN-P-247 1.0.F. Aug 2019) (TOU, Aug 2019)
- Shoalhaven Starches (2022) Shoalhaven Starches Ethanol Upgrade Odour Management Plan (ref: EN-P-247 1.0.G. Mar 2022) (TOU, Mar 2022)
- Shoalhaven Starches (2022) Shoalhaven Starches Ethanol Upgrade Odour Management Plan (ref: EN-P-247 1.0.H. July 2022) (TOU, July 2022); and
- Shoalhaven Starches (2020) Pollution Incident Response Management Plan (ref: EN-P-248 1.0.L. Nov 2021).

3.1.1. Odour Management Plan

The versions of the Odour Management Plan (OMP) in force during the audit period were revisions 1.0.F (Aug 2019) which was reviewed and replaced by version 1.0.G during March 2022, at the end of this audit period. Version 1.0.H has also been provided but this will relate to the 2022/23 audit period.

Subsequent to the last odour audit it is noted that there have been no updates to the OMP between versions 1.0.F and 1.0.G.

At the request of NSW EPA during the 2020/21 audit, the odour complaint procedure presented in the OMP has been reviewed, to facilitate a review of how the reported complaints have been recorded and responded to.

The procedure for responding to odour complaints is presented in section 4.3.1 of the OMP (ref: EN-P-247 1.0.F, 30-Aug-2019):

1. *The Environmental Complaints Handling procedure must reflect the requirements of Licence No. 883 set out in sections M5 of the licence.*
2. *The Environmental Manager and Site Manager have ownership of the system and have authority and responsibility to ensure that necessary corrective actions are taken.*
3. *Environmental complaints can be received through any of the following avenues:*
    a. *Environment Protection Authority (EPA)*
    b. *24 hour a day complaints hotline*
    c. *Ringing main office*
4. *The following procedure is followed when a complaint is received:*
    a. *All environmental complaints must be directed immediately to the Environmental Manager.*

b. *If the Manager is not available, then directed to Farm Manager and then if not available to the Site Manager.*
c. *The following details are recorded (where given by the complainant) in the Environmental Complaints Database*
    i. *Name of complainant and contact details (if they want to be identified). Details are required to enable Shoalhaven Starches to report back to the person once the complaint is investigated.*
    ii. *Nature of complaint – noise, dust/smoke, odour, spill, incident etc*
    iii. *Duration of the problem (dates and times)*
d. *The Environmental Manager then investigates the complaint and if applicable initiates corrective action. This information is recorded in the Environmental Complaints Database.*
e. *Once the investigation is complete, the details are give to the Quality Assurance department and the details entered into the Environmental Complaints section in the Fastrack Document Control system.*
f. *A copy of the complaint is forwarded to the Site Manager and relevant Plant Manager as required.*

5. *Details of complaints received direct from the EPA are sent to the Environmental Manager for investigation and dealt with as per the above procedure.*
6. *If the complaint is the same as one received directly by the company, then the EPA reference Number is added to the existing complaint (hence so doubling up does not occur).*
7. *Environmental Complaints are reviewed on an annual basis as part of the company's Annual Environmental Report. This annual review includes comparison with previous years.*

3.1.2. Pollution Incident Response Management Plan (Updated 2021)

The version of the PIRMP relevant to the audit period is revision 1.0.L (Nov 2021) which supersedes version 1.0.K which was audited during the previous independent odour audit.

The document revision record on p2/33 of the PIRMP outlines the changes as:

> *"updates to section 1 and section 10 contact. Addition of Appendix A site stormwater management plan"*

The following observations are noted:

Table 1 should be updated with reference to the relevant sections of the stated Regulation (currently "*Protection of the Environment Operations (General) Regulation 2009, Chapter 7, Part 3A*" which is (a) superseded by the 2021 Regulation (relevant to the audit period) and (b) incorrectly referenced, as the text in the PIRMP is taken from the requirements of 8, Part 4, Section 131(a)-(p) of the 2021 Regulation.

Irrespective, the PIRMP should be updated to reference the relevant requirements of the updated version of the Regulation in due course.

The updates have been reviewed and are not considered to be significant in terms of the Odour Audit.

3.2. Odour Complaints

Odour complaints may be reported through two principal routes: (i) directly as a telephone call to Shoalhaven Starches (via the 24-hr/day hotline or directly to the Environmental Manager); or (ii) indirectly through the EPA.

Table 2 below presents a summary of the odour complaints received over the reporting period with some information relating to the complainant and/or location removed. Details of the complaints recorded from direct calls and response and follow-up are presented in **Appendix F**.

Table 2 Odour complaints

Date / Time	Route	Complaint	Description	Action	Complaint Status
11/10/21	EPA	Odour (064)	Odour complaint was received via EPA on 11 October 2021 from a resident in Bomaderry, Melinda, complaining of "cheese whey smell" detected on the evening of 6 October which persisted for the next two days.	The likely cause of odour was not coming from the Shoalhaven Starches premises but from local farmers applying fertiliser (chook manure) on their land.	Closed

Details of the complaints recorded from direct calls and response and follow-up are presented in **Appendix F**. These have been reviewed with regard to the complaint procedure discussed in **Section 3.1.1**, and no discrepancies have been identified.

3.3. Review of Production Data

As required, a review of the facility's production data at the times of the odour monitoring (refer **Section 3.6**) has been performed.

The production data correspond to the periods of emission testing, as reported in:

- Manildra Ethanol Production Volumes 2021-22 (measurements taken between 7 June 2021 and 22 March 2022).

Copies of the monitoring reports are presented in **Appendix D** of this report. The production volumes relevant to the odour monitoring events are presented in **Table 3**.

Table 3 Odour monitoring and production rates

Quarter	Date of Quarterly Odour Sampling	Daily Ethanol Production (L)	Annual Production Rate Equivalent ($ML \cdot yr^{-1}$)
1	7/06/2021	598 033	218
	8/06/2021	570 000	208
	20/07/2021	460 843	168
	22/07/2021	667 919	244
2	30/09/2021	647 441	236
	5/10/2021	790 590	289
	6/10/2021	793 894	290
	20/10/2021	716 298	261
3	9/12/2021	879 273	321
	14/12/2021	606 441	221
	15/12/2021	824 058	301
	20/12/2021	803 514	293
	21/12/2021	567 245	207
4	17/03/2022	613 366	224
	21/03/2022	803 923	293
	22/03/2022	793 234	290
Minimum		460 843	168
Maximum		879 273	321
Mean		696 005	254
Range (Max/Min)		1.91	1.91

For comparison purposes only, the production rates reported in the 2020-21 independent odour audit report were in the range of 396 159 $L \cdot day^{-1}$ (145 $ML \cdot y^{-1}$) to 707 683 $Lday^{-1}$ (258 $ML \cdot y^{-1}$) with a mean of 581 683 $L \cdot day^{-1}$ 212 $ML \cdot y^{-1}$). The production rates during the 2021-22 audit period were higher than those in the previous year by a factor of around 20 % determined through a comparison of the calculated mean values.

3.4. Independent Environmental Audit

Whilst some developments documented in the independent environmental audit report (Malo Sustainability Consulting (2019) *Independent Environmental Audit*) have a direct implication on the management of odour from the facility, most of the content in the audit report is outside of the scope of the Independent Odour Audit, and no comment is offered. A search of the document did not identify any incomplete recommendations relating to odour control.

3.5. Biofilter Capacity and Condition Assessments

A copy of the DDG Biofilter Capacity and Condition Assessment Reports performed by The Odour Unit over the audit period are presented in **Appendix C**, namely:

- DDG Biofilter Capacity and Condition Assessment #25 – 6 April 2022

The report presented in **Appendix C** has not been replicated in the main body of this audit report but presented below is a summary of the key observations and measurements.

The design airflow of the installed biofilter system is stated as 15 000 $m^3 \cdot hr^{-1}$. The combined inlet flow (main duct + dryer 4 duct) is reported as 21 090 $m^3 \cdot hr^{-1}$ which is 141 % of the design airflow.

The operating conditions of the biofilters are summarised in **Table 4**, and the odour measurements are summarised in **Table 5**.

Table 4 Biofilter capacity and condition report (#25) – operating parameters

Date	Position	Airflow ($m^3 \cdot hr^{-1}$)	RH (%)	Observation	Air Temp (°C)	Surface Temp (°C)	UB Pressure (Pa)
6-Apr-22 (#25)	Main duct	18,210	100%	NR	46.0	NR	220
	DDG bf#2	8,500	100%	saturated	44.6	NR	190
	Dryer 4 duct	2,880	100%	NR	33.0	NR	350
	DDG bf#1	9,600	100%	saturated	44.4	40.6	70

Notes: bf – biofilter

NR – not reported

Table 5 Biofilter capacity and condition reports – odour measurements

Date	BCCA (#)	Inlet (OU)	DDG bf#1 (OU)		DDG bf#2 (OU)		Flow weighted (OU)	Efficiency (%)
			South cell	North cell	South cell	North cell		
6 Apr-22	25	8 930	5 790	6 890	1 330	4 470	8 930	56

Notes: BCCA – biofilter capacity and condition assessment

With reference to **Table 5**, a flow weighted average odour concentration of 8 930 OU was measured which exceeds the *de facto* standard of 500 OU.

Recommendation: 21/22-REC-A

Whilst it is acknowledged that the biofilters are achieving a reasonable degree of odour control (56 % efficacy), the flow-weighted average odour concentration is not achieving the d*e-facto* 500 OU standard. This matter remains an unresolved issue and it is recommended that it is resolved at the earliest opportunity.

3.6. Odour Monitoring Results

The results of the monitoring programs performed over the monitoring period are presented in **Table 6**, **Table 7** and **Table 8**. Copies of the monitoring reports are presented in **Appendix D** of this report.

These data are taken from the following reports:

- Ektimo (2021) R011036 Odour Emission Testing Report Quarter 1 2020-2021 (measurements taken during June and July 2021) (Ektimo, Sep 2021)
- Ektimo (2021) R011744 Odour Emission Testing Report Quarter 2 2020-2021 (measurements taken during September and October 2021) (Ektimo, Jan 2022)
- Ektimo (2021) R12022 Odour Emission Testing Report Quarter 3 2020-2021 (measurements taken during December 2021) (Ektimo, Feb 2022)
- Ektimo (2022) R012511 Odour Emission Testing Report Quarter 4 2020-2021 (measurements taken during March 2022) (Ektimo, Apr 2022)

3.6.1. Process Conditions during the Monitoring

The Ektimo monitoring reports do not present any information regarding plant conditions during the monitoring campaigns. From the monitoring data summary (see Section 3.6.3), it is noted that the following EPL discharge points were not tested:

- EPA ID 42 Boiler 4, during quarter 3; and
- EPA ID 46b DDG Pellet Stack, during quarter 4; and
- EPA ID 20 Effluent Storage Dam 2 and 4, during quarter 3 (including the annual testing requirements.

It is noted that EPA ID 20 Effluent Storage Dam 2 was not tested during the 2021/22 monitoring period, with the previous SEMA odour monitoring report stating that it was "unsafe for sampling".

Recommendation: 21/22-REC-B

It is recommended that the safety issue(s) preventing EPA 20 from being tested are resolved to ensure that EPA 20 is available to be tested during the 2022-2023 period. It is understood that the safety issue is the stability of the dam banks due to the low water levels and the dam is used when all other dams are full.

3.6.2. Summary of Measurements – Annual Testing

Table 6 presents a summary of the annual odour tests over the reporting period, conducted on the effluent storage dams (EPA ID nos 19-24) and the sulphur oxidation pond (EPA ID 25).

Table 6 Summary of annual odour monitoring results

EPA Ref	Location	Frequency	Q3 and Annual (OU)
19	Effluent Storage Dam 1	Annual	37
20	Effluent Storage Dam 2	Annual	nd
21	Effluent Storage Dam 3	Annual	34
22	Effluent Storage Dam 4	Annual	nd
23	Effluent Storage Dam 5	Annual	57
24	Effluent Storage Dam 6	Annual	49
25	Sulphur Oxidation Pond	Annual	41

Note: nd no data. (Ektimo, Feb 2022)

3.6.3. Summary of Measurements – Quarterly Testing

Table 7 presents a summary of the quarterly monitoring results measured over the reporting period. The table has been presented by source (EPA source ref) and by testing quarter (Q1 to Q4, with the corresponding dates). The data is presented as odour concentrations (OU) and as mass odour emission rates (MOER) (OU·Nm^3·s^{-1}).

Note: It is noted that the MOER stated in the quarterly monitoring reports are presented at standard temperature and pressure (STP) as stated in Appendix A of the test reports.

It is noted that biofilter odour concentration measurements taken during the Q1, Q2 and Q3 tests exceed the *de facto* emission standard of 500 OU. These data are highlighted in **Table 7**.

Where the quarterly testing reports indicate no data ('nd'), these are similarly highlighted in **Table 7** for clarity.

Table 7 Summary of quarterly odour monitoring results

EPA Ref	Location	Frequency	Q1		Q2		Q3		Q4	
			OU	OU·Nm³·s⁻¹	OU	OU·Nm³·s⁻¹	OU	OU·Nm³·s⁻¹	OU	OU·Nm³·s⁻¹
8	No 1 Gluten Dryer	Quarterly	970	nd(b)	130	nd(b)	680	nd(b)	480	nd(b)
9	No 2 Gluten / Starch Dryer	Quarterly	680	10 200	450	6 750	310	4 030	340	5 100
10	No 3 Gluten Dryer	Quarterly	530	32 330	310	11 780	440	34 760	310	13 330
11	No 4 Gluten Dryer	Quarterly	750	21 750	440	11 000	340	10 200	480	15 360
12	No 1 Starch Dryer	Quarterly	190	3 610	87	1 740	340	6 460	520	10 920
13	No 3 Starch Dryer	Quarterly	89	1 602	79	1 422	180	3 240	88	1 496
14	No 4 Starch Dryer	Quarterly	230	4 370	62	1 054	260	5 200	74	1 332
16	CO_2 Scrubber Outlet	Quarterly	20 000	38 000	51 000	96 900	15 000	22 500	7 200	7 920
--	CO_2 Scrubber Inlet	Quarterly	14 000	22 400	65 000	123 500	25 000	37 500	66 000	66 000
35	Combined Stack Boilers No5&6	Quarterly	480	14 880	400	13 200	810	23 490	610	17 690
39	Inlet Pipe Biofilters A&B	Quarterly	4 900	15 680	5 400	18 360	11 000	38 500	5 200	16 120
39A	Inlet Pipe Biofilters A&B (DDG#4)	Quarterly	60 000	43 200	10 000	4 800	33 000	21 780	nd(a)	nd(a)
40	Outlet of Biofilter A (east)	Quarterly	7 100	nd(b)	10 000	nd(b)	8 000	nd(b)	1 200	nd(b)
	Outlet of Biofilter A (west)	Quarterly	8 100	nd(b)	7 500	nd(b)	7 400	nd(b)	2 500	nd(b)
41	Outlet of Biofilter B (east)	Quarterly	6 200	nd(b)	9 600	nd(b)	7 300	nd(b)	4 500	nd(b)
	Outlet of Biofilter B (west)	Quarterly	8 700	nd(b)	9 400	nd(b)	8 100	nd(b)	4 500	nd(b)
42	Boiler 4	Quarterly	1 900	22 800	400	4 800	nd(a)	nd(a)	940	12 220
44	Fermenters	Quarterly	11 000	13 200	11 000	1 430	9 600	2 400	2 300	391
45	Boiler No2 Outlet	Quarterly	440	2 156	520	2 600	1 000	8 000	940	4 136
46	DDG Pellet Plant Stack	Quarterly	1 300	31 200	2 000	34 000	740	17 760	nd(a)	nd(a)
47	No 5 Starch Dryer	Quarterly	1 400	14 000	1 600	92 800	310	18 290	160	7 520

Note: (a) nd = no data.

(b) No data relating to odour volumetric flow rate provided in the relevant reports.

3.6.4. Variability of Measurements

It is noted that EPA letter DOC16574291-21 dated 27 July 2017 confirms satisfaction that the matter of emission variability has been resolved, but for ongoing review and transparency, the variability of the measured odour emission rates (MOER) during this reporting period has been reviewed.

In terms of assessing the odour emission variability, the MOER (as $OU \cdot Nm^3 \cdot s^{-1}$) is the critical metric and is the product of the measured odour concentration (OU) and the measured volumetric discharge rate ($Nm^3 \cdot s^{-1}$). The variability in the MOER across the audit period is presented in **Table 8**.

Table 8 Observed variability in the measured odour emission rate (by quarter)

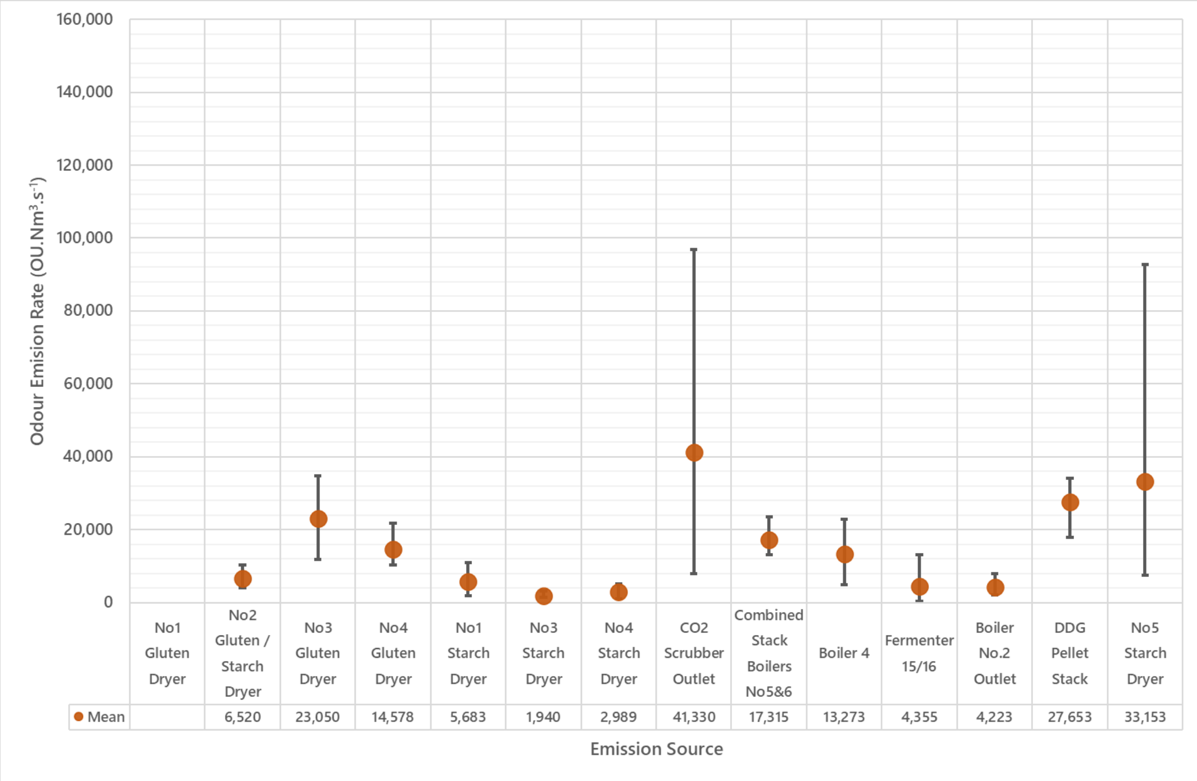
EPA Ref	Location	MOER ($OU \cdot Nm^3 \cdot s^{-1}$)					
		Count	Min.	Max.	Mean	±STDev	Max/ Min
8	No 1 Gluten Dryer	0	nd	nd	nd	nd	nd
9	No 2 Gluten / Starch Dryer	4	4 030	10 200	6 520	2 696	2.5
10	No 3 Gluten Dryer	4	11 780	34 760	23 050	12 176	3.0
11	No 4 Gluten Dryer	4	10 200	21 750	14 578	5 292	2.1
12	No 1 Starch Dryer	4	1 740	10 920	5 683	3 995	6.3
13	No 3 Starch Dryer	4	1 422	3 240	1 940	870	2.3
14	No 4 Starch Dryer	4	1 054	5 200	2 989	2 104	4.9
16	CO_2 Scrubber Outlet	4	7 920	96 900	41 330	39 030	12.2
35	Combined Stack Boilers No5&6	4	13 200	23 490	17 315	4 514	1.8
39	Inlet Pipe to Biofilters A&B	4	15 680	38 500	22 165	10 953	2.5
39A	Inlet Pipe to Biofilters A&B (DDG4)	3	4 800	43 200	23 260	19 243	9.0
42	Boiler 4	3	4 800	22 800	13 273	9 046	4.8
44	Fermenter 15/16	4	391	13 200	4 355	5 953	33.8
45	Boiler No2 Outlet	4	2 156	8 000	4 223	2 657	3.7
46	DDG Pellet Stack	3	17 760	34 000	27 653	8 682	1.9
47	No 5 Starch Dryer	4	7 520	92 800	33 153	40 011	12.3

The variation in odour emission rates, as range (represented by the observed minimum and maximum) and the arithmetic mean is illustrated in **Figure 2**.

Recommendation: 21/22-REC-C

With regard to flow measurements at EPA ID 8 the odour monitoring reports state: "*Sampling was undertaken at the exit of the stack as it was the only accessible area for the samples to be taken. No temperature or flow rate readings could be taken due to access issues.*" It is recommended that the access restrictions to EPA ID 8 are resolved to enable compliant odour monitoring to be performed. It is understood that new sampling ports have been installed (Sep 2022) that would be in compliance during the following odour audit period.

Figure 2 Variation in measured emission rates (range and mean)S



It is noted that for a number of emission points there is a noted significant variation in the rate of odour emissions (presented as OU·Nm^3·s^{-1}), notably:

- EPA ID 16 (CO_2 Scrubber Outlet) × 12.2
- EPA ID 44 Fermenter 15/16 × 33.8
- ID 47 No 5 Starch Drier of × 12.3

As noted in the previous independent odour audit reports, the atypical odour emission profile highlights an inherent potential variability in the emission rate subject to process operations. It is further noted that the odour measurement uncertainty, as performed in accordance with AS4323.3 and AS4323.4 is (generally) within the range of $0.7OU < OU < 1.4OU$. The Ektimo test reports present upper and lower uncertainty limits for odour measurements which confirms this uncertainty (at the 95th percentile confidence limits).

The data comparing the mean measured odour concentration as compared to the previous three odour audit periods is presented in **Table 9** below:

Table 9 Observed variability in the measured odour emission rate (by audit year)

EPA Ref	Source	MOER (OU·Nm^3·s^{-1})			
		2021-22	2020-21	2019-20	2018-19
8	No1 Gluten Dryer	nd	7 979	6 375	7 152
9	No2 Gluten / Starch Dryer	6 520	6 287	6 225	4 915
10	No3 Gluten Dryer	23 050	23 780	15 675	19 411

EPA Ref	Source	MOER ($OU \cdot Nm^3 \cdot s^{-1}$)			
		2021-22	2020-21	2019-20	2018-19
11	No4 Gluten Dryer	14 578	12 923	11 600	14 355
12	No1 Starch Dryer	5 683	4 353	3 130	6 068
13	No3 Starch Dryer	1 940	5 181	9 513	5 376
14	No4 Starch Dryer	2 989	3 549	6 285	3 824
16	CO_2 Scrubber Outlet	41 330	14 470	19 950	18 171
35	Combined Stack Boilers No5&6	17 315	55 982	52 750	43 831
39	Inlet Pipe to Biofilters A&B	22 165	46 149	56 900	31 757
39A	Inlet Pipe to Biofilters A&B DDG#4	23 260	15 307	8 500	nd
42	Boiler 4	13 273	19 796	23 633	18 926
44	Fermenter 15/16[(A)]	4 355	2 168	3 412	1 303
45	Boiler No.2 Outlet	4 223	6 068	7 167	nd
46	DDG Pellet Plant Stack	27 653	66 514	40 167	46 073
47	No5 Starch Dryer	33 153	17 676	21 621	nd
	aggregate ($OU \cdot Nm^3 \cdot s^{-1}$)	241,487	308 181	292 902	221 160
	mean ethanol production rate ($ML \cdot yr^{-1}$)	254	212	182	223
	odour emission intensity ($OU \cdot ML^{-1}$)	951	1 452	1 607	993

Note: (A) As compared to Fermenter 11 in 2017-18

The mean ethanol production rates (as $ML \cdot year^{-1}$) have been refenced from **Section 3.3**. It is noted that the production rates relate to the mean daily production rates averaged across all days during the Q1-Q4 testing periods, expressed as an annualised production volume only, and is not the total measured ethanol production rate. The aggregated MOER has been divided by the annual ethanol production rates to derive a "odour emission intensity" to provide a benchmark of emissions against the production rates. As may be observed, the more recent data for 2020-21 and 2021-22 shows a decrease in the pro-rata odour emission intensity. It is noted that not all MOER are scalable by ethanol production rates, and this metric should be viewed acknowledging that uncertainty.

The MOER is the product of the measured odour concentration (OU) and the volumetric discharge rate ($Nm^3 \cdot s^{-1}$) expressed as $OU \cdot Nm^3 \cdot s^{-1}$. **Table 10** below presents a breakdown of the two component factors to the MOER, to add some light on whether the odour concentration and/or the volumetric discharge rate is overly influencing the variability in the MOER. All max/min ratios of <5 are highlighted.

Table 10 Observed variability in the measured odour concentration and volumetric discharge rate

EPA Ref	Location	Odour Concentration (OU)				Volumetric Discharge Rate ($Nm^3 \cdot s^{-1}$)			
		Max	Mean	Min	Max/ Min	Max	Mean	Min	Max/ Min
8	No1 Gluten Dryer	970	565	130	7.5	nd	nd	nd	nd
9	No2 Gluten / Starch Dryer	680	445	310	2.2	15.00	14.50	13.00	1.2

EPA Ref	Location	Odour Concentration (OU)				Volumetric Discharge Rate ($Nm^3 \cdot s^{-1}$)			
		Max	Mean	Min	Max/ Min	Max	Mean	Min	Max/ Min
10	No3 Gluten Dryer	530	398	310	1.7	79.00	55.25	38.00	2.1
11	No4 Gluten Dryer	750	503	340	2.2	32.00	29.00	25.00	1.3
12	No1 Starch Dryer	520	284	87	6.0	21.00	19.75	19.00	1.1
13	No3 Starch Dryer	180	109	79	2.3	18.00	17.67	17.00	1.1
14	No4 Starch Dryer	260	157	62	4.2	20.00	18.50	17.00	1.2
16	CO2 Scrubber Outlet	51 000	23 300	7 200	7.1	1.90	1.60	1.10	1.7
35	Combined Stack Boilers No5&6	810	575	400	2.0	33.00	30.50	29.00	1.1
39	Inlet Pipe to Biofilters A&B	11 000	6 625	4 900	2.2	3.50	3.30	3.10	1.1
39A	Inlet Pipe to Biofilters A&B DDG #4	60 000	34 333	10 000	6.0	0.72	0.62	0.48	1.5
42	Boiler 4	1 900	1 080	400	4.8	13.00	12.33	12.00	1.1
44	Fermenter 15/16	11 000	8 475	2 300	4.8	1.20	0.44	0.13	9.2
45	Boiler No.2 Outlet	1 000	725	440	2.3	4.40	3.45	2.50	1.8
46	DDG Pellet Stack	2 000	1 347	740	2.7	24.00	20.50	17.00	1.4
47	No5 Starch Dryer	1 600	868	160	10.0	59.00	43.50	10.00	5.9

Further to the variability in the MOER from EPA 16 (CO_2 Scrubber Outlet) by a factor of × 12.2 (see **Table 8**), **Table 10** shows that the measured odour concentration is variable (a factor of ×7.1) and the measured volumetric discharge rate, with a factor of ×1.7 is relatively consistent.

For EPA ID 44 Fermenter 15/16, the measured odour emission concentration and volumetric flow rates vary by factors of × 4.8 and × 9.2 respectively, and similarly for EPA ID 47 by × 10.02 × 5.9.

3.7. Odour Modelling

During the audit period, two modelling assessments have been performed as relates to MOD 21 (modification to packing plant and other works), described as MOD21 Q2 and MOD21 Q3, and the second for MOD23 (gas-fired co-generation), which are reported in:

- GHD (Nov 2021) Shoalhaven Starches Modification 21 – Proposed Modification to Packing Plant and other works, Air Quality Assessment (GHD, Nov 2021); and
- GHD (Nov 2021) Shoalhaven Starches Modification 23 – Gas-fired Co-Generation, Air Quality Assessment (GHD, Jan 2022)

Those two modelling reports have been presented in **Appendix E** of this independent odour audit report.

MOD 21 Modelling - Emissions Assumptions

The assumptions and changes to the previous odour modelling for MOD 21 are presented in section 7.2.2 of (GHD, Nov 2021) and are reproduced below:

- *Peak odour emission rates were sourced from the odour monitoring conducted by SEMA in the previous four quarters for EPA ID sources. The sources were scaled to an ethanol production rate of 300 ML per year production. The quarter with the maximum measured total OER was selected for use in the assessment and is consistent with guidance in the Approved Methods and the recommendation from EPA (16 February 2017) that peak emissions should be assessed. The peak period was found to be quarter 2, 2020 (August 2020).*
- *The exit velocities and temperatures for EPA ID sources were adjusted to the modelled quarter. These measurements include the mitigation modifications made to No. 3 and No. 4 gluten dryer exhausts as part of the Mod 11 and 12 air quality assessment recommendations.*
- *No. 1 and No. 2 gluten dryers were proposed to be modified to starch dryers as part of 16 assessment. Therefore, the emission rates assigned to these dryers remains unchanged from the Mod 16 assessment as the dryers have not been modified yet.*
- *Mod 16 assessed the addition of a new gluten dryer (GD8). The emission rates assumed in Mod 16 remain unchanged as the dryer has not been constructed yet.*
- *Mod 17 assessed the addition of a new product dryer (No. 9) (PD9), which is planned to be installed within the speciality products building. The product dryer will comprise about 20% of the size and production capacity of the approved (but not yet constructed) Gluten Dryer 8. It is envisaged that Product Dryer 9 will be used on an interim basis to process gluten allowing for an incremental increase in processing of gluten until the approved product dryer building is constructed and gluten dryer 8 is operational.*
- *Once gluten dryer 8 is operational, it is envisaged that product dryer 9 will revert to processing starch. PD9 will not result in any increase in production above the current approval limit for flour processing under Mod 16 of 25,400 tonnes per week.*
- *For the purposes of odour modelling, as part of Mod 17, PD9 was modelled as processing gluten with odour emission rates conservatively modelled as per gluten dryer 1 (which is of a similar size). The stack from the dryer will rise above and through the roof of the speciality product building at a height of 35.6 m. The diameter of the stack is proposed to be 0.85 m. The flow rates were calculated based on 20% of the proposed gluten dryer 8.*

- *As part of the Mod 19 proposal, a new distillation plant (with columns and associated processing equipment) is proposed to be installed immediately to the west of the existing Ethanol Distillery Plant. One additional emission source associated with this change is the new Distillation plant Column Washing Vent (CWV2), which is a duplication of the existing source (CWV). The stack height of the new source as provided by Manildra, is 55 metres tall. Stack diameter, exit velocity and temperature were sourced from the sampling report for the similar existing source (Odour Research Laboratories Australia (2020) Olfactometry Test Report for Beverage Ethanol D500 Vent Report No. 7091/ORLA/01).*
- *Cooling tower odours are not included in the Mod 19 emissions inventory based on improvements at the site and subsequently being removed as a EPL odour sampling point*
- *As part of the current proposal (Mod 21), the following changes were made:*
  - *Increased indirect cooking facility odour emissions by 50%.*
  - *Odour concentrations from the upgraded biofilters A and B were estimated based on sampling from quarter 4 of 2017-2018. A biofilter outlet odour concentration of 669.3 OU was adopted. This was the highest measured biofilter outlet value (highest quarterly value for the average of biofilters A and B outlets) in the year before odorous air from DDG4 was diverted to the biofilter.*
- *Odour emission rates were assumed to be unchanged for the other emission sources.*

It is noted that the discharge temperatures reported in Table C.1 and Table C.2, Appendix C (GHD, Nov 2021) for EPA ID 42 (Boiler 4) and EPA ID 45 (Boiler 2) are presented as 30 K and 28 K respectively (in both tables). The monitoring reports appended to (GHD, Nov 2021) indicate measured gas temperatures of 164.6 °C and 216-214 °C respectively.

Subsequent correspondence from GHD to Manildra states:

> *The discharge temperatures for boiler 2 and 4 in TableC.1 and C.2 of MOD21 AQIA are a typographical error (exit velocity rounded to 1 d.p. presented instead of discharge temperature). The values modelled and those that should be presented in appendix C tables are:*
>
> - *Boiler 2 = 489.0 K (216°C)*
> - *Boiler 4 = 437.6 K (164.6°C)*

MOD23 Modelling – Emissions Assumptions

The assumptions and changes to the previous odour modelling for MOD 23 are presented in section 7.2.2 of (GHD, Nov 2021) and are reproduced below:

- *As part of the Mod 21 proposal, the following changes were added:*

- *installation of additional biofilter capacity to improve odour performance and increase biofilter ability to treat a higher volume of odorous air. Therefore odour concentrations from biofilter sampling undertaken prior to the diversion of odorous air from DDG4 have been used in this assessment.*
  - *odour emissions from the indirect cooking facility were increased by 50%.*
  - *Boiler 5/6 emissions were modelled with an exit velocity of 10 metres per second.*
- *As part of the current proposal (Mod 23), the following changes were made:*
  - *All boilers would be converted to gas fired. Odour emissions from boiler no 5 & 6 (gas fired) was estimated based on quarterly odour sampling data scaled based on proposed flowrate. Odour emission rates were assumed to be unchanged for the other emission sources.*

It is noted that the emissions inventory presented in Appendix C of (GHD, Jan 2022) does not include emission rates for EPA ID 42 (Boiler 4) and EPA ID 45 (Boiler 2). Section 8.1.1 of the modelling report (GHD, Jan 2022) states:

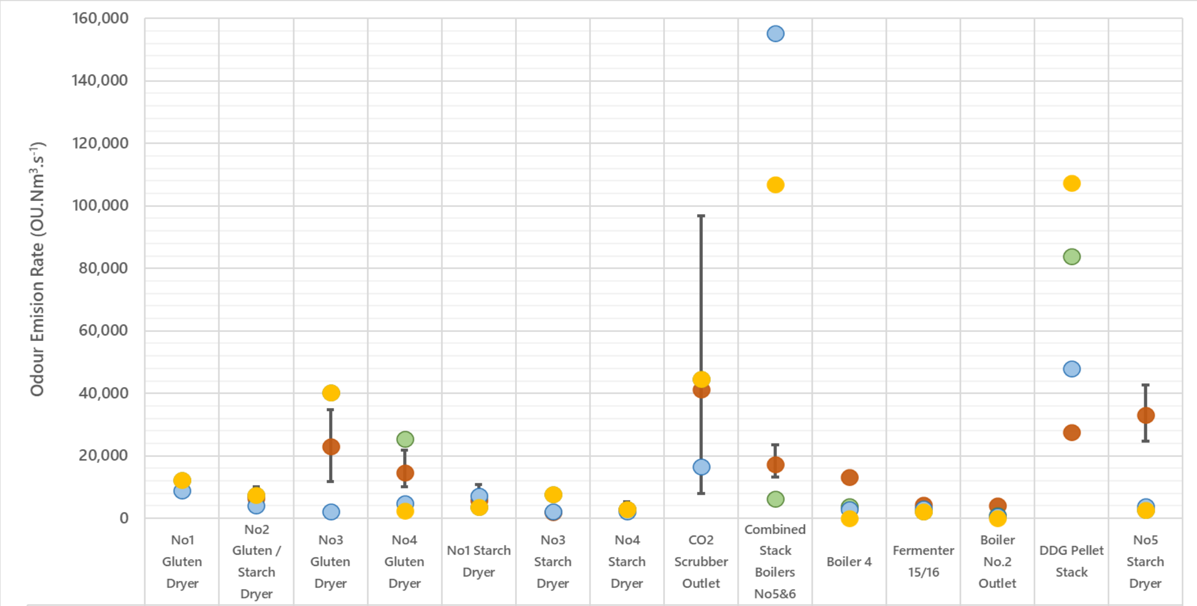
> *The existing gas boilers (boilers 1, 3, 7 and proposed gas boiler 8) will continue to be maintained and the existing coal and mixed coal and woodchip fired boilers (boilers 2, 4, 5, 6) will be converted from coal to biogas / natural gas fired.*
>
> *For typical operational conditions, boilers 1, 2, 3, 4, 7 and 8 would be on standby, while only boilers 5 and 6 are proposed to be used.*
>
> *Boilers allocated to standby duty (i.e. Boilers 1, 2, 3, 4, 7 and 8) would not be operational (no fuel usage and no emissions) and would only be brought online during statutory maintenance periods while a gas turbine or boiler 5 and 6 is offline for inspection and maintenance or in emergency situations.*

The odour emissions inventories for MOD21 Q2, MOD21 Q3 and MOD23 presents assumptions for a range of sources not covered by this odour audit. However, a simple comparison of the aggregated odour emission rates measured and modelled for sources (EPA ID, 8, 9, 10, 11, 12, 13, 14, 16, 35, 39, 39A, 40(E/W), 41(E/W), 42, 44, 45, 26, 47) shows the following (noting that these emission rates have been corrected to 273 K).

- Measured: 196 061 $OU \cdot Nm^{-3} \cdot s^{-1}$
- Modelled (MOD21 Q2): 248 956 $OU \cdot Nm^{-3} \cdot s^{-1}$ (127 % of measured)
- Modelled (MOD21 Q2): 273 282 $OU \cdot Nm^{-3} \cdot s^{-1}$ (139 % of measured)
- Modelled (MOD23) 345 292 $OU \cdot Nm^{-3} \cdot s^{-1}$ (176 % of measured)

The distribution of the measured and modelled odour emission rates is presented in **Figure 3**.

Figure 3 Comparison of measured and modelled odour emission rates



	No1 Gluten Dryer	No2 Gluten / Starch Dryer	No3 Gluten Dryer	No4 Gluten Dryer	No1 Starch Dryer	No3 Starch Dryer	No4 Starch Dryer	CO2 Scrubber Outlet	Combined Stack Boilers No5&6	Boiler 4	Fermenter 15/16	Boiler No.2 Outlet	DDG Pellet Stack	No5 Starch Dryer
Mean		6,520	23,050	14,578	5,683	1,940	2,989	41,330	17,315	13,273	4,355	4,223	27,653	33,153
GHD MOD21 Q2	12,363	7,385	40,217	25,385	3,623	7,649	2,837	44,643	6,237	3,820	2,218	913	83,989	2,646
GHD MOD21 Q3	9,002	4,138	2,185	4,782	7,199	2,185	2,097	16,501	155,299	2,996	3,109	772	47,879	3,954
GHD MOD23	12,349	7,385	40,205	2,542	3,622	7,647	2,839	44,583	106,969	0	2,220	0	107,259	2,644

Mod21 Modelling - Odour Modelling Results

The odour modelling results presented in (GHD, Nov 2021) are presented in table 7.2 on page 48 of that report. These data have been extracted are reproduced below in **Table 11**.

Table 11 Summary of odour modelling results (MOD 21) (99th percentile 1-second OU)

Receptor	Range (m)	Nearest odour source	Dir.	Odour criterion	Odour impact, OU, 99th percentile, nose-response time					
					MOD 13	MOD 16	MOD 17	MOD 19	MOD 21 Q2	MOD 21 Q3
R1 Bomaderry	150	Packing plant	W	6	3.3	3.5	4	4	5	4
R2 North Nowra	1 300	Factory	SW	3	2.5	2.6	3	3	4	3
R3 Nowra	700	Factory	S	5	4	4.6	5	5	6	5
R4 Terara	1 300	Factory	SE	5	3.7	3.7	4	4	5	4
C1	45	Factory	N	n/a	n/a	10.3	12	12	16	14
C2	20	Factory	N	n/a	n/a	5.8	8	10	10	9
C3	30	Factory	N	n/a	n/a	5.3	7	9	9	8
C4	75	Factory	NW	n/a	n/a	4.4	6	7	8	7
C5	125	Factory	NW	n/a	n/a	6.1	7	7	8	7
C6	30	Factory	NW	n/a	n/a	5.4	7	10	10	9
C7	55	Factory	NW	n/a	n/a	4.8	7	8	10	9

Note: Predicted exceedances of the relevant criterion are highlighted

It may be noted that for MOD21 the modelling predicts exceedances with stated odour impact assessment criteria for the Q2 emission estimation at receptors R2 and R3 The isopleth plots for the predicted odour footprints is replicated in **Figure 4** (figure 7.2 (GHD, 2021)).

Mod23 Modelling - Odour Modelling Results

The odour modelling results presented in (GHD, Jan 2022) are presented in table 7.2 on page 32 of that report. These data have been extracted are reproduced below in **Table 11**.

Table 12 Summary of odour modelling results (MOD 23) (99th percentile 1-second OU)

Rec	Range (m)	To nearest odour source	Dir.	OAC	Odour impact, OU, 99th percentile, nose-response time						
					MOD 13	MOD 16	MOD 17	MOD 19	MOD 21 Q2	MOD 21 Q3	MOD 23
R1	150	Packing plant	W	6	3.3	3.5	4	4	5	4	5
R2	1 300	Factory	SW	3	2.5	2.6	3	3	4	3	3
R3	700	Factory	S	5	4	4.6	5	5	6	5	5
R4	1 300	Factory	SE	5	3.7	3.7	4	4	5	4	5
C1	45	Factory	N	n/a	n/a	10.3	12	12	~~16~~ 14	~~14~~ 12	12
C2	20	Factory	N	n/a	n/a	5.8	8	10	10	9	8
C3	30	Factory	N	n/a	n/a	5.3	7	9	9	8	8
C4	75	Factory	NW	n/a	n/a	4.4	6	7	8	7	7
C5	125	Factory	NW	n/a	n/a	6.1	7	7	8	7	7
C6	30	Factory	NW	n/a	n/a	5.4	7	10	10	9	9
C7	55	Factory	NW	n/a	n/a	4.8	7	8	~~10~~ 9	~~9~~ 8	8

Note: Predicted exceedances of the relevant criterion are highlighted

It may be noted that for MOD23 the modelling predicts no exceedances with stated odour impact assessment criteria. The isopleth plot for the predicted odour footprints is replicated in **Figure 4** (figure 7.2 (GHD, 2021)).

It is noted that the reported odour concentrations at receptors C1 and C7 within (GHD, Jan 2022) are different to those presented in (GHD, Nov 2021) (see **Table 11**). The identified discrepancies are indicated with strike through data, replaced by the MOD 23 reported values.

Recommendation: 21/22-REC-D

It is recommended that the difference between reported predicted concentration values as reported in (GHD, Nov 2021) and (GHD, Jan 2022) is clarified so that there is consistency between the modelling reports.

Figure 4 Ground level odour predictions (MOD 21) (GHD, Nov 2021) northstar

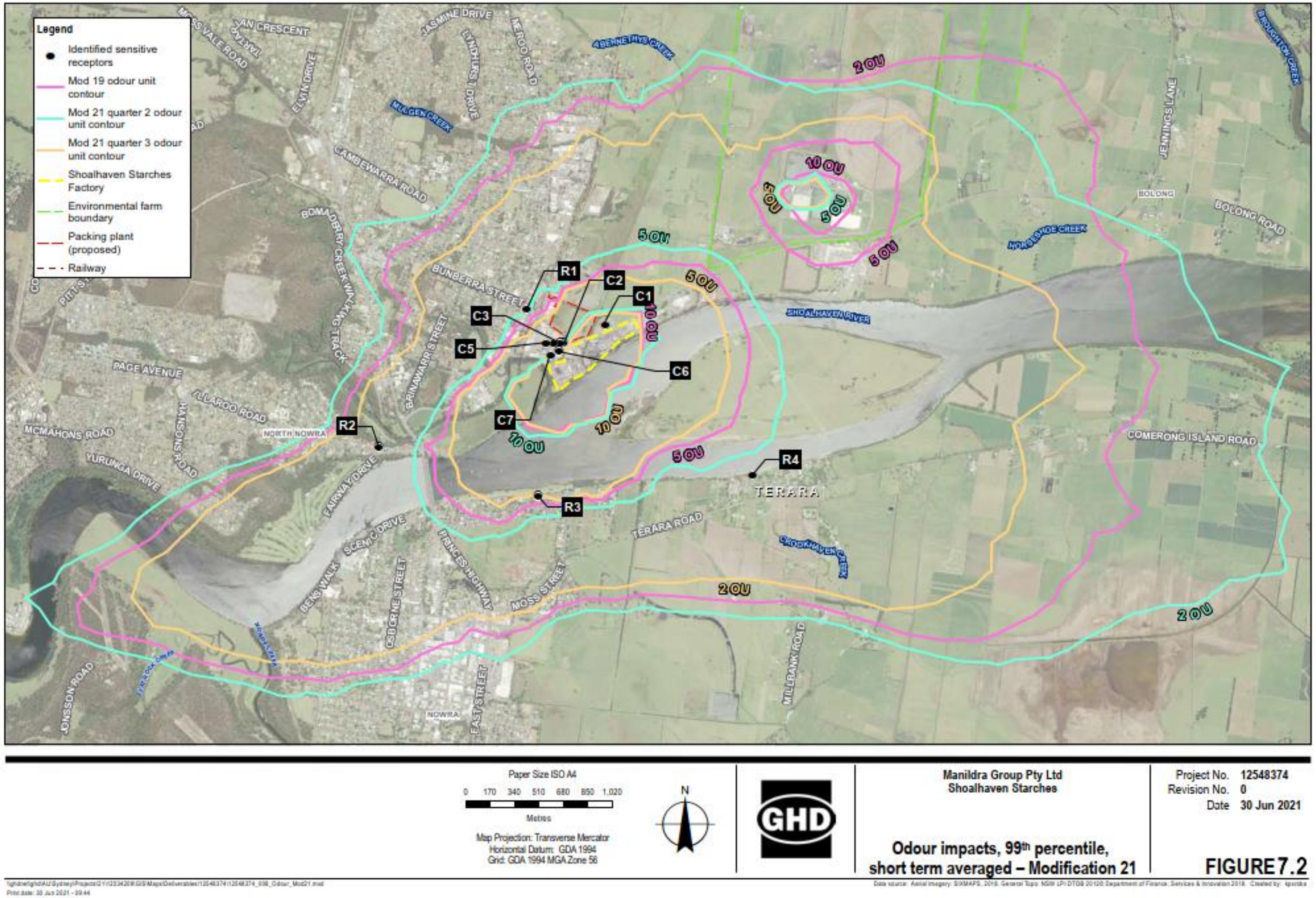
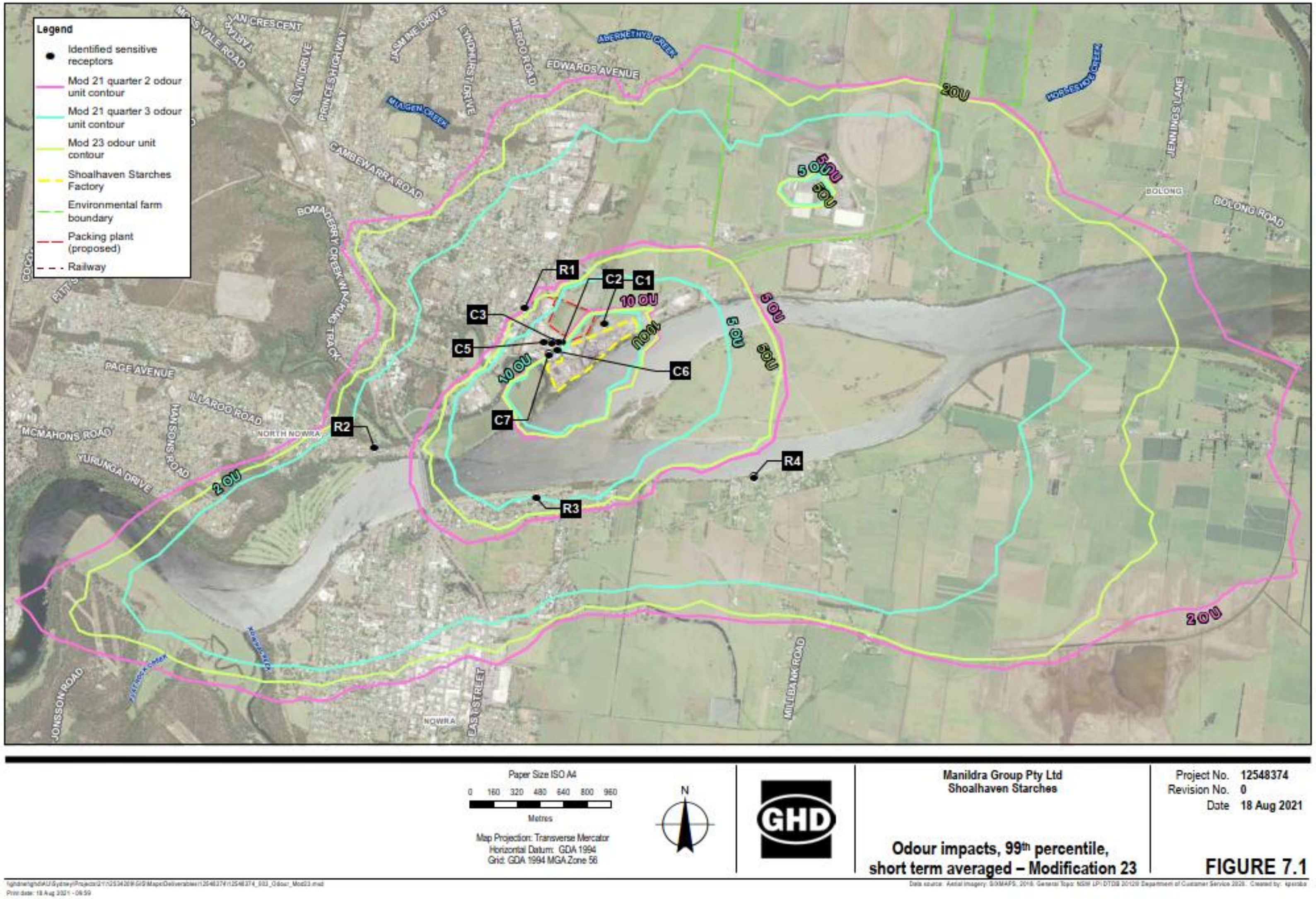

Legend
Identified sensitive receptors
Mod 19 odour unit contour
Mod 21 quarter 2 odour unit contour
Mod 21 quarter 3 odour unit contour
Shoalhaven Starches Factory
Environmental farm boundary
Packing plant (proposed)
Railway
R1
R2
R3
R4
C1
C2
C3
C5
C6
C7
2 OU
5 OU
10 OU
SHOALHAVEN RIVER
TERARA
BOLONG
NORTH NOWRA
NOWRA
BUNBERRA STREET
PAGE AVENUE
ILLAROO ROAD
MCMAHONS ROAD
YURUNGA DRIVE
FAIRWAY DRIVE
SCENIC DRIVE
BENS WALK
OSBORNE STREET
PRINCES HIGHWAY
MOSS STREET
EAST STREET
TERARA ROAD
MILLBANK ROAD
COMERONG ISLAND ROAD
BOLONG ROAD
JENNINGS LANE
CAMBEWARRA ROAD
JASMINE DRIVE
MEROO ROAD
BRINAWARR STREET
JONSSON ROAD
ABERNETHYS CREEK
HORSESHOE CREEK
CROOKHAVEN CREEK
BROUGHTON CREEK
Paper Size ISO A4
0 170 340 510 680 850 1,020
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56
N
GHD
Manildra Group Pty Ltd
Shoalhaven Starches
Odour impacts, 99th percentile, short term averaged – Modification 21
Project No. 12548374
Revision No. 0
Date 30 Jun 2021
FIGURE 7.2

Figure 5 Ground level odour predictions (MOD 23) (GHD, Jan 2022)



4. ODOUR AUDIT FINDINGS

The compiled audit table of the above information is presented in **Table 13**.

Table 13 Consolidated odour conditions and summary of compliance (MOD 16, Schedule 3)

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
Offensive Odour				
1	The Applicant shall not cause or permit the emission of offensive odours from the site, as defined under Section 129 of the POEO Act.	**Section 3.2** provides a summary of the odour complaints, and these are replicated (with redaction) in **Appendix F**.	The number of odour complaints received in this period is one (1), which has been investigated and are closed.	Compliant
Implementation of Mandatory Odour Controls				
2	Prior to increasing ethanol production rates on site above 126 million litres a year or within 12 months of this approval, whichever is sooner, the Applicant shall implement all the mandatory odour controls listed in Appendix 3 and described in detail in the Odour Management Plan (see condition 4 below), to the satisfaction of the Secretary.	Controls implemented as evidenced in previous IOA.	None.	Compliant
3	The Applicant shall implement additional mandatory odour controls as may be directed by the Secretary, arising from the Department's assessment of any:	Controls implemented as evidenced in previous IOA.	None.	Not triggered
	a) Independent Odour Audit (see condition 5 below);	None.	None.	--

northstar

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
	b) Independent Environmental Audit (see condition 4 of schedule 4); or	None.	None.	--
	c) any monitoring results, incidents or complaints related to the project.	None.	None.	--
3A	Prior to commissioning the duct work that directs additional emissions from the evaporator plant area and load-out chute to the bio-filter (as identified in the amended modification proposal) the Applicant must demonstrate to the satisfaction of the Secretary and the EPA that the bio-filter can accommodate the additional load while maintaining acceptable treatment performance.	Controls implemented as evidenced in previous IOA.	Completed.	Compliant
3B	Should the Applicant opt to install a DDG pelletising plant as identified in the additional odour controls in Appendix 3 the plant must comply with all regulatory requirements including air and odour emissions standards that are in force at the time of installation. Compliance must be demonstrated to the satisfaction of the Secretary and EPA before installation work begins.	Controls implemented as evidenced in previous IOA.	Completed.	Compliant
3C	Deleted	None.	None	--

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
3D	Prior to construction of any part of MOD 11 and MOD 12 as described in Schedule 2, Condition 2, the Applicant shall implement odour mitigation controls on the gluten dryers 3 and 4. The controls shall include re-orienting the discharge vents and increasing the velocity of discharges to improve odour dispersion, as described in MOD 11 and MOD 12. The Applicant shall provide evidence to the satisfaction of the Secretary to demonstrate that the odour mitigation controls have been successfully implemented.	The plant modifications, including the re-orientation of the discharge vents have been implemented, although it is noted that neither of the modified discharges are vertical.	A letter from DPI&E (ref: 10/06422-11, dated 24/10/17) provides evidence of DPI&E satisfaction on the installation of the odour controls on gluten dryers 3 and 4.	Compliant
Odour Management Plan				
4	The Applicant shall prepare an Odour Management Plan for the project to the satisfaction of the Secretary. This plan must: a) be prepared in consultation with EPA by a suitably independent, qualified and experienced expert whose appointment has been endorsed by the Secretary, and submitted to the Secretary for approval within 3 months of the date of this approval;	The OMP is discussed in **Section 3.1.1**.	It has been completed by The Odour Unit, who are a suitably qualified and experienced expert in odour management. It is noted that the OMP has received DPI&E review.	Compliant

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
	b) describe in detail the measures that would be implemented on site to control the odour impacts of the project, and to ensure that these controls remain effective over time;	The OMP is discussed in **Section 3.1.1**.	Section 2 and 3 of the OMP adequately addresses odour control.	Compliant
	c) identify triggers for remedial action; and	The OMP is discussed in **Section 3.1.1**.	Section 3 of the OMP addresses upset conditions that would prompt remedial actions to assist reduce the resultant potential impacts.	Compliant
	d) include a program for monitoring the odour impacts of the project.	The OMP is discussed in **Section 3.1.1**.	Section 4 of the OMP presents details of the system monitoring program.	Compliant
4A	Prior to increasing ethanol production the Odour Management Plan for the project must be updated to the satisfaction of the Secretary to include the additional Appendix 3 mandatory odour controls specified in the modification approval MOD 1 – Deletion of DDG Pelletiser.	None.	Completed.	Compliant

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
Independent Odour Audit				
5	Within 3 months of the implementation of the mandatory odour controls (see Appendix 3), and annually thereafter unless the Secretary directs otherwise, the Applicant shall commission and pay the full cost of an Independent Odour Audit of the project. This audit must be conducted by a suitably qualified, experienced and independent expert whose appointment has been endorsed by the Secretary. During the audit, this expert must:	The Letter of Endorsement from the Director General is provided in **Appendix A**.	The Letter of Endorsement from the Director General is provided in **Appendix A**.	Compliant
	a) consult with the EPA and the Department	**Section 1.2** presents a summary of the consultation with the EPA and DPE.	Consultation performed and recommendations for the odour audit adopted	Compliant
	b) audit the effectiveness of the odour controls on site in regard to protecting receivers against offensive odour;	**Section 3** presents the collated information regarding odour control.	The information provided and reviews includes a wide range of ongoing compliance monitoring data to quantify and evaluate the odour control performance of the plant.	Compliant

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
	c) review the Applicant's production data (that are relevant to the odour audit) and complaint records;	**Section 3.3** presents a summary of the production data corresponding to the monitoring program dates. **Section 3.2** presents a summary of the odour complaints for the audit period.	The production data provided by Shoalhaven Starches has been reviewed and is tabulated in **Table 3**. The number of odour complaints received in this period is one (1) (#064) which has been closed out.	Compliant
	d) review the Odour Management Plan for the project;	**Section 3.1.1** provides a summary of any relevant updates to the OMP.	During this audit period, there are no relevant updates relevant to this odour audit.	Compliant
	e) measure all key odour sources on site, and compare the results of these measurements against the predictions in the EA;	Audit of monitoring data presented in **Sections 3** and **3.6**. The comparison against modelling assessment provided in **Section 3.7**	The quarterly and annual emission testing has been completed over the auditing period.	Compliant
	f) determine whether the project is complying with the requirements in this approval; and	Reference should be made to the rest of the document.	Reference should be made to the rest of the document in which specific compliance (or otherwise) is documented.	--
	g) if necessary, recommend and prioritise measures to either improve the odour controls on site and/or the Odour Management Plan, such that receivers would be protected against offensive odour from the site.	**Section 5** provides a summary of this Independent Odour Audit. **Section 5.1** provides a summary of non-compliances and **Section 5.2** provides recommendations.	Recommendations as documented in **Section 5.2**.	Compliant

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
	Note: The Secretary may vary the frequency of the audit depending on the performance of the project.	None	None.	--
6	Within 6 weeks of the completion of this audit, the Applicant shall submit a copy of the audit report to both EPA and the Secretary with a response to any recommendations contained in the audit report.	Outside the scope of the Independent Odour Audit.	None	--
Odour verification (MP 06_0228 MOD 2)				
6A	The Applicant shall ensure that any Independent Odour Audit submitted to the Secretary in accordance with Condition 5 of this Schedule includes: a) 3 monthly (quarterly) odour monitoring with samples taken from the carbon dioxide/ethanol recovery scrubber inlet/s and outlet/s; and	The quarterly odour monitoring reports are discussed in **Section 3.6**, and attached as **Appendix D** to this audit report.	The quarterly and annual emission testing has been completed over the auditing period.	Compliant
	b) quarterly odour monitoring with samples taken of single vent stack (direct to atmosphere) emissions from a filling fermenter tank.	The quarterly odour monitoring reports are discussed in **Section 3.6**, and attached as **Appendix D** to this audit report.	The quarterly and annual emission testing has been completed over the auditing period.	Compliant
6B	Deleted	None required	The quarterly and annual emission testing has been completed over the auditing period.	--

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
6C	The Applicant shall conduct quarterly odour monitoring from the DDG exhaust stack and report the results in the independent odour audit required under Condition 5 of Schedule 3.	The quarterly odour monitoring reports are discussed in **Section 3.6**, and attached as **Appendix D** to this audit report.	The quarterly and annual emission testing has been completed over the auditing period.	Compliant
6D	The Applicant shall conduct odour monitoring on the relocated starch dryer described in MOD 7 in accordance with the requirements of the EPL and report the results in the independent odour audit required under Condition 5 of Schedule 3.	The quarterly odour monitoring reports are discussed in **Section 3.6**, and attached as **Appendix D** to this audit report.	MOD7 relates to the No5 Starch Dryer (as captured in the EPL variation dated June 2018).	Compliant

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
6E	If the results of odour monitoring show any odour impact greater than that predicted by the odour dispersion modelling in the EA and the modification proposals referred to in Condition 2 of Schedule 2, the Applicant shall investigate and implement further odour treatment options as directed by the Secretary or the EPA.	Section 3.7 presents a summary of the modelled odour emission rates as presented in the MOD21 and MOD 23 air quality assessment reports.	The sequential process modifications have been modelled and assessed, up to MOD23, including further odour treatment options, noting MOD21 Q2 showed some predicted exceedances of the odour impact assessment criteria at R2 and R3. A comparison presented in Section 3.7 shows modelled emissions were in the order of 127 % to 176 % of the corresponding measured odour emission rates. It is noted that the MOD21 and MOD23 modelling includes a significant number of additional sources not included within the scope of this audit. Overall, it is considered that the modelling represents the site adequately.	Compliant

Condition	Requirement	Evidence	Independent Audit Findings and Recommendations	Compliance Status & UIN
6F	The Applicant shall conduct odour validation monitoring on the gluten dryers 3 and 4, following implementation of the mitigation controls required by Condition 3D. Results of the odour validation monitoring shall be included in the independent odour audit required under Condition 5 of Schedule 3.	The quarterly odour monitoring reports are discussed in **Section 3.6**, and attached as **Appendix D** to this audit report.	The quarterly and annual emission testing has been completed over the auditing period.	Compliant

5. SUMMARY

Based upon the information reviewed the following recommendations are proposed.

5.1. Identified Non-Compliances

Table 14 below presents the observed non-compliances against the consolidated odour conditions (see **Table 13**).

Table 14 Independent odour audit non-compliances

UIN	Condition and Requirement	Evidence & Independent Audit Findings and Recommendations	Compliance Status
None	None	None	None

5.2. Recommendations

Recommendations from this 2021-22 audit and any remaining unresolved recommendations from the previous audits are summarised in **Table 15**.

Table 15 Independent odour audit recommendations

Reference	Recommendation	Implementation
2021-22 Odour Audit Recommendations		
21/22-REC-A	Whilst it is acknowledged that the biofilters are achieving a reasonable degree of odour control (56 % efficacy), the flow-weighted average odour concentration is not achieving the de-facto 500 OU standard. This matter remains an unresolved issue and it is recommended that it is resolved at the earliest opportunity.	Identified in this report for consideration
21/22-REC-B	It is recommended that the safety issue(s) preventing EPA 20 from being tested are resolved to ensure that EPA 20 is available to be tested during the 2022-2023 period. It is understood that the safety issue is the stability of the dam banks due to the low water levels and the dam is used when all other dams are full.	Identified in this report for consideration
21/22-REC-C	With regard to flow measurements at EPA ID 8 the odour monitoring reports state: "*Sampling was undertaken at the exit of the stack as it was the only accessible area for the samples to be taken. No temperature or flow rate readings could be taken due to access issues.*" It is recommended that the access	Identified in this report for consideration

Reference	Recommendation	Implementation
	restrictions to EPA ID 8 are resolved to enable compliant odour monitoring to be performed. It is understood that new sampling ports have been installed (Sep 2022) that would be in compliance during the following odour audit period.	
21/22-REC-D	It is recommended that the difference between reported predicted concentration values as reported in (GHD, Nov 2021) and (GHD, Jan 2022) is clarified so that there is consistency between the modelling reports.	Identified in this report for consideration
2020-21 Odour Audit Recommendations		
20/21-REC-A	Whilst it is acknowledged that the biofilters are achieving a high degree of odour control (i.e. >90 %), the flow-weighted average odour concentration is not achieving the de-facto 500 OU standard. This matter remains an unresolved issue and it is recommended that it is resolved.	Ongoing
20/21-REC-C	It is recommended that a source apportionment study is completed as a component of the next odour modelling performed, to further understand the relationship between emission rates and the relative contribution of sources to aggregated off-site impacts.	Ongoing
2019-20 Odour Audit Recommendations		
2019-20-IOA-A	As identified at **Section 3.1** and **Section 3.6**, and as stated in the Biofilter Capacity and Condition Assessment report #23, the biofilters are not achieving the *de facto* 500 OU standard. This should be flagged for ongoing observation and remedial action as required.	Ongoing
2018-19 Odour Audit Recommendations		
2018-19-IOA-B	As identified at Section 2.4, Section 2.9.3 (of the 2018-19 audit) and stated in the Biofilter Capacity and Condition Assessment report #22 (June 2019), the biofilters are not achieving the *de facto* 500 OU standard. This should be flagged for ongoing observation and remedial action as required.	Ongoing
2017-18 Odour Audit Recommendations		
2017-18-IOA-C	As identified at Section 2.3 (of the 2017-18 audit) and stated in the Biofilter Capacity and Condition Assessment report #21 (April 2018), the biofilters are not achieving the *de facto* 500 OU standard. This should be flagged for ongoing observation and remedial action as required.	Ongoing

Appendix A – Director General's Letter of Appointment

Planning & Infrastructure

Contact: Deana Burn
Phone: (02) 9228 6453
Email: deana.burn@planning.nsw.gov.au

Mr John Studdert
Quality Assurance & Environmental Coordinator
Manildra Group
PO Box 123
NOWRA NSW 2541

Ref: 10/06422-9

Shoalhaven Starches Ethanol Expansion Project (06_0228)
Independent Environmental Audit and Independent Odour Audit 2016

Dear Mr Studdert

I refer to your email of 1 March 2016 seeking approval for Edge Environment Pty Ltd (Edge) to undertake the Independent Environmental Audit and Northstar Air Quality Pty Ltd (Northstar) to undertake the Independent Odour Audit for the above project.

Independent Environmental Audit – Schedule 4 Condition 4
The Department approves the proposed audit team, including Jon Panic from Edge, Gary Graham from Northstar and Matthew Verth from Resonate Acoustics. In undertaking the audit, Edge must ensure the audit:

- is conducted in accordance with AS/NZS ISO 19011:2003 *Australian/New Zealand Standard: Guidelines for quality and/or environmental management systems auditing*;
- includes a compliance table indicating the compliance status of each condition of approval (and any other statutory instrument required to be audited);
- avoids terms such as "partial compliance". An audit is to make findings of either "compliance", "non-compliance" or "inability to be determined";
- includes recommended actions in response to non-compliances;
- identifies opportunities for improved environmental management and performance;
- covers all modifications to the project approval; and
- includes detailed consideration of odour, noise, wastewater and traffic management.

Please ensure that Edge, Northstar and Resonate Acoustics are advised of these requirements. Should Edge wish to discuss the scope of the audit with the Department, please advise them to contact myself or Deana Burn.

Independent Odour Audit – Schedule 3 Condition 5
Having considered the qualifications and experience of Mr Gary Graham from Northstar, approval is granted for Mr Graham to conduct the independent odour audit. Please ensure the scope of the audit addresses the requirements of condition 5a) to 5g) and 6A, 6C, 6D and 6E.

Finally, the Department requests that you:

- review both the audit reports to ensure they comply with the relevant conditions of approval, prior to submitting the reports to the Secretary; and
- submit an action plan detailing your response to the auditor's recommendations and timeframes to implement the recommendations.

Should you have any enquiries, please contact Deana Burn on 9228 6453.

Yours sincerely

C. Ritchie 8/3/16.

Chris Ritchie
Director - Industry Assessments
as the Secretary's nominee

Declaration of Independence Form

Project Name:	Shoalhaven Starches
Consent Number:	06_0228
Description of Project	Shoalhaven Starches Independent Odour Audit (2021-2022)
Project Address	160 Bolong Road, Bomaderry, NSW 2541
Proponent	Shoalhaven Starches Pty Ltd
Title of Audit	Shoalhaven Starches Independent Odour Audit (2021-2022)
Date	20 October 2022

I declare that:

i. I am not related to any proponent, owner, operator or other entity involved in the delivery of the project. Such a relationship includes that of employer/employee, a business partnership, sharing a common employer, a contractual arrangement outside an Independent Audit, or that of a spouse, partner, sibling, parent, or child;

ii. I do not have any pecuniary interest in the project, proponent or related entities. Such an interest includes where there is a reasonable likelihood or expectation of financial gain (other than being reimbursed for performing the audit) or loss to the auditor, or their spouse, partner, sibling, parent, or child;

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

iv. I am not an Environmental Representative for the project; and

v. I will not accept any inducement, commission, gift or any other benefit from auditee organisations, their employees or any interested party, or knowingly allow colleagues to do so. Notes:

Notes:

a) Under section 10.6 of the Environmental Planning and Assessment Act 1979 a person must not include false or misleading information (or provide information for inclusion in) in a report of monitoring data or an audit report produced to the Minister in connection with an audit if the person knows thatthe information is false or misleading in a material respect. The proponent of an approved project must not fail to include information in (or provide information for inclusion in) a report of monitoring data or an audit report produced to the Minister in connection with an audit if the person knows that the information is materially relevant to the monitoring or audit. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000; and

b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 307B (giving false or misleading information – maximum penalty 2 years imprisonment or 200 penalty units, or both)

Name of Auditor	Gary Graham
Qualification	BSc(hons), MSc, CSci, CEnv, CAQP
Company	Northstar Air Quality Pty Ltd
Company Address	Suite 1504, 275 Alfred Street, North Sydney NSW 2060
Signature	

APPENDIX B – BIOFILTER PHOTOGRAPHS

Biofilter A (Shoalhaven Starches, photographed on 01/08/22)

Biofilter B (Shoalhaven Starches, photographed on 01/08/22)

APPENDIX C – DDG BIOFILTER & CAPACITY & CONDITION ASSESSMENT REPORTS

TO: JOHN STUDDERT
COMPANY: MANILDRA GROUP, SHOALHAVEN STARCHES
FROM: MICHAEL ASSAL
DATE: 6 APRIL 2022
SUBJECT: DDG BIOFILTER PERFORMANCE AND CONDITION ASSESSMENT 25 – 9 DECEMBER 2021

1. Introduction

In December 2011, Shoalhaven Starches commissioned The Odour Unit Pty Ltd (**TOU**) to carry out regular inspections of the Dried Distillers Grain (**DDG**) Biofilter System. The objective of these assessments is to provide feedback to Shoalhaven Starches on the condition and performance of the biofilter-based odour control system on an as required basis.

The assessments are currently carried out on a half-yearly basis. The following report covers the findings of Biofilter Assessment 25, undertaken on 9 December 2021 by TOU.

2. Biofilter Design – DDG Biofilters 1 & 2

The designs for Biofilters 1 & 2 are identical and summarised below:

Construction:	Concrete, twin-cells
Bed area:	Two cells, each 55 m^2, total surface area of 110 m^2
Bed depth:	1.8 m
Medium:	Proprietary bark/green waste compost blend
Design airflow:	15,000 m^3/hr per biofilter
Design loading rates:	137 m^3/m^2/hr, 76 m^3/m^3/hr, 48 seconds EBRT at 15,000 m^3/hr per biofilter
Moisture control:	Pre-humidified airstream

It is understood that the medium in Biofilter 2 was replaced mid-October 2020 and that Biofilter 1 has not been refurbished since mid-2019.

3. Assessment Methodology

The assessment followed an identical methodology to that used in all previous assessments, as follows:

- Velocity and airflow into each biofilter;
- Temperature and relative humidity measurements into the biofilters;
- Pressure readings in each inlet duct;

- Visual inspection and pressure reading at biofilter drain sumps;
- Spatial surface outflow readings on the biofilter beds (see below); and
- A visual and olfactory assessment of the biofilter by the assessor.

The spatial testing involves the use of a TOU sampling hood, systematically placed at selected locations on the biofilter surface. The readings for velocity are taken from the 100 mm Polyvinyl Chloride (**PVC**) vent pipe on the lid of the hood. Due to the low velocities in the vent pipe and the exposed location on the biofilter surface, the measurement technique is prone to the effects of ambient wind conditions. The high wind velocities can upset the measured velocities in the vent pipe. At the time of this assessment, the prevailing winds were suitable for the undertaking of spatial testing on the DDG biofilter system.

The sampling port installed in the main duct to the DDG biofilters, upstream of the flow splitter junction has enabled more accurate measurement of airflow velocity to the overall system. In this assessment, the airflow to DDG Biofilter 1 was determined as the difference between the combined readings from this common inlet location and the new Dryer duct, and the reading into DDG Biofilter 2.

4. Physical Assessment Results – Main Duct into DDG Biofilter System

The **Main Duct** measurements yielded the following results in this assessment:

Airflow:	16.23 m/s, 18,210 m^3/hr (ϕ = 600 mm)
Inlet air relative humidity:	100%
Inlet air temperature:	46.0 °C
Inlet air pressure:	+220 Pa

The **DDG Biofilter 2** measurements yielded the following results:

Airflow:	8.41 m/s, 8,500 m^3/hr (ϕ = 600 mm)
Inlet air relative humidity:	100%
Inlet air temperature:	44.6 °C
Inlet air pressure:	+78 Pa (+86 Pa Cell 1, +70 Pa Cell 2)
Biofilter outlet air humidity:	saturated
Duct pressure in header manifold:	+190 Pa
Biofilter under-bed drain pressure:	+31 Pa Cell 1, +35 Pa Cell 2

Dryer #4 Duct measurements yielded the following results in this assessment, noting that Dryer #4 was offline:

Airflow:	10.26 m/s, 2,880 m^3/hr (ϕ = 300 mm)
Inlet air relative humidity:	100%
Inlet air temperature:	33.0°C
Inlet air pressure:	+350 Pa

The derived results for the **DDG Biofilter 1** are as follows:

Airflow:	9,600 m^3/hr
Inlet air relative humidity:	100%
Inlet air temperature:	44.4^{o}C
Inlet air pressure:	+70 Pa
Biofilter outlet air humidity:	saturated
Biofilter surface air temperature:	40.6^{o}C (mean)

The combined total flow to the biofilters is 18,210 m^3/hr

The distribution of airflow to the two biofilters is relatively even.

5. Spatial Testing Results

The spatial testing locations are shown in **Figure 5.1** & **Figure 5.2** for DDG Biofilter 1 & DDG Biofilter 2, with the spatial testing results presented in **Table 5.1** & **Table 5.2**, respectively. The spatial testing results for DDG Biofilter 1 & DDG Biofilter 2 are visually depicted in **Figure 5.3** & **Figure 5.4**.

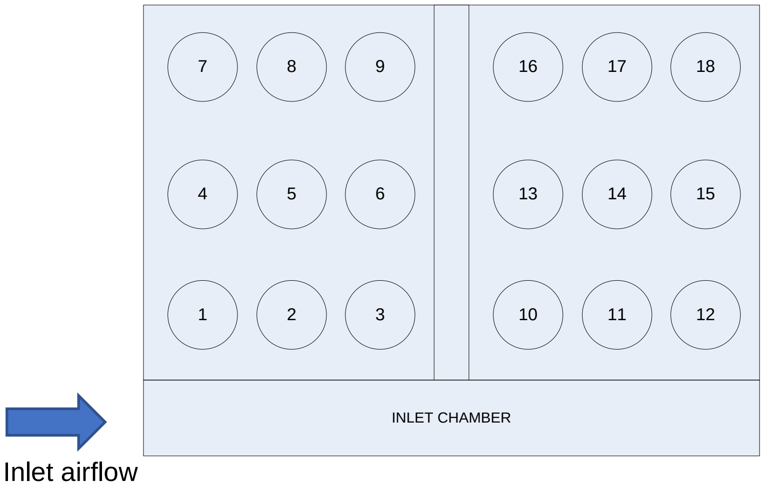


Figure 5.1 – Spatial Testing Locations – DDG Biofilter 1

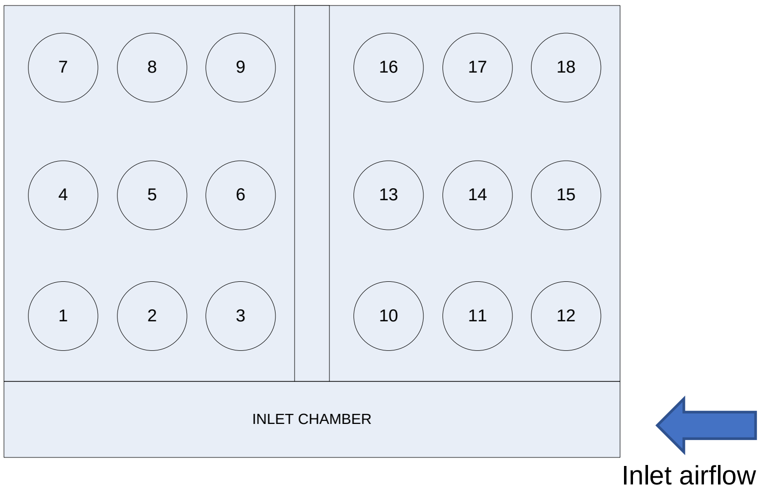


Figure 5.2 – Spatial Testing Locations – DDG Biofilter 2

Table 5.1 – Spatial airflow results: DDG Biofilter 1: 9 December 2021			
Biofilter Cell	**Location ID**	**Outflow Velocity (m/s)**	**Mean Outlet Temperature (^{0}C)**
Cell 1 (Northern Cell)	Location 1	0.93	Refer to **Section 4**
	Location 2	0.81	
	Location 3	0.73	
	Location 4	0.65	
	Location 5	0.61	
	Location 6	0.63	
	Location 7	0.70	
	Location 8	0.58	
	Location 9	0.67	
Cell 2 (Southern Cell)	Location 10	0.77	
	Location 11	0.76	
	Location 12	0.93	
	Location 13	0.66	
	Location 14	0.63	
	Location 15	0.72	
	Location 16	0.66	
	Location 17	0.64	
	Location 18	0.70	
Spatial Outflow Statistical Analysis		**Cell 1**	**Cell 2**
Average (m/s)		0.70	0.72
Standard deviation (m/s)		± 0.1	± 0.09
Percentage variation (%)		1.5	1.1

Table 5.2 – Spatial airflow results: DDG Biofilter 2: 9 December 2021

Biofilter Cell	Location ID	Outflow Velocity (m/s)	Mean Outlet Temperature (°C)
Cell 1 (Southern Cell)	Location 1	0.81	Refer to **Section 4**
	Location 2	0.86	
	Location 3	0.90	
	Location 4	0.88	
	Location 5	0.74	
	Location 6	0.97	
	Location 7	0.87	
	Location 8	0.88	
	Location 9	0.74	
Cell 2 (Northern Cell)	Location 10	0.65	
	Location 11	0.80	
	Location 12	0.90	
	Location 13	0.97	
	Location 14	0.89	
	Location 15	0.74	
	Location 16	0.93	
	Location 17	0.86	
	Location 18	0.85	
Spatial Outflow Statistical Analysis		**Cell 1**	**Cell 2**
Average (m/s)		0.85	0.84
Standard deviation (m/s)		± 0.07	± 0.09
Percentage variation (%)		0.6	1.0

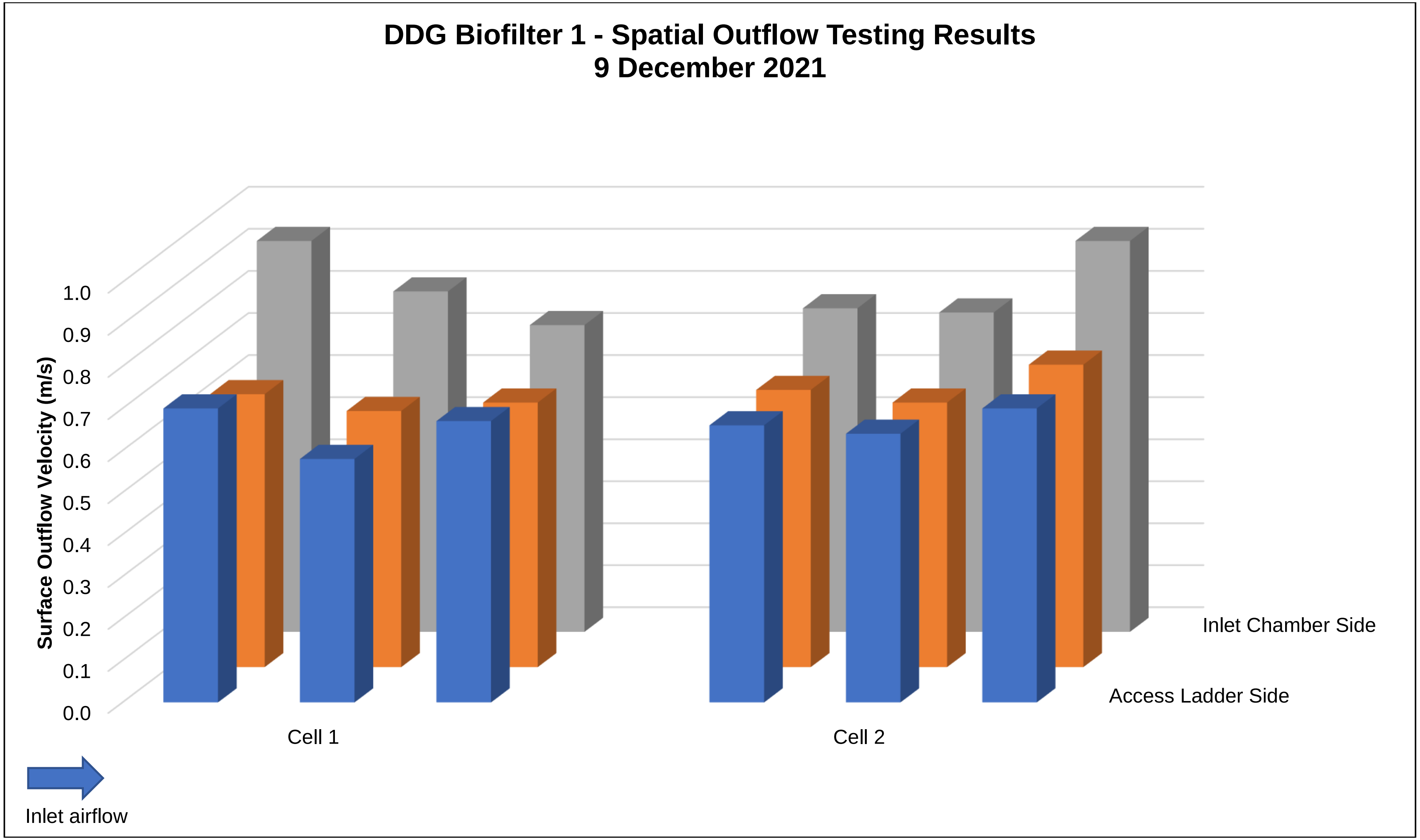


Figure 5.3 – Biofilter 1: Spatial Outflow Testing Results on 9 December 2021

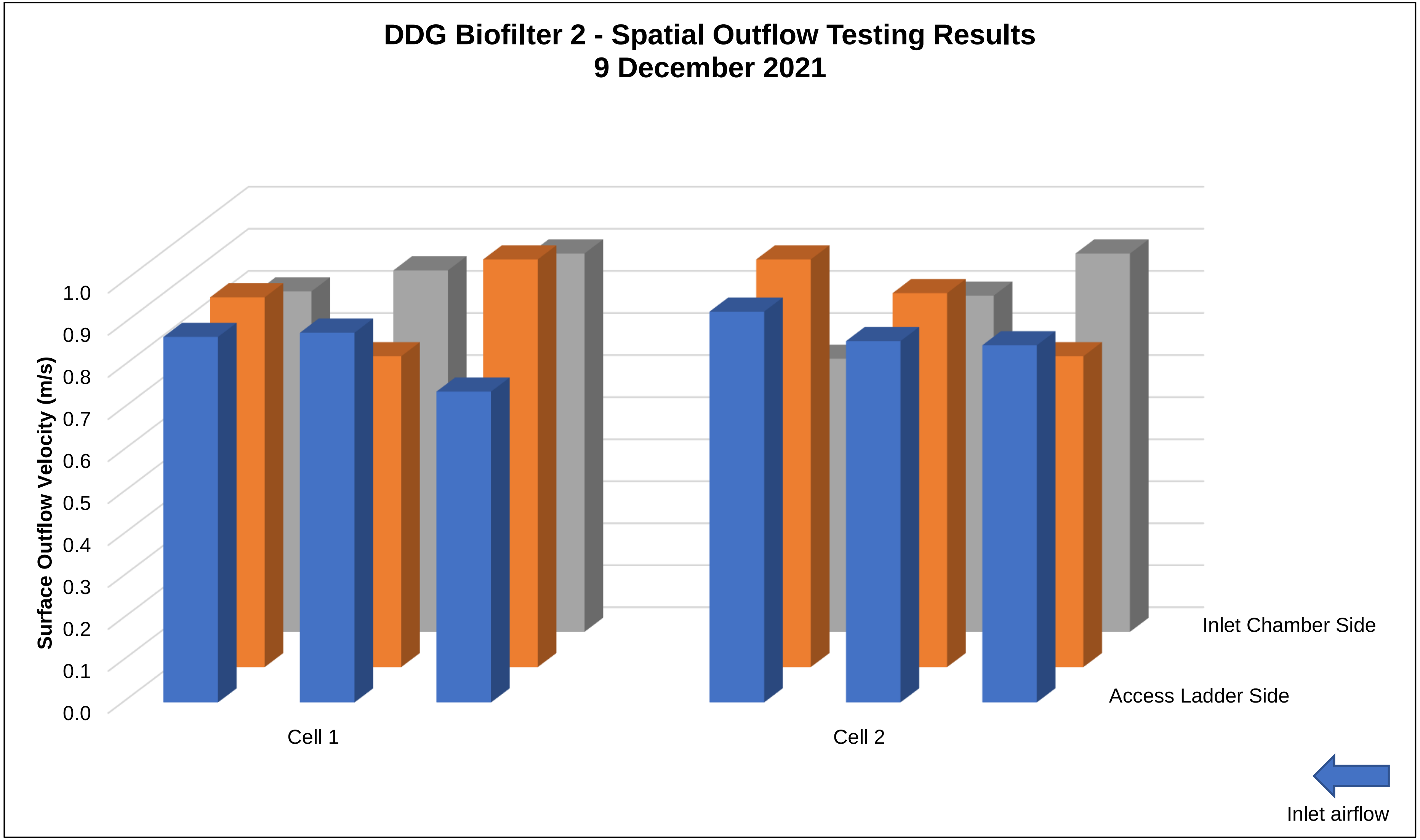


Figure 5.4 – Biofilter 2: Spatial Outflow Testing Results on 9 December 2021

6. Odour Destruction Efficiency Results

As with previous assessments, odour samples were collected from the DDG biofilters' common inlet duct, and outlet samples from the surface of each cell from both Biofilters 1 & 2. A sample was not collected from the Dryer #4 duct as it was offline for the duration of this assessment. Each surface sample was a composite, prepared from three locations across the biofilter beds. One biofilter inlet sample was collected and tested on this occasion. The results of the odour testing of these samples are appended to this report, and are summarised as follows:

Common Biofilter Inlet:	8,930 ou (grain, oil)
Dryer #4 Duct:	N/A (offline)
Flow Weighted Inlet to biofilters:	8,930 ou
Biofilter 2 Cell 2 Outlet – Southern Cell:	1,330 ou (grain, oil, fermented)
Biofilter 2 Cell 1 Outlet – Northern Cell:	4,470 ou (grain, oil, fermented)
Biofilter 1 Cell 2 Outlet – Southern Cell:	5,790 ou (grain, oil, fermented)
Biofilter 1 Cell 1 Outlet – Northern Cell:	6,890 ou (grain, oil, fermented)
Mean Result:	3,920 ou
Mean Odour Destruction Efficiency:	56%

The above results indicate that neither biofilter met the target outlet concentration of 500 ou.

7. Trend Data Analyses

Commencing with the testing results following the commissioning of DDG Biofilter 2 in October 2011, the results of the regular assessments are plotted for key parameters, to identify potentially adverse trends as they occur. These have been plotted as **Figure 7.1** to **Figure 7.5** and include temperature, airflow, back-pressure, and odour concentration, respectively.

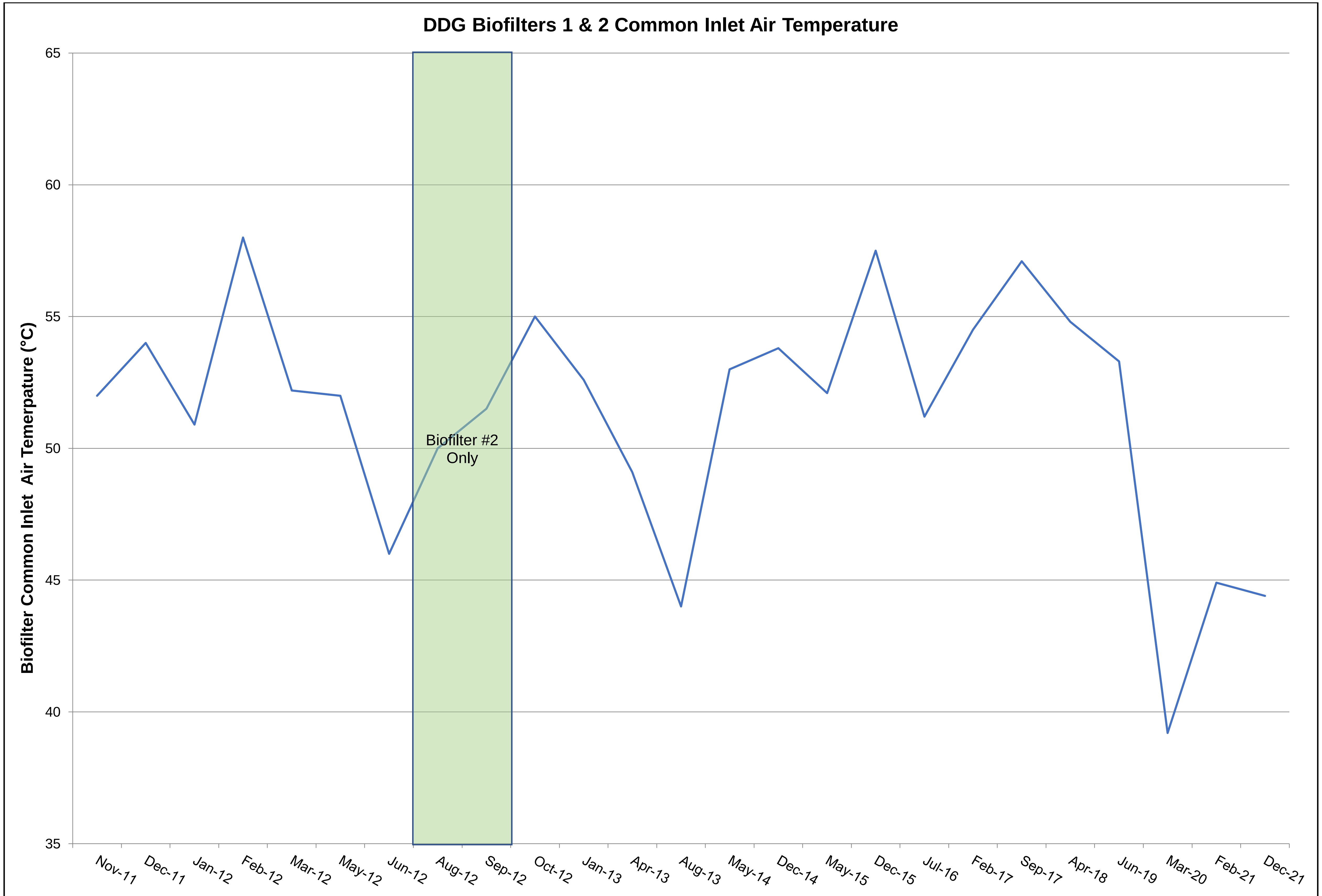


Figure 7.1 – DDG Biofilters 1 & 2 Common Inlet Air Temperature Monitoring

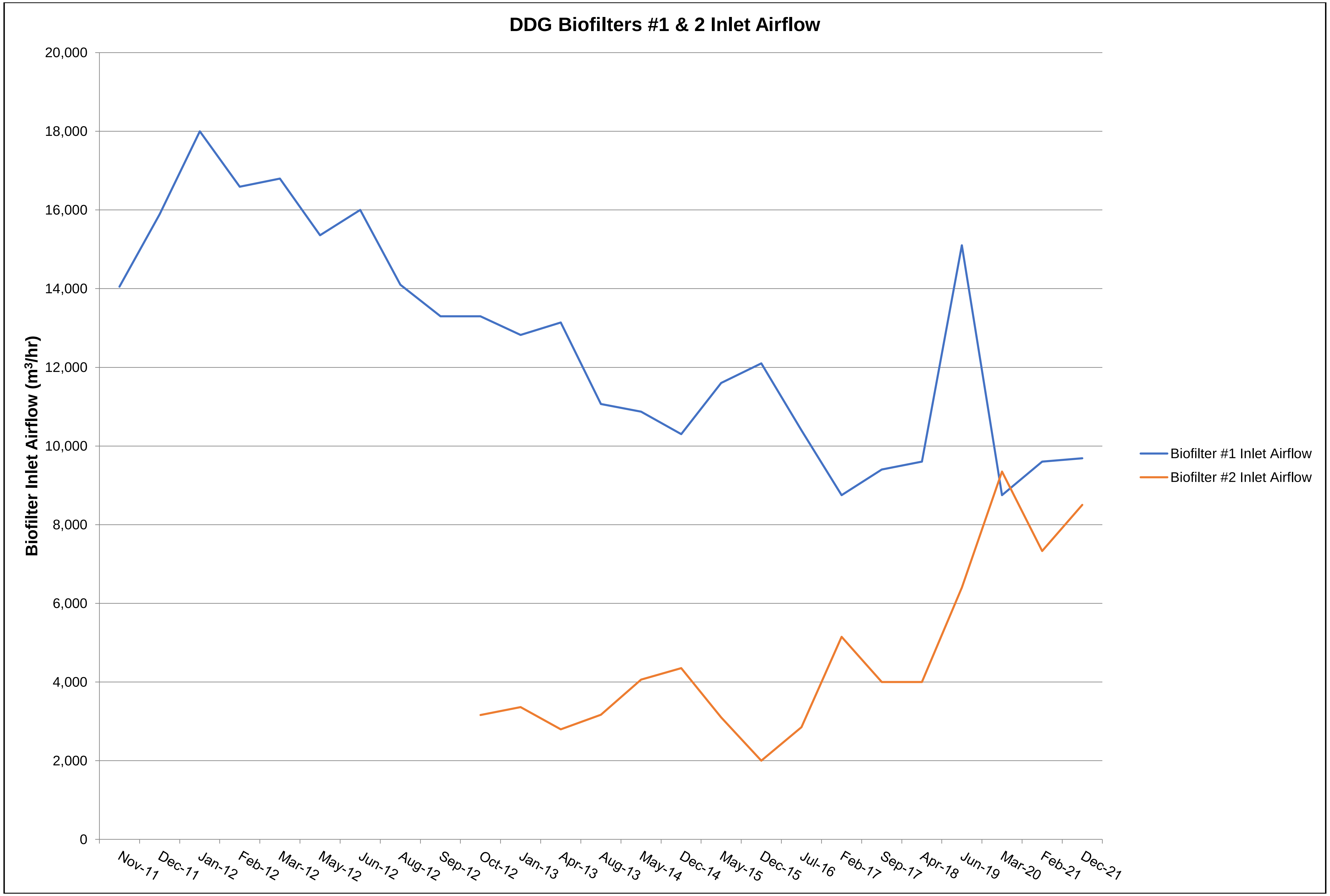


Figure 7.2 – DDG Biofilters 1 & 2 Inlet Airflows

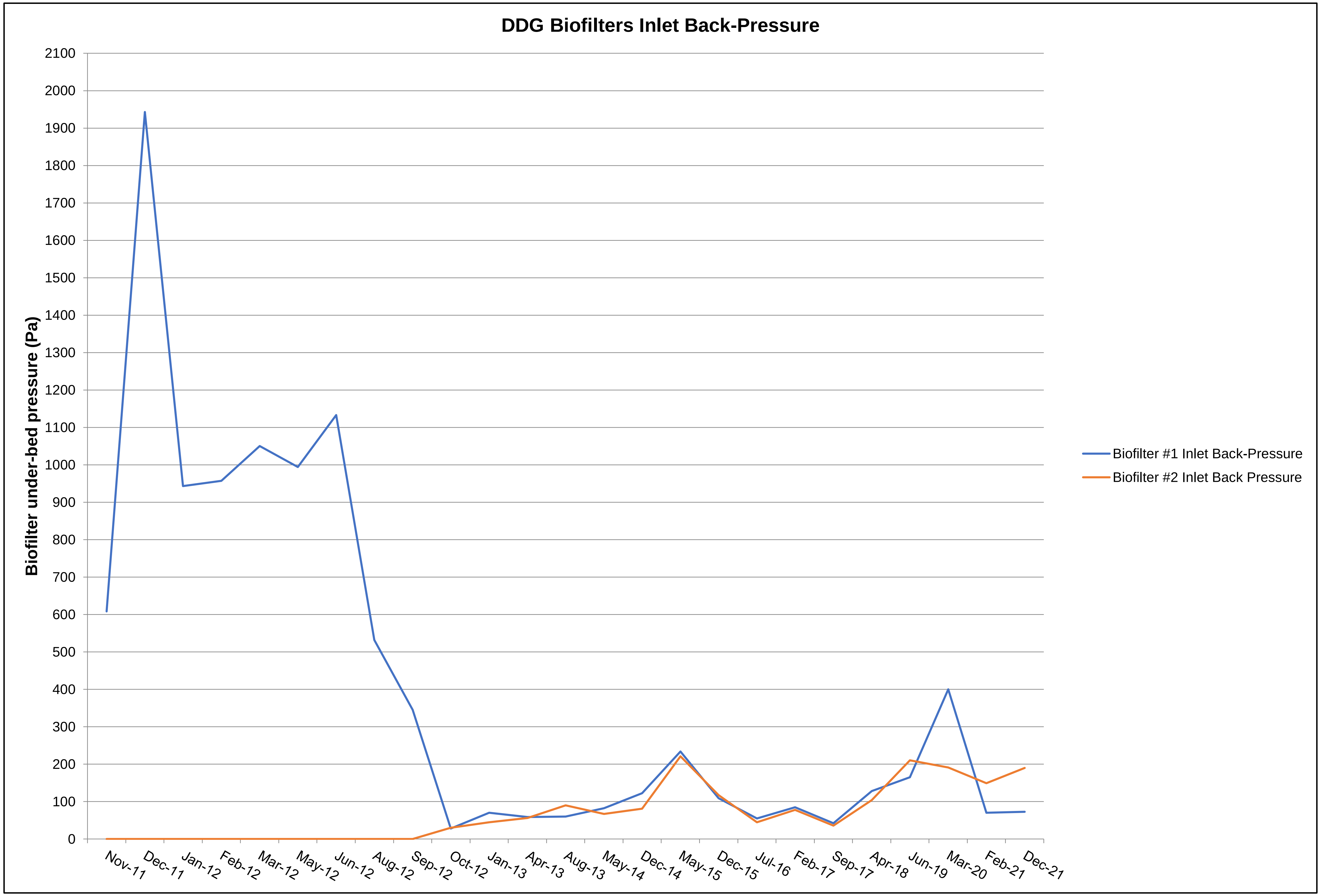


Figure 7.3 – DDG Biofilters 1 & 2 Inlet Back-Pressures

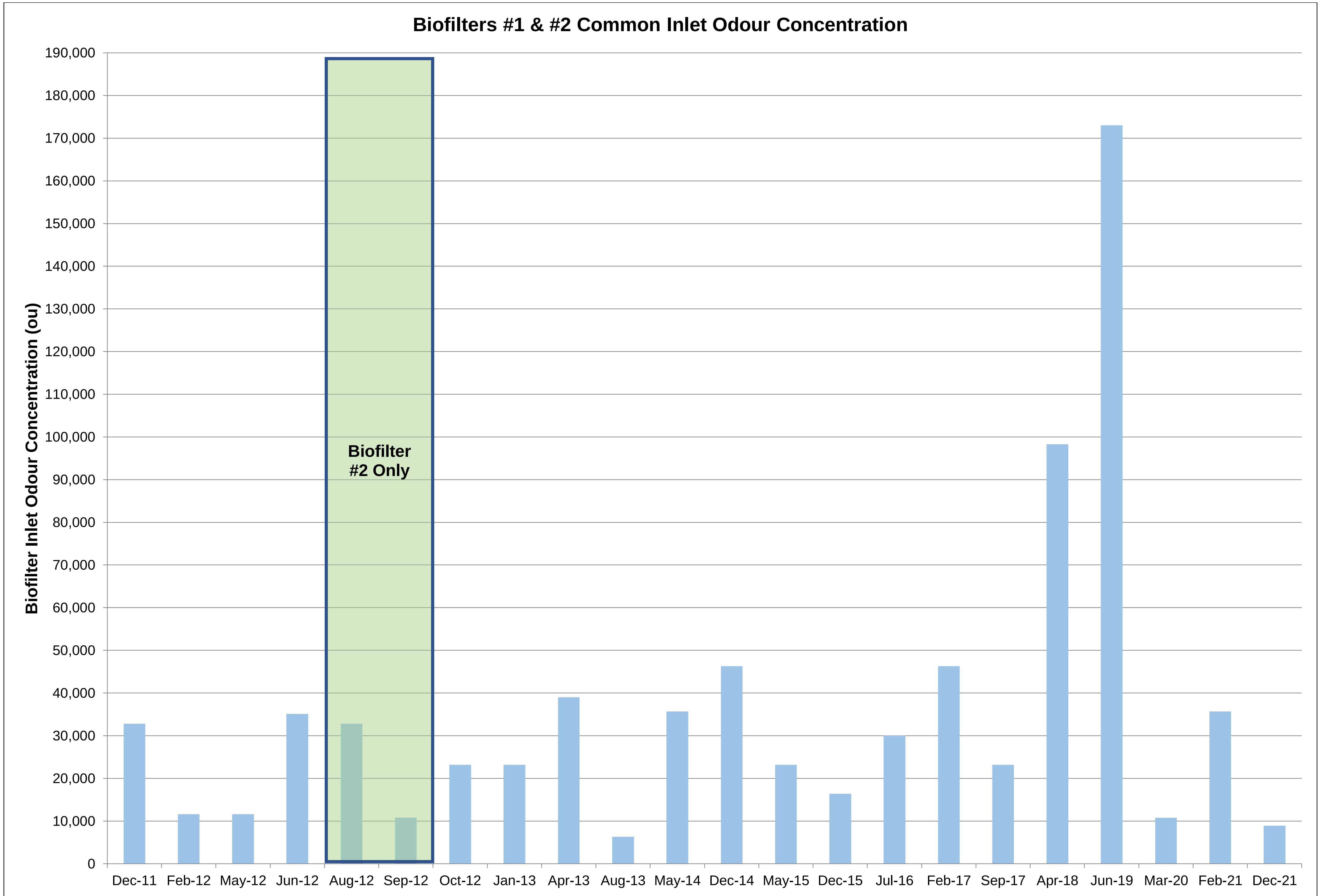


Figure 7.4 – DDG Biofilters 1 & 2 Common Inlet Odour Concentration

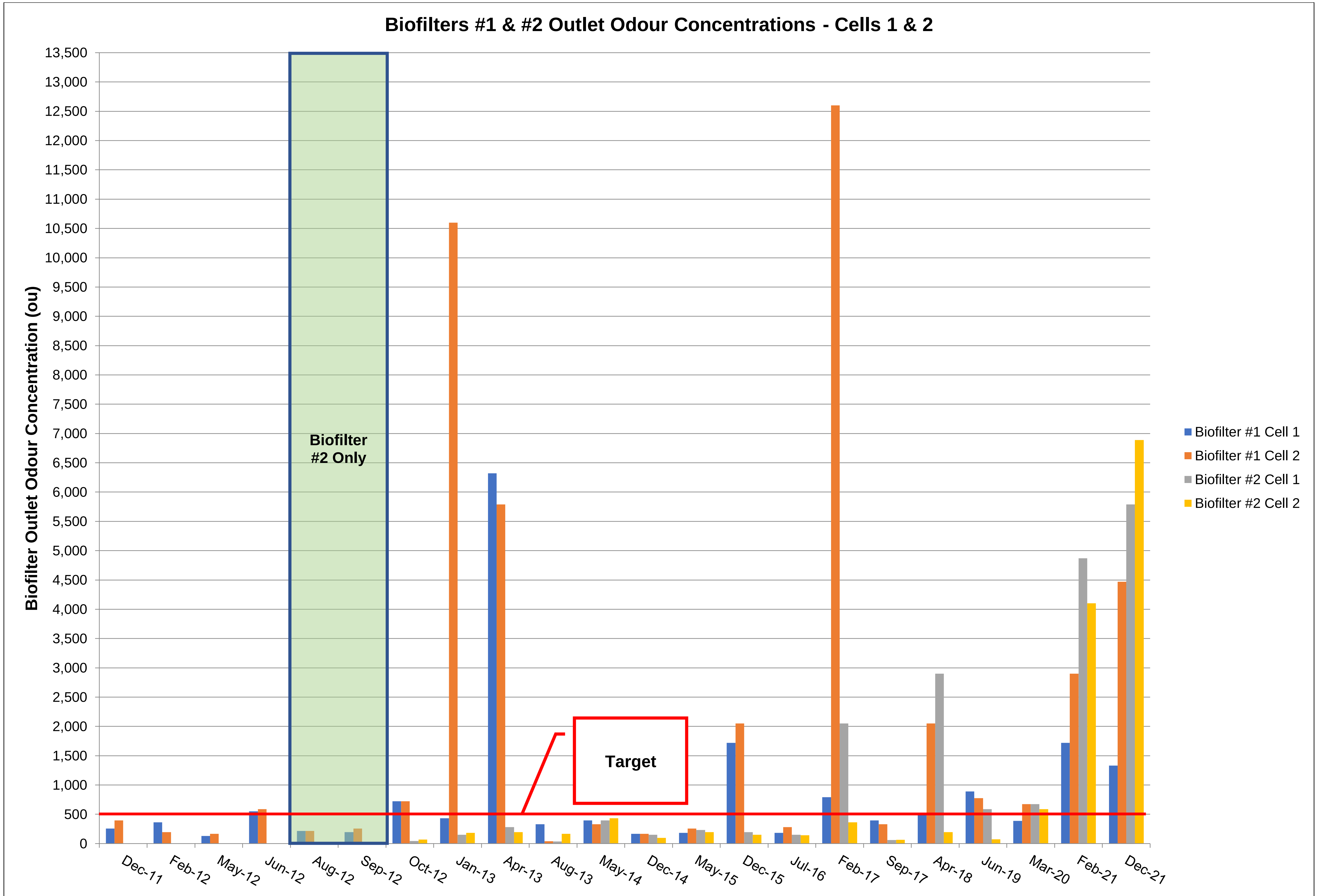


Figure 7.5 – DDG Biofilters 1 & 2 Outlet Odour Concentrations

8. Visual and Olfactory Assessment

During the assessment, the condition of the DDG biofilter medium was visually assessed, with the performance also assessed by an olfactory evaluation.

Photo 1 – A view of DDG Biofilter 1 as found on 9 December 2021

Photo 2 – A view of DDG Biofilter 2 as found on 9 December 2021

The medium in both biofilters, although of different ages, appeared to be in good condition.

The odour emitted from the DDG biofilter system still contained residual inlet odour. This odour was detectable beyond the perimeter of the biofilter. This issue is discussed below.

It is understood that the medium age of Biofilter 1 is over 24 months old, with Biofilter 2 refurbished in late-October 2020.

9. Biofilter Drainage

The drainage flows from the biofilter appeared normal.

10. Discussion and Recommendations

The following comments are made based on the assessment results:

- The airflow to the biofilter system has maintained the historical airflow rate. The distribution of airflow between the two biofilters is very even (53%/47%, in favour of Biofilter 1) and within the historical range. This balance is expected and acceptable from both a performance and medium life perspective;

- The mean flow-weighted outlet odour concentration of 4,250 ou significantly exceeded the nominal 500 ou target concentration. The presence of residual DDG odour character in the treated samples indicates that full odour removal is not occurring. The fact that all four biofilter cells exceeded the target concentration suggests that the loading rate on the system may now be excessive for the current configuration, rather than a specific problem with one or more cells

- Notwithstanding the above comment, the inlet odour concentration was typical of the pre-April 2018 levels and lower than the 2018 and 2019 results;

- The temperature of the inlet air has been maintained in the mid-40°C range but lies below the historical mean for this parameter. This biofilter system has shown itself to be resilient to elevated and variable temperatures. These minor variations are likely due to changes in operating conditions, and are normal for this biofilter system;

- Biofilter back-pressures and spatial outflow distribution results are within the normal range and are acceptable; and

- The inlet air relative humidity remains in a saturated condition.

11. Concluding Remarks

In summary, the reason for the decrease in odour removal performance for this biofilter system is being investigated by TOU and Shoalhaven Starches with gas speciation laboratory samples collected as part of this assessment (including an outlet sample from Bioflter 1 and Biofilter 2, a common inlet sample to the biofilter and a sample from DDG Dryer 1 Exhaust Fan). The outcomes from the gas speciation laboratory analysis is reported in a separate documentation. However, if follow-up testing confirms this level of performance the capacity of the biofilters may need to be increased and/or refurbished.

The next assessment is scheduled for **August 2022**.

The Odour Unit Pty Ltd

Signed by:

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

Isaac Farrugia B.Eng (Chem)
Consultant Engineer

Attachment:

- Odour Concentration Laboratory Results: 9 December 2021

THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

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NATA
Accreditation Number: 14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	Manildra Group	Telephone	(02) 4423 8200
Contact	J. Studdert	Facsimile	(02) 4423 8331
Sampling Site	Bomaderry, NSW	Email	John.studdert@manildra.com.au
Sampling Method	Drum & Pump	Sampling Team	TOU

Order details:

Order requested by	J. Studdert	Order accepted by	M. Assal
Date of order	Refer to correspondence	TOU Project #	N1752L
Order number	Refer to correspondence	Project Manager	M. Assal
Signed by	J. Studdert	Panel Operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – *Part 3*: '*Determination of odour concentration by dynamic olfactometry* (AS/NZS4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \le \chi \le 2^{18}$ 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 at 22 ºC ±3 ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: TOU-OLF-004.
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \le 0.477$ in accordance with the AS/NZS 4323.3. $r = 0.280$ Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \le 0.217$ in accordance with the AS/NZS 4323.3. $A = 0.076$ Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. Note Disclaimers on last page of this document.

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

Date: 14 January 2022

Panel Roster Number: SYD20211210_113-1

A. Schulz
Authorised Signatory

THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20211210_113-1

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Sample Odour Concentration (ou)
Sample 2 – DDG Biofilter #1 Cell 1 (North)	SC21837	09/12/2021 13:40 hrs	10/12/2021 10:07 hrs	4	8	1,330
Sample 3 - DDG Biofilter #1 Cell 2 (South)	SC21838	09/12/2021 13:48 hrs	10/12/2021 10:37 hrs	4	8	4,470
Sample 4 – DDG Biofilter #2 Cell 1 (North)	SC21839	09/12/2021 13:54 hrs	10/12/2021 11:32 hrs	4	8	5,790
Sample 5 – DDG Biofilter #2 Cell 2 (South)	SC21840	09/12/2021 13:59 hrs	10/12/2021 12:03 hrs	4	8	6,890
Sample 6 – DDG Biofilter Common Inlet (Pre DDG 4)	SC21841	09/12/2021 14:05 hrs	10/12/2021 14:51 hrs	4	8	8,930

Samples Received in Laboratory – From: A. Schulz Date: 10/12/2021 Time: 0900 hrs

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

1. The collection of samples by the methods of AS/NZS 4323.4 and the calculation of Specific Odour Emission Rate (SOER).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS 4323.3 (Yes / No)
n-butanol	SYD20211210_113	51,000	$20 \leq \chi \leq 80$	861	59	Yes

Comments

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

SC21837	grainy, oil, fermented cabbage
SC21838	grainy, oil, fermented cabbage
SC21839	grainy, oil, fermented
SC21840	grainy, oil, fermented
SC21481	grainy, oil

Disclaimers

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

Report Status

Status	Version	Date	Prepared by	Checked by	Change	Reason
Draft	0.1	14.01.2022	M. Gilbert	I. Farrugia	-	-
Final	1.0	14.01.2022	I. Farrugia	M. Assal	-	-
Revised	-	-	-	-	-	-

END OF DOCUMENT

APPENDIX D – ANNUAL AND QUARTERLY ODOUR EMISSION SURVEYS

Ektimo

REPORT NUMBER R011036

Odour Emission Testing Report , Quarter 1 2021-22
Manildra Group, Shoalhaven Starches Pty Ltd, Bomaderry

Document Information

Template Version; 160621

Client Name:	Manildra Group
Report Number:	R011036
Date of Issue:	30 September 2021
Attention:	John Studdert
Address:	160 Bolong Rd. Bomaderry NSW 2541
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

NATA Accredited Laboratory
No. 14601

Zoe Parker
Air Monitoring Consultant

Steven Cooper
Ektimo Signatory

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

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

Table of Contents

1 Executive Summary 4
1.1 Background 5
1.2 Project Objectives 5
2 Results 6
2.1 Results summary 6
2.2 EPA ID 8 – No. 1 Gluten Dryer Baghouse 7
2.3 EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse 8
2.4 EPA ID 10 - No. 3 Gluten Dryer Baghouse 9
2.5 EPA ID 11 - No. 4 Gluten Dryer Baghouse 10
2.6 EPA ID 12 – No. 1 Starch Dryer Scrubber 11
2.7 EPA ID 13 – No. 3 Starch Dryer Scrubber 12
2.8 EPA ID 14 – No. 4 Starch Dryer Scrubber 13
2.9 EPA ID 16 – CO_2 Scrubber Outlet 14
2.10 EPA ID 35 - Combined Boiler 5 & 6 Stack 15
2.11 EPA ID 39 - Biofilter Inlet 16
2.12 EPA ID 39A - Biofilter inlet 17
2.13 EPA ID 40 - Biofilter A East 18
2.14 EPA ID 40 - Biofilter A West 19
2.15 EPA ID 41 - Biofilter B East 20
2.16 EPA ID 41 - Biofilter B West 21
2.17 EPA ID 42 - Boiler 4 22
2.18 EPA ID 44 – Fermenter 11 23
2.19 EPA ID 45 - Boiler 2 24
2.20 EPA ID 46 - DDG Pellet Plant Stack 25
2.21 EPA ID 47 - No. 5 Starch Dryer Scrubber 26
2.22 CO_2 Scrubber Inlet 27
3 Plant Operating Conditions 28
4 Test Methods 28
5 Quality Assurance/Quality Control Information 28
6 Definitions 29
7 Appendix 1: Site Photos 30
8 Appendix 2: Historical odour results 34

Table of Figures

Figure 1. Starch Dryers No 1, 3 & 4 (EPA 12, EP13, EPA14) 34
Figure 2. Gluten Dryers No 1,2,3 & 4 (EPA 8, EPA 9, EPA 10, EPA 11) 34
Figure 3. Starch Dryer 5 (EPA 47) 35
Figure 4. Fermenters (EPA 44) 35
Figure 5. Carbon dioxide Scrubber Outlet (EPA 16) 36
Figure 6. Combined Boiler 5 & 6 Stack (EPA 35) 36
Figure 7. Boiler 4 Stack (EPA 42) 37
Figure 8. Boiler 2 Stack (EPA 45) 37
Figure 9. Biofilters (EPA 39,40, 41) 38
Figure 10. DDG Pellet Plant (EPA 46) 38

1 EXECUTIVE SUMMARY

1.1 *Background*

Ektimo was engaged by Manildra Group to perform odour and emission testing at their Bomaderry plant.

1.2 *Project Objectives*

The objectives of the project were to conduct a monitoring programme to quantify odour emissions from 19 discharge points to comply with Shoalhaven Starches' Environment Protection Licence 883.

Monitoring was performed as follows:

<table>
<tr><th>Location</th><th>Test Date</th><th>Test Parameters*</th></tr>
<tr><td>EPA ID 8 – No. 1 Gluten Dryer Baghouse</td><td rowspan="2">22 July 2021</td><td rowspan="9">Odour, oxygen</td></tr>
<tr><td>EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse</td></tr>
<tr><td>EPA ID 10 - No. 3 Gluten Dryer Baghouse</td><td rowspan="2">8 June 2021</td></tr>
<tr><td>EPA ID 11 - No. 4 Gluten Dryer Baghouse</td></tr>
<tr><td>EPA ID 12 – No. 1 Starch Dryer Scrubber</td><td>22 July 2021</td></tr>
<tr><td>EPA ID 13 – No. 3 Starch Dryer Scrubber</td><td rowspan="2">20 July 2021</td></tr>
<tr><td>EPA ID 14 – No. 4 Starch Dryer Scrubber</td></tr>
<tr><td>EPA ID 16 – CO_2 Scrubber Outlet</td><td>22 July 2021</td></tr>
<tr><td>EPA ID 35 - Combined Boiler 5 & 6 Stack</td><td>8 June 2021</td></tr>
<tr><td>EPA ID 39A - Biofilter inlet</td><td>7 June 2021</td><td>Odour</td></tr>
<tr><td>EPA ID 40 - Biofilter A</td><td rowspan="2">7 June 2021</td><td rowspan="2">Duplicate odour</td></tr>
<tr><td>EPA ID 41 - Biofilter B</td></tr>
<tr><td>EPA ID 42 - Boiler 4</td><td>8 June 2021</td><td>Odour, oxygen</td></tr>
<tr><td>EPA ID 44 – Fermenter</td><td>22 July 2021</td><td rowspan="2">Odour</td></tr>
<tr><td>EPA ID 39 - Biofilter Inlet</td><td>7 June 2021</td></tr>
<tr><td>EPA ID 45 - Boiler 2</td><td>8 June 2021</td><td>Odour, oxygen</td></tr>
<tr><td>EPA ID 46 - DDG Pellet Plant Stack</td><td>19 July 2021</td><td>Odour</td></tr>
<tr><td>EPA ID 47 - No. 5 Starch Dryer Scrubber</td><td>7 June 2021</td><td rowspan="2">Odour, oxygen</td></tr>
<tr><td>CO_2 Scrubber Inlet</td><td>22 July 2021</td></tr>
</table>

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

All results are reported on a dry basis at STP (except odour wet – STP).
Plant operating conditions have been noted in the report.

2 RESULTS

2.1 *Results summary*

Location	Date	Odour		Hedonic Tone	Character
		Concentration [ou]	Mass Rate [oum^3/min]		
EPA ID 8 - No. 1 Gluten Dryer Baghouse	22/07/2021	970	-	Mildly unpleasant	Wet wheat & oats, chemical, fizzy
EPA ID 9 - No. 2 Gluten Dryer/Starch Dryer Baghouse	22/07/2021	680	660,000	Mildly unpleasant	Wet wheat & oats, dough, chemical, fizzy
EPA ID 10 - No. 3 Gluten Dryer Baghouse	8/06/2021	530	2,100,000	Neutral	Dough, playdough
EPA ID 11 - No. 4 Gluten Dryer Baghouse	8/06/2021	750	1,400,000	Mildly unpleasant	Wet, soil, dough
EPA ID 12 - No. 1 Starch Dryer Scrubber	22/07/2021	190	240,000	Mildly unpleasant	Grain, bread, dough, starch
EPA ID 13 - No. 3 Starch Dryer Scrubber	20/07/2021	89	100,000	Neutral	Flour, musty
EPA ID 14 - No. 4 Starch Dryer Scrubber	20/07/2021	230	280,000	Neutral	Sweet, playdough
EPA ID 16 - CO_2 Scrubber Outlet	22/07/2021	20,000	2,300,000	Mildly pleasant	Alcohol, fruit, sweet
EPA ID 35 - Combined Boiler 5 & 6 Stack	8/06/2021	480	930,000	Mildly unpleasant	Sulfur, chlorine
EPA ID 39 - Biofilter Inlet	7/06/2021	4,900	970,000	Mildly unpleasant	Bread, dough, yeast
EPA ID 39A - Biofilter Inlet	7/06/2021	60,000	2,700,000	Mildly unpleasant	Bread, dough, yeast
EPA ID 40 - Biofilter A East	7/06/2021	7,100	16,000,000	Very unpleasant	Yeast, vegemite
EPA ID 40 - Biofilter A West	7/06/2021	8,100	18,000,000	Very unpleasant	Yeast, vegemite
EPA ID 41 - Biofilter B East	7/06/2021	6,200	14,000,000	Very unpleasant	Yeast, vegemite
EPA ID 41 - Biofilter B West	7/06/2021	8,700	19,000,000	Very unpleasant	Yeast, vegemite
EPA ID 42 - Boiler 4	8/06/2021	1,900	1,500,000	Very unpleasant	Sulfur, chlorine
EPA ID 44 - Fermenter 11	22/07/2021	11,000	770,000	Very unpleasant	Alcohol, fruit, sweet, stale
EPA ID 45 - Boiler 2	8/06/2021	440	140,000	Mildly unpleasant	Sulfur, chlorine
EPA ID 46 - DDG Pellet Plant Stack	19/07/2021	1,300	1,800,000	Neutral	Sweet, bread, grain
EPA ID 47 - No. 5 Starch Dryer Scrubber	7/06/2021	1,400	920,000	Neutral	Glue, bread, starch
CO_2 Scrubber Inlet	22/07/2021	14,000	1,600,000	Mildly unpleasant	Alcohol, fruit, sweet

2.2 *EPA ID 8 – No. 1 Gluten Dryer Baghouse*

Date	22/07/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 8 - No. 1 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Scott Woods & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		

Sampling Plane Details	
Sampling plane dimensions	2400 x 2560 mm
Sampling plane area	6.14 m²
Sampling port size, number	Tested from exit
Access & height of ports	Stairs & ladders 22 m
Duct orientation & shape	Horizontal Rectangular
Sample plane compliance to AS4323.1	Non-compliant

Comments
Sampling was undertaken at the exit of the stack as it was the only accessible area for the samples to be taken. No temperature or flow rate readings could be taken due to access issues.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters	
Moisture content, %v/v	5.3
Gas molecular weight, g/g mole	28.4 (wet)
Gas density at STP, kg/m³	1.27 (wet)
Velocity difference, %	<1

Gas Analyser Results	Average
Sampling time	1200 - 1259
	Concentration % v/v
Oxygen	20.9

Odour	Results
Sampling time	1209 - 1219
	Concentration ou
Results	970
Lower uncertainty limit	680
Upper uncertainty limit	1400
Hedonic tone	Mildly unpleasant
Odour character	Wet wheat & oats, chemical, fizzy
Analysis date & time	23/07/21, 1000
Holding time	22 hours
Dilution factor	1
Bag material	Teflon™
Butanol threshold (ppb)	73.6
Laboratory temp (°C)	22
Last calibration date	October 2020

2.3 *EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse*

Date	22/07/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 9 - No. 2 Gluten Dryer / Starch Dryer
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Scott Woods & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210720

Sampling Plane Details	
Sampling plane dimensions	1190 mm
Sampling plane area	1.11 m²
Sampling port size, number & depth	2" BSP (x4), 90 mm
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 2 D
Upstream disturbance	Bend 0.5 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	4.3	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.94	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1145 & 1245
Temperature, °C	63
Temperature, K	336
Velocity at sampling plane, m/s	20
Volumetric flow rate, actual, m³/s	22
Volumetric flow rate (wet STP), m³/s	16
Volumetric flow rate (dry STP), m³/s	15
Mass flow rate (wet basis), kg/hour	74000
Velocity difference, %	<1

Gas Analyser Results	Average
Sampling time	1146 - 1244
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1220 - 1230	
	Concentration ou	Mass Rate oum³/min
Results	680	660000
Lower uncertainty limit	470	
Upper uncertainty limit	980	
Hedonic tone	Mildly unpleasant	
Odour character	Wet wheat & oats, dough, chemical, fizzy	
Analysis date & time	23/07/21, 1000	
Holding time	22 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	73.6	
Laboratory temp (°C)	22	
Last calibration date	October 2020	

2.4 *EPA ID 10 - No. 3 Gluten Dryer Baghouse*

Date	8/06/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 10 - No. 3 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210525

Sampling Plane Details	
Sampling plane dimensions	2100 x 2400 mm
Sampling plane area	5.04 m²
Sampling port size, number	2" Ball valve (x3)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 5 D
Upstream disturbance	Change in diameter 2.5 D
No. traverses & points sampled	3 21
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The gas velocity at some or all sampling points is less than 3 m/s
The highest to lowest differential pressure ratio exceeds 9:1
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	6.4	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.99	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1425 & 1525
Temperature, °C	74
Temperature, K	347
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/s	83
Volumetric flow rate (wet STP), m³/s	65
Volumetric flow rate (dry STP), m³/s	61
Mass flow rate (wet basis), kg/hour	300000
Velocity difference, %	2

Gas Analyser Results	Average
Sampling time	1425 - 1526
	Concentration %v/v
Oxygen	20.8

Odour	Results	
Sampling time	1411 - 1421	
	Concentration ou	Mass Rate oum³/min
Results	530	2100000
Lower uncertainty limit	370	
Upper uncertainty limit	750	
Hedonic tone	Neutral	
Odour character	Dough, playdough	
Analysis date & time	09/06/21, 1400-1500	
Holding time	24 hours	
Dilution factor	1	
Bag material	Teflon™	
Butanol threshold (ppb)	47.1	
Laboratory temp (°C)	22.65	
Last calibration date	October 2020	

2.5 EPA ID 11 - No. 4 Gluten Dryer Baghouse

Date	8/06/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 11 - No. 4 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210525

Sampling Plane Details	
Sampling plane dimensions	1400 x 1700 mm
Sampling plane area	2.38 m²
Sampling port size, number	4" BSP (x3)
Access & height of ports	Stairs 30 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 6 D
No. traverses & points sampled	3 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	4.1	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.00	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1550 & 1650
Temperature, °C	74
Temperature, K	347
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/s	39
Volumetric flow rate (wet STP), m³/s	31
Volumetric flow rate (dry STP), m³/s	29
Mass flow rate (wet basis), kg/hour	140000
Velocity difference, %	2

Gas Analyser Results	Average
Sampling time	1550 - 1649
	Concentration %v/v
Oxygen	20.7

Odour	Results	
Sampling time	1640 - 1650	
	Concentration ou	Mass Rate oum³/min
Results	750	1400000
Lower uncertainty limit	530	
Upper uncertainty limit	1100	
Hedonic tone	Mildly unpleasant	
Odour character	Wet, soil, dough	
Analysis date & time	09/06/21, 1400-1500	
Holding time	21 hours	
Dilution factor	1	
Bag material	Teflon™	
Butanol threshold (ppb)	47.1	
Laboratory temp (°C)	22.65	
Last calibration date	October 2020	

2.6 EPA ID 12 – No. 1 Starch Dryer Scrubber

Date	22/07/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 12 - No. 1 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Scott Woods & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210720

Sampling Plane Details	
Sampling plane dimensions	1500 x 1500 mm
Sampling plane area	2.25 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 25 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Silencer 0 D
No. traverses & points sampled	3 15
Sample plane compliance to AS4323.1	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The highest to lowest differential pressure ratio exceeds 9:1
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	4.1	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.12	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1245 & 1345	
Temperature, °C	34	
Temperature, K	307	
Velocity at sampling plane, m/s	10	
Volumetric flow rate, actual, m³/s	23	
Volumetric flow rate (wet STP), m³/s	20	
Volumetric flow rate (dry STP), m³/s	19	
Mass flow rate (wet basis), kg/hour	93000	
Velocity difference, %	2	

Gas Analyser Results	Average
Sampling time	1247 - 1346
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1302 - 1312	
	Concentration ou	Mass Rate oum³/min
Results	190	240000
Lower uncertainty limit	140	
Upper uncertainty limit	280	
Hedonic tone	Mildly unpleasant	
Odour character	Grain, bread, dough, starch	
Analysis date & time	23/07/21, 1000	
Holding time	21 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	73.6	
Laboratory temp (°C)	22	
Last calibration date	October 2020	

2.7 EPA ID 13 – No. 3 Starch Dryer Scrubber

Date	20/07/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 13 - No. 3 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210720

Sampling Plane Details	
Sampling plane dimensions	1000 x 1050 mm
Sampling plane area	1.05 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	3 15
Sample plane compliance to AS4323.1	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	3.6	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.16	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1245 & 1345	
Temperature, °C	28	
Temperature, K	301	
Velocity at sampling plane, m/s	20	
Volumetric flow rate, actual, m³/s	21	
Volumetric flow rate (wet STP), m³/s	19	
Volumetric flow rate (dry STP), m³/s	18	
Mass flow rate (wet basis), kg/hour	88000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1245 - 1344
	Concentration % v/v
Oxygen	20.8

Odour	Results	
Sampling time	1328 - 1338	
	Concentration ou	Mass Rate oum³/min
Results	89	100000
Lower uncertainty limit	62	
Upper uncertainty limit	130	
Hedonic tone	Neutral	
Odour character	Flour, musty	
Analysis date & time	21/07/21, 0930-1030	
Holding time	20 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	51.9	
Laboratory temp (°C)	22.7	
Last calibration date	October 2020	

2.8 EPA ID 14 – No. 4 Starch Dryer Scrubber

Date	20/07/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 14 - No. 4 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210720

Sampling Plane Details	
Sampling plane dimensions	1000 x 1050 mm
Sampling plane area	1.05 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	3 15
Sample plane compliance to AS4323.1	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	5.8	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.11	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1245 & 1345	
Temperature, °C	37	
Temperature, K	310	
Velocity at sampling plane, m/s	22	
Volumetric flow rate, actual, m³/s	23	
Volumetric flow rate (wet STP), m³/s	20	
Volumetric flow rate (dry STP), m³/s	19	
Mass flow rate (wet basis), kg/hour	92000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1245 - 1344
	Concentration % v/v
Oxygen	20.4

Odour	Results	
Sampling time	1301 - 1311	
	Concentration ou	Mass Rate oum³/min
Results	230	280000
Lower uncertainty limit	160	
Upper uncertainty limit	330	
Hedonic tone	Neutral	
Odour character	Sweet, playdough	
Analysis date & time	21/07/21, 0930-1030	
Holding time	20 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	51.9	
Laboratory temp (°C)	22.7	
Last calibration date	October 2020	

2.9 EPA ID 16 – CO_2 Scrubber Outlet

Date	22/07/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 16 - CO2 Scrubber Outlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Scott Woods & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210720

Sampling Plane Details	
Sampling plane dimensions	505 mm
Sampling plane area	0.2 m²
Sampling port size, number & depth	3" BSP (x1), 60 mm
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >6 D
Upstream disturbance	Junction >10 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	1	
Gas molecular weight, g/g mole	42.1 (wet)	42.4 (dry)
Gas density at STP, kg/m³	1.88 (wet)	1.89 (dry)
Gas density at discharge conditions, kg/m³	1.75	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1005 & 1045
Temperature, °C	18
Temperature, K	291
Velocity at sampling plane, m/s	10
Volumetric flow rate, actual, m³/s	2.1
Volumetric flow rate (wet STP), m³/s	1.9
Volumetric flow rate (dry STP), m³/s	1.9
Mass flow rate (wet basis), kg/hour	13000
Velocity difference, %	-1

Gas Analyser Results	Average
Sampling time	0932 - 1031
	Concentration %v/v
Oxygen	0.3

Odour	Results	
Sampling time	1016 - 1026	
	Concentration ou	Mass Rate oum³/min
Results	20000	2300000
Lower uncertainty limit	14000	
Upper uncertainty limit	29000	
Hedonic tone	Mildly pleasant	
Odour character	Alcohol, fruit, sweet	
Analysis date & time	23/07/21, 1000	
Holding time	24 hours	
Dilution factor	8	
Bag material	Teflon™	
Butanol threshold (ppb)	73.6	
Laboratory temp (°C)	22	
Last calibration date	October 2020	

2.10 *EPA ID 35 - Combined Boiler 5 & 6 Stack*

Date	8/06/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 35 - Combined Boiler 5 & 6 Stack
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210525

Sampling Plane Details	
Sampling plane dimensions	1985 mm
Sampling plane area	3.09 m²
Sampling port size, number & depth	4" BSP (x4), 100 mm
Access & height of ports	Stairs & ladders 40 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

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

Stack Parameters		
Moisture content, %v/v	5.4	
Gas molecular weight, g/g mole	29.5 (wet)	30.2 (dry)
Gas density at STP, kg/m³	1.32 (wet)	1.35 (dry)
Gas density at discharge conditions, kg/m³	0.91	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1110 & 1310	
Temperature, °C	121	
Temperature, K	394	
Velocity at sampling plane, m/s	15	
Volumetric flow rate, actual, m³/s	47	
Volumetric flow rate (wet STP), m³/s	32	
Volumetric flow rate (dry STP), m³/s	31	
Mass flow rate (wet basis), kg/hour	150000	
Velocity difference, %	5	

Gas Analyser Results	Average
Sampling time	1125 - 1302
	Concentration %v/v
Oxygen	8.9

Odour	Results	
Sampling time	1246 - 1256	
	Concentration ou	Mass Rate oum³/min
Results	480	930000
Lower uncertainty limit	340	
Upper uncertainty limit	680	
Hedonic tone	Mildly unpleasant	
Odour character	Sulfur, chlorine	
Analysis date & time	09/06/21, 1400-1500	
Holding time	25 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	47.1	
Laboratory temp (°C)	22.65	
Last calibration date	October 2020	

2.11 *EPA ID 39 - Biofilter Inlet*

Date	7/06/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 39 - Biofilter Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Steven Cooper	**State**	NSW
Process Conditions	Please refer to client records.		210525

Sampling Plane Details	
Sampling plane dimensions	600 mm
Sampling plane area	0.283 m²
Sampling port size, number & depth	1 x 1 inch port, 45 mm
Access & height of ports	Ground 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 6 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	4	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.06	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1540 & 1640	
Temperature, °C	38	
Temperature, K	312	
Velocity at sampling plane, m/s	14	
Volumetric flow rate, actual, m³/s	4	
Volumetric flow rate (wet STP), m³/s	3.3	
Volumetric flow rate (dry STP), m³/s	3.2	
Mass flow rate (wet basis), kg/hour	15000	
Velocity difference, %	1	

Gas Analyser Results	Average
Sampling time	1336 - 1435
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1540 - 1550	
	Concentration ou	Mass Rate oum³/min
Results	4900	970000
Lower uncertainty limit	3400	
Upper uncertainty limit	6900	
Hedonic tone	Mildly unpleasant	
Odour character	Bread, dough, yeast	
Analysis date & time	08/06/21, 1100-1230	
Holding time	19 hours	
Dilution factor	2	
Bag material	Teflon™	
Butanol threshold (ppb)	50.0	
Laboratory temp (°C)	23.35	
Last calibration date	October 2020	

2.12 *EPA ID 39A - Biofilter inlet*

Date	7/06/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 39A - Biofilter Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Steven Cooper	**State**	NSW
Process Conditions	Please refer to client records.		210525

Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number	1 x 1 inch port
Access & height of ports	Ground 0.6 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1.5 D
Upstream disturbance	Inlet >2 D
No. traverses & points sampled	1 4
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	2.9	
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	1.16	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1450 & 1550	
Temperature, °C	29	
Temperature, K	302	
Velocity at sampling plane, m/s	12	
Volumetric flow rate, actual, m³/s	0.82	
Volumetric flow rate (wet STP), m³/s	0.74	
Volumetric flow rate (dry STP), m³/s	0.72	
Mass flow rate (wet basis), kg/hour	3400	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1450 - 1549
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1450 - 1452	
	Concentration ou	Mass Rate oum³/min
Results	60000	2700000
Lower uncertainty limit	42000	
Upper uncertainty limit	85000	
Hedonic tone	Mildly unpleasant	
Odour character	Bread, dough, yeast	
Analysis date & time	08/06/21, 1100-1230	
Holding time	20 hours	
Dilution factor	9	
Bag material	Nalophan	
Butanol threshold (ppb)	50.0	
Laboratory temp (°C)	23.35	
Last calibration date	October 2020	

Ektimo

2.13 *EPA ID 40 - Biofilter A East*

Client	Manildra Group	**Test Location**	EPA ID 40 - Biofilter A East
Date	7/06/2021	**Plant/Site**	Ethanol Plant
Report No.	R011036		Bomaderry, NSW
Ektimo Staff	Zoe Parker & Steven Cooper		*210617*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	74
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	26
Sampling Results	
Sampling time, hrs	1511 - 1521
Sample dilution	1
Odour concentration, ou	**7100**
Hedonic tone	Very unpleasant
Odour character	Yeast, Vegemite
95% Confidence Interval	5000 - 10000
Odour Flux Rate, ou/m²/min	**5200**
Odour mass rate, ou/min	**520000**

2.14 *EPA ID 40 - Biofilter A West*

Client	Manildra Group	**Test Location**	EPA ID 40 - Biofilter A West
Date	7/06/2021	**Plant/Site**	Ethanol Plant
Report No.	R011036		Bomaderry, NSW
Ektimo Staff	Zoe Parker & Steven Cooper		*210617*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	63
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	22
Sampling Results	
Sampling time, hrs	1456 - 1506
Sample dilution	1
Odour concentration, ou	**8100**
Hedonic tone	Very unpleasant
Odour character	Yeast, Vegemite
95% Confidence Interval	5700 - 12000
Odour Flux Rate, ou/m²/min	**5100**
Odour mass rate, ou/min	**510000**

2.15 *EPA ID 41 - Biofilter B East*

Client	Manildra Group	**Test Location**	EPA ID 41 - Biofilter B East
Date	7/06/2021	**Plant/Site**	Ethanol Plant
Report No.	R011036		Bomaderry, NSW
Ektimo Staff	Zoe Parker & Steven Cooper		*210617*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	74
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	26
Sampling Results	
Sampling time, hrs	1440 - 1450
Sample dilution	1
Odour concentration, ou	**6200**
Hedonic tone	Very unpleasant
Odour character	Yeast, Vegemite
95% Confidence Interval	4400 - 8800
Odour Flux Rate, ou/m²/min	**4600**
Odour mass rate, ou/min	**460000**

2.16 *EPA ID 41 - Biofilter B West*

Client	Manildra Group	**Test Location**	EPA ID 41 - Biofilter B West
Date	7/06/2021	**Plant/Site**	Ethanol Plant
Report No.	R011036		Bomaderry, NSW
Ektimo Staff	Zoe Parker & Steven Cooper		*210617*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	76
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	27
Sampling Results	
Sampling time, hrs	1425 - 1435
Sample dilution	1
Odour concentration, ou	**8700**
Hedonic tone	Very unpleasant
Odour character	Yeast, Vegemite
95% Confidence Interval	6100 - 12000
Odour Flux Rate, ou/m²/min	**6600**
Odour mass rate, ou/min	**660000**

2.17 *EPA ID 42 - Boiler 4*

Date	8/06/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 42 - Boiler 4
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210525

Sampling Plane Details	
Sampling plane dimensions	1140 mm
Sampling plane area	1.02 m²
Sampling port size, number & depth	4" BSP (x2), 100 mm
Access & height of ports	Stairs 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >3 D
Upstream disturbance	Change in diameter 1 D
No. traverses & points sampled	2 16
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The upstream disturbance is <2D from the sampling plane

Stack Parameters		
Moisture content, %v/v	4.3	
Gas molecular weight, g/g mole	29.0 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.78	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1540 & 1640	
Temperature, °C	176	
Temperature, K	449	
Velocity at sampling plane, m/s	21	
Volumetric flow rate, actual, m³/s	21	
Volumetric flow rate (wet STP), m³/s	13	
Volumetric flow rate (dry STP), m³/s	12	
Mass flow rate (wet basis), kg/hour	60000	
Velocity difference, %	2	

Gas Analyser Results	Average
Sampling time	1540 - 1639
	Concentration % v/v
Oxygen	14.2

Odour	Results	
Sampling time	1546 - 1606	
	Concentration ou	Mass Rate oum³/min
Results	1900	1500000
Lower uncertainty limit	1400	
Upper uncertainty limit	2700	
Hedonic tone	Very unpleasant	
Odour character	Sulfur, chlorine	
Analysis date & time	09/06/21, 1400-1500	
Holding time	22 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	47.1	
Laboratory temp (°C)	22.65	
Last calibration date	October 2020	

Ektimo

2.18 *EPA ID 44 – Fermenter 11*

Date	22/07/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 44 - Fermenter 11
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Scott Woods & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210720

Sampling Plane Details	
Sampling plane dimensions	295 mm
Sampling plane area	0.0683 m²
Sampling port size, number & depth	3" BSP (x1), 75 mm
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 10 D
Upstream disturbance	Junction 2 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The stack or duct does not have the required number of access holes (ports)

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.9	
Gas molecular weight, g/g mole	34.3 (wet)	34.8 (dry)
Gas density at STP, kg/m³	1.53 (wet)	1.55 (dry)
Gas density at discharge conditions, kg/m³	1.38	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0950 & 1000	
Temperature, °C	28	
Temperature, K	301	
Velocity at sampling plane, m/s	19	
Volumetric flow rate, actual, m³/s	1.3	
Volumetric flow rate (wet STP), m³/s	1.2	
Volumetric flow rate (dry STP), m³/s	1.2	
Mass flow rate (wet basis), kg/hour	6500	
Velocity difference, %	<1	

Odour	Results	
Sampling time	0953 - 0958	
	Concentration ou	Mass Rate oum³/min
Results	11000	770000
Lower uncertainty limit	7500	
Upper uncertainty limit	15000	
Hedonic tone	Very unpleasant	
Odour character	Alcohol, fruit, sweet, stale	
Analysis date & time	23/07/21, 1000	
Holding time	24 hours	
Dilution factor	4	
Bag material	Nalophan	
Butanol threshold (ppb)	73.6	
Laboratory temp (°C)	22	
Last calibration date	October 2020	

2.19 *EPA ID 45 - Boiler 2*

Date	8/06/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 45 - Boiler 2
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210525

Sampling Plane Details	
Sampling plane dimensions	1070 mm
Sampling plane area	0.899 m²
Sampling port size, number & depth	4" Flange (x2), 180 mm
Access & height of ports	Ladders 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter 5 D
No. traverses & points sampled	2 16
Sample plane compliance to AS4323.1	Compliant but non-ideal

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

Stack Parameters		
Moisture content, %v/v	4.3	
Gas molecular weight, g/g mole	29.3 (wet)	29.8 (dry)
Gas density at STP, kg/m³	1.31 (wet)	1.33 (dry)
Gas density at discharge conditions, kg/m³	0.76	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1429 & 1529	
Temperature, °C	193	
Temperature, K	467	
Velocity at sampling plane, m/s	9.9	
Volumetric flow rate, actual, m³/s	8.9	
Volumetric flow rate (wet STP), m³/s	5.2	
Volumetric flow rate (dry STP), m³/s	4.9	
Mass flow rate (wet basis), kg/hour	24000	
Velocity difference, %	-1	

Gas Analyser Results	Average
Sampling time	1429 - 1528
	Concentration % v/v
Oxygen	12.1

Odour	Results	
Sampling time	1445 - 1505	
	Concentration ou	Mass Rate oum³/min
Results	440	140000
Lower uncertainty limit	310	
Upper uncertainty limit	620	
Hedonic tone	Mildly unpleasant	
Odour character	Sulfur, chlorine	
Analysis date & time	09/06/21, 1400-1500	
Holding time	23 hours	
Dilution factor	1	
Bag material	Teflon™	
Butanol threshold (ppb)	47.1	
Laboratory temp (°C)	22.65	
Last calibration date	October 2020	

2.20 *EPA ID 46 - DDG Pellet Plant Stack*

Date	19/07/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 46 - DDG Pellet Plant Stack
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker	**State**	NSW
Process Conditions	Please refer to client records.		210720

Sampling Plane Details	
Sampling plane dimensions	1460 mm
Sampling plane area	1.67 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Elevated work platform 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Junction 2.1 D
No. traverses & points sampled	1 16
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.6	
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	1.08	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1105 & 1125
Temperature, °C	51
Temperature, K	324
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/s	29
Volumetric flow rate (wet STP), m³/s	24
Volumetric flow rate (dry STP), m³/s	24
Mass flow rate (wet basis), kg/hour	110000
Velocity difference, %	<1

Odour	Results	
Sampling time	1109 - 1119	
	Concentration ou	Mass Rate oum³/min
Results	1300	1800000
Lower uncertainty limit	870	
Upper uncertainty limit	1800	
Hedonic tone	Neutral	
Odour character	Sweet, bread, grain	
Analysis date & time	19/07/21, 1345-1410	
Holding time	2 hours	
Dilution factor	1	
Bag material	Teflon™	
Butanol threshold (ppb)	73.6	
Laboratory temp (°C)	24.05	
Last calibration date	October 2020	

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2.21 *EPA ID 47 - No. 5 Starch Dryer Scrubber*

Date	7/06/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	EPA ID 47 - No. 5 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Steven Cooper	**State**	NSW
Process Conditions	Please refer to client records.		210525

Sampling Plane Details	
Sampling plane dimensions	800 mm
Sampling plane area	0.503 m²
Sampling port size, number & depth	4" Flange (x2), 120 mm
Access & height of ports	Stairs 20 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 9 D
Upstream disturbance	Bend 3.75 D
No. traverses & points sampled	2 16
Sample plane compliance to AS4323.1	Compliant but non-ideal

Sampling was undertaken from an alternative sampling location upstream of the actual emission point as directed by

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	4.4	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1320 & 1420	
Temperature, °C	58	
Temperature, K	331	
Velocity at sampling plane, m/s	26	
Volumetric flow rate, actual, m³/s	13	
Volumetric flow rate (wet STP), m³/s	11	
Volumetric flow rate (dry STP), m³/s	10	
Mass flow rate (wet basis), kg/hour	49000	
Velocity difference, %	1	

Gas Analyser Results	Average
Sampling time	1336 - 1435
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1325 - 1335	
	Concentration ou	Mass Rate oum³/min
Results	1400	920000
Lower uncertainty limit	1000	
Upper uncertainty limit	2000	
Hedonic tone	Neutral	
Odour character	Glue, bread, starch	
Analysis date & time	08/06/21, 1100-1230	
Holding time	22 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	50.0	
Laboratory temp (°C)	23.35	
Last calibration date	October 2020	

Ektimo

2.22 CO_2 Scrubber Inlet

Date	22/07/2021	**Client**	Manildra Group
Report	R011036	**Stack ID**	CO2 Scrubber Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Scott Woods & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210720

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	1 inch ball valve, 80 mm
Access & height of ports	Ground level 1.5 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 0.5 D
Upstream disturbance	Bend 0.5 D
No. traverses & points sampled	1 2
Sample plane compliance to AS4323.1	Non-compliant

Comments

Flow measurement readings were applied from EPA ID 16, the CO2 scrubber outlet, as flow was unable to be measured at this location.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	<0.4	
Gas molecular weight, g/g mole	42.4 (wet)	42.5 (dry)
Gas density at STP, kg/m³	1.89 (wet)	1.90 (dry)
Gas density at discharge conditions, kg/m³	1.70	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1031 & 1130
Temperature, °C	28
Temperature, K	301
Velocity at sampling plane, m/s	11
Volumetric flow rate, actual, m³/s	2.1
Volumetric flow rate (wet STP), m³/s	1.9
Volumetric flow rate (dry STP), m³/s	1.9
Mass flow rate (wet basis), kg/hour	13000

Gas Analyser Results	Average
Sampling time	1031 - 1130
	Concentration % v/v
Oxygen	0.2

Odour	Results	
Sampling time	1040 - 1050	
	Concentration ou	Mass Rate oum³/min
Results	14000	1600000
Lower uncertainty limit	9900	
Upper uncertainty limit	20000	
Hedonic tone	Mildly unpleasant	
Odour character	Alcohol, fruit, sweet	
Analysis date & time	23/07/21, 1000	
Holding time	23 hours	
Dilution factor	8	
Bag material	Teflon™	
Butanol threshold (ppb)	73.6	
Laboratory temp (°C)	22	
Last calibration date	October 2020	

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3 PLANT OPERATING CONDITIONS

See Manildra Group records for complete process conditions.

4 TEST METHODS

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

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sampling points - Selection	USEPA Method 1	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW TM-2	NSW TM-2	8%, 2%, 7%	NA	✓
Moisture content	NSW TM-22	NSW TM-22	19%	✓	✓
Molecular weight	NA	NSW TM-23	not specified	NA	✓
Oxygen	NSW TM-25	NSW TM-25	13%	✓	✓
Odour	NSW OM-7	NSW OM-7¥	Refer to results	✓	✓
Odour Characterisation	NA	direct observation	NA	NA	×

210607

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

* 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 8 June 2021 in report number ON-00082.
Results were reported on 9 June 2021 in report number ON-00083.
Results were reported on 19 July 2021 in report number ON-00087.
Results were reported on 21 July 2021 in report number ON-00088.
Results were reported on 23 July 2021 in report number ON-00089.

5 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 APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised worldwide.

6 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	Continuous Emission Monitoring
CEMS	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 defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. 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
Lower Bound	Defines values reported below detection as equal to zero.
Medium Bound	Defines values reported below detection are equal to half 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	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
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
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 will be determined by matching the integrated 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 afterflows.
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry
Upper Bound	Defines values reported below detection are equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

7 APPENDIX 1: SITE PHOTOS

EPA ID 39 - Biofilter Inlet

EPA ID 39A - Biofilter Inlet

EPA ID 47 - Starch Dryer 5

EPA ID 40 - Biofilter A

EPA ID 41 - Biofilter B

EPA ID 10 - Gluten Dryer 3

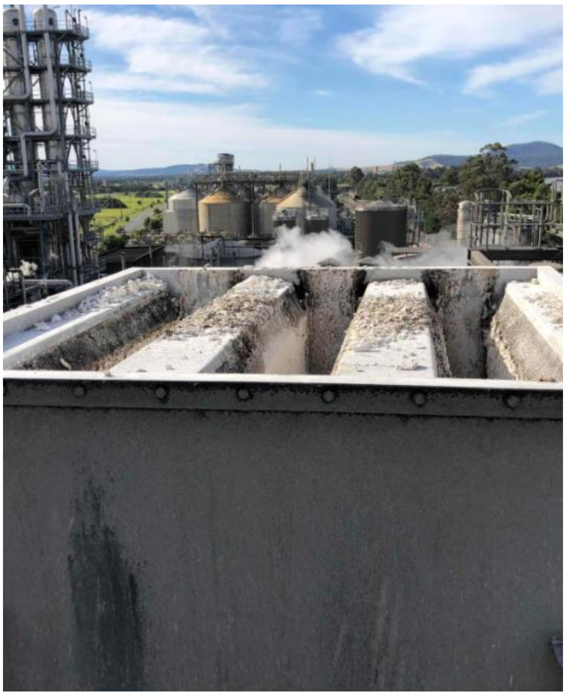
EPA ID 11 - Gluten Dryer 4

EPA ID 35 - Combined Boilers 5 & 6

EPA ID 42 - Boiler 4

EPA ID 45 - Boiler 2

EPA ID 9 – No. 2 Gluten Dryer



EPA ID 12 – No. 1 Starch Dryer Scrubber

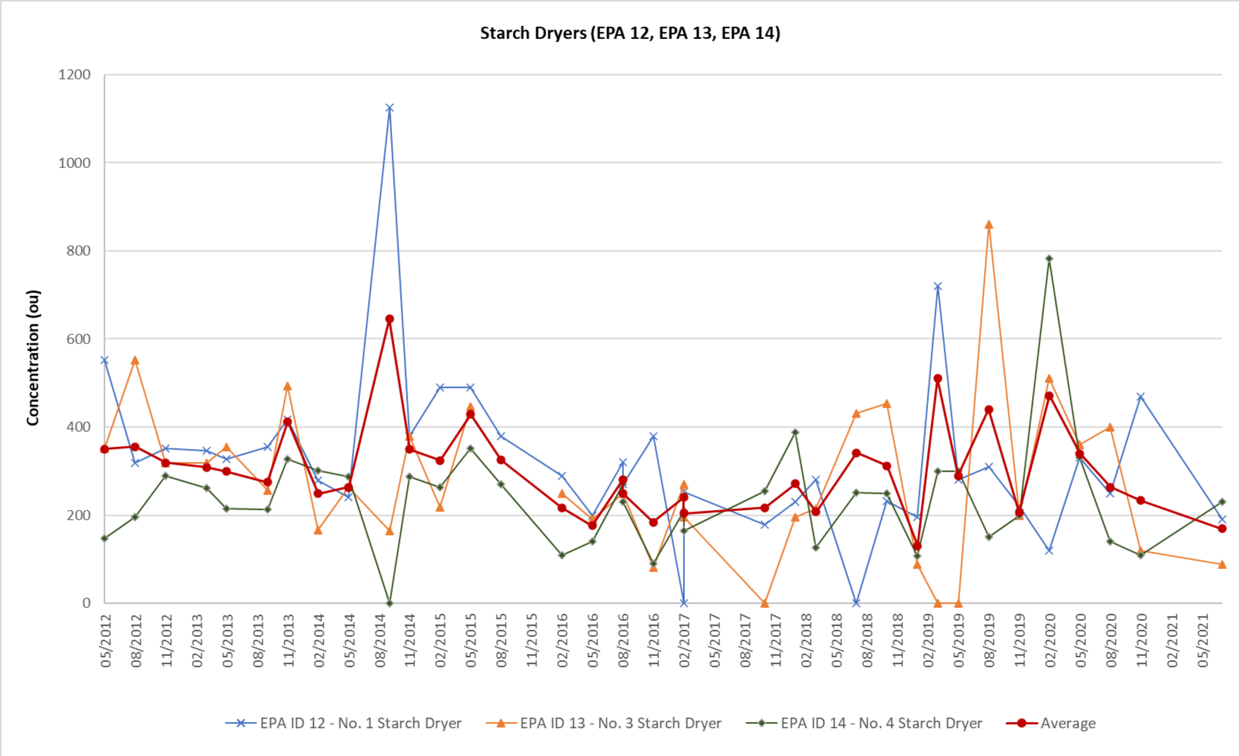
EPA ID 13 – No. 3 Starch Dryer Scrubber

EPA ID 14 – No. 4 Starch Dryer Scrubber

EPA ID 46 – DDG Pellet Plant Stack

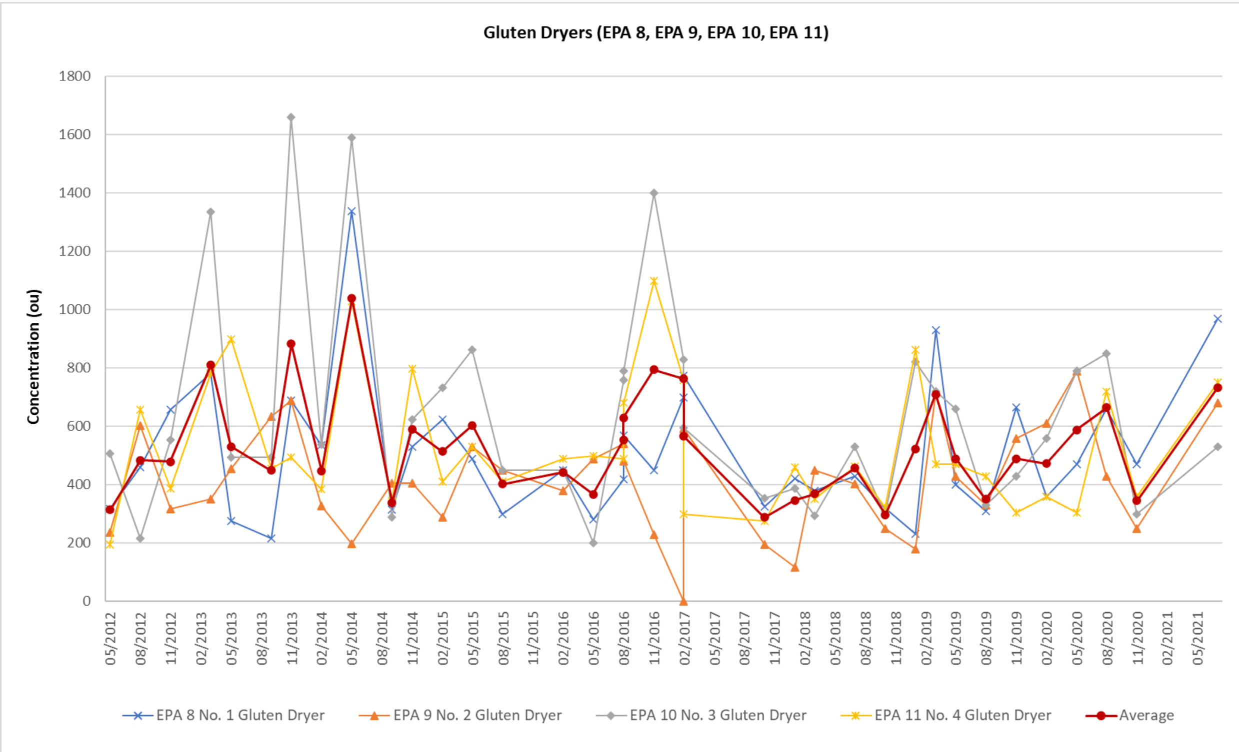
8 APPENDIX 2: HISTORICAL ODOUR RESULTS

Figure 1. Starch Dryers No 1, 3 & 4 (EPA 12, EP13, EPA14)



Zero result represents Dryer not operating on days of testing

Figure 2. Gluten Dryers No 1,2,3 & 4 (EPA 8, EPA 9, EPA 10, EPA 11)



Zero result represents Dryer not operating on days of testing

Figure 3. Starch Dryer 5 (EPA 47)

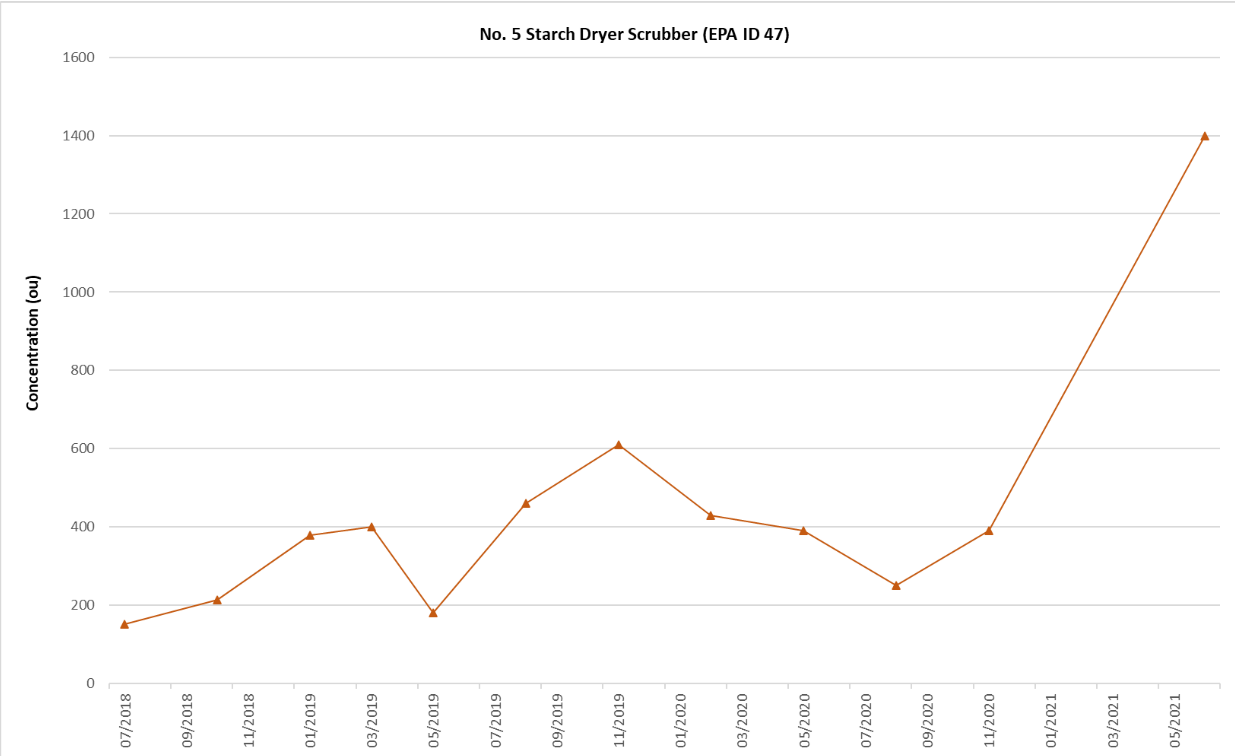
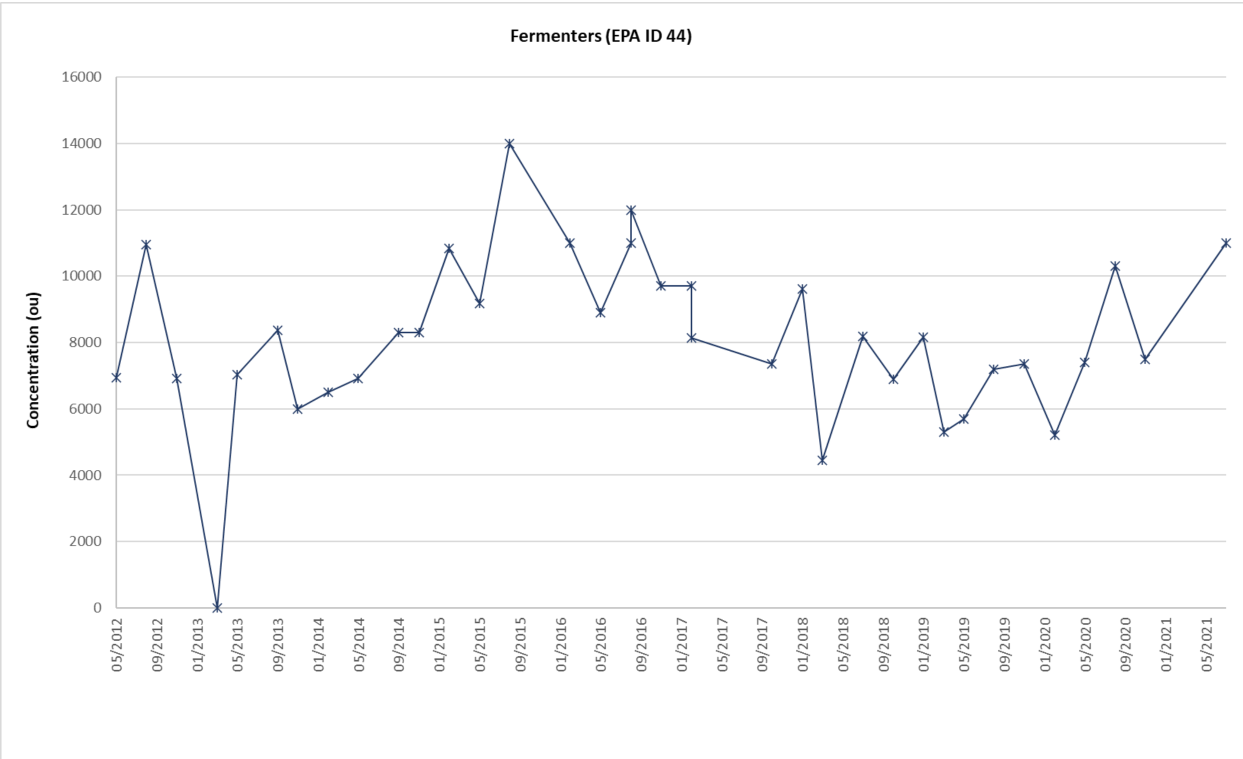


Figure 4. Fermenters (EPA 44)



Zero result represents Fermenter not operating on days of testing

Figure 5. Carbon dioxide Scrubber Outlet (EPA 16)

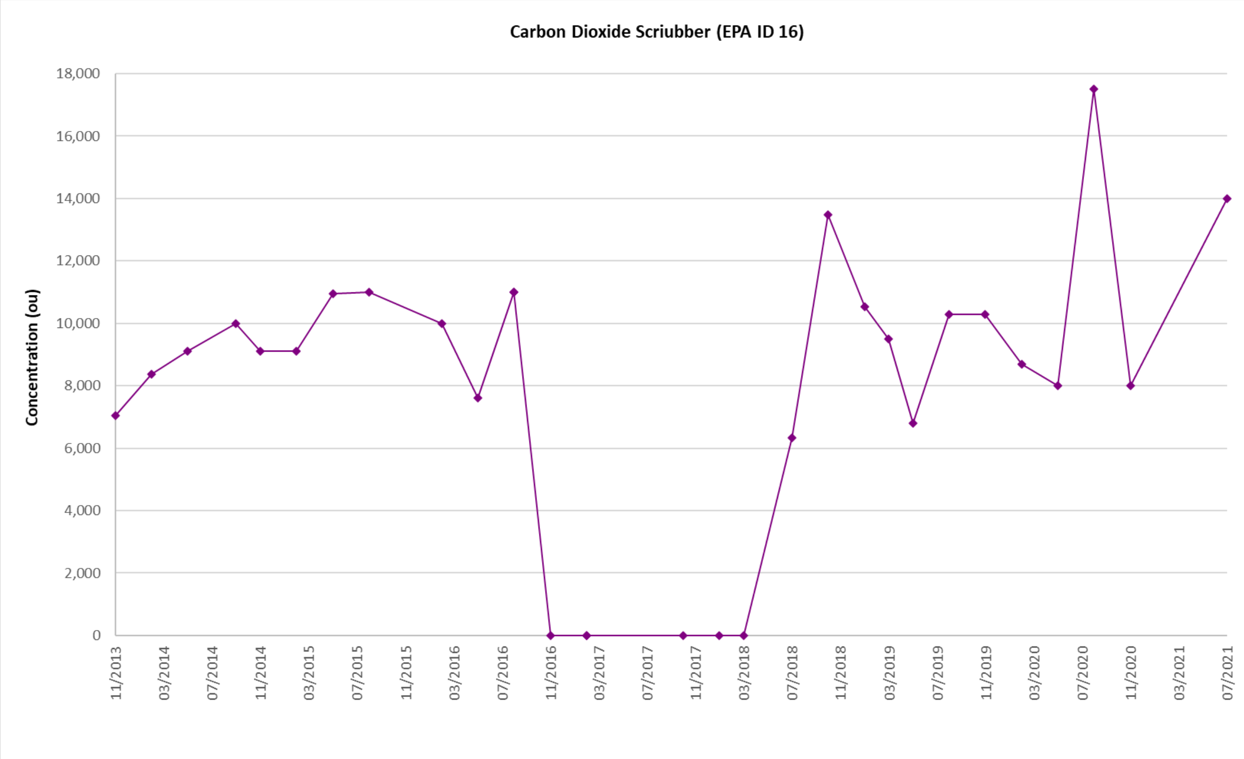


Figure 6. Combined Boiler 5 & 6 Stack (EPA 35)

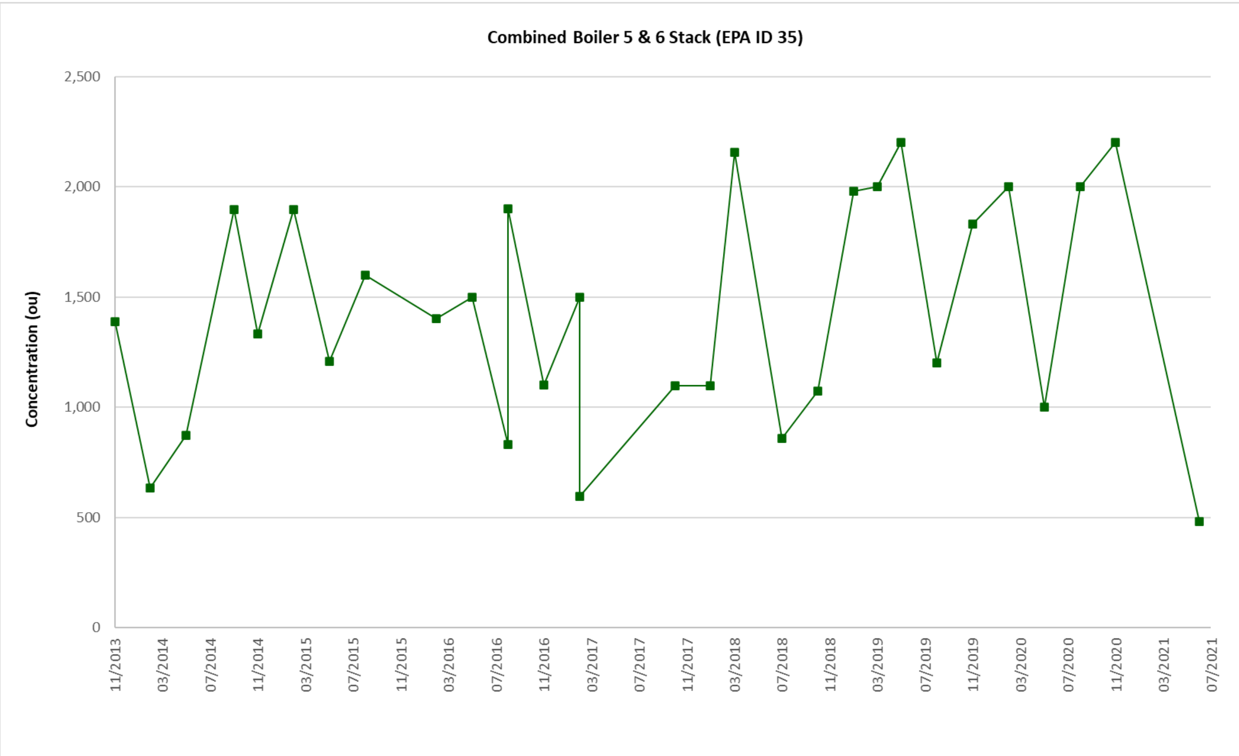


Figure 7. Boiler 4 Stack (EPA 42)

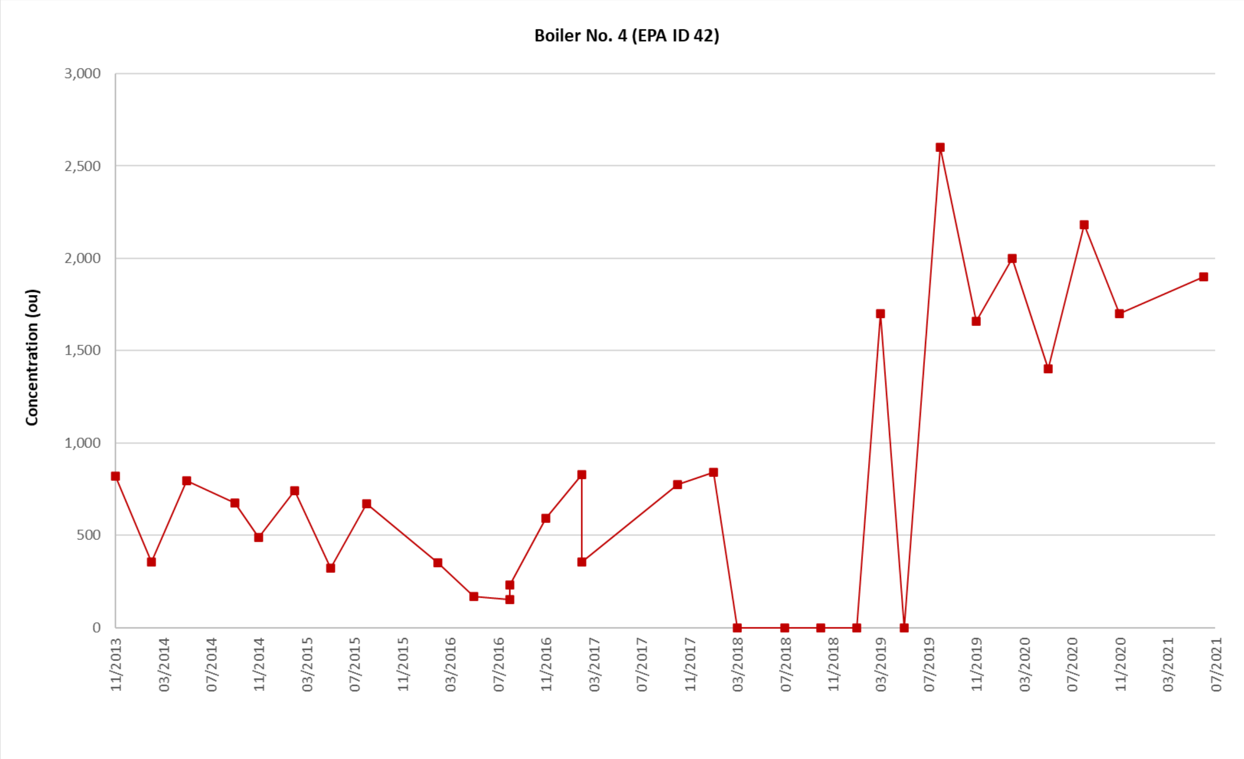


Figure 8. Boiler 2 Stack (EPA 45)

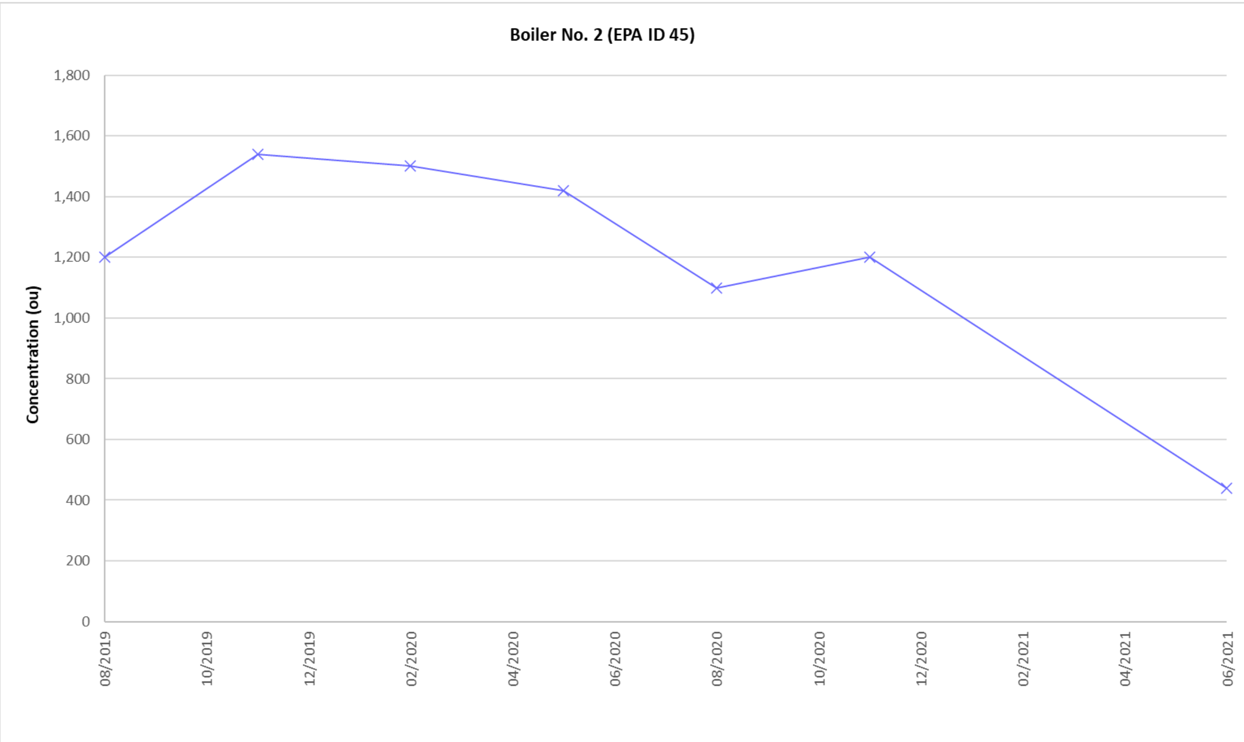
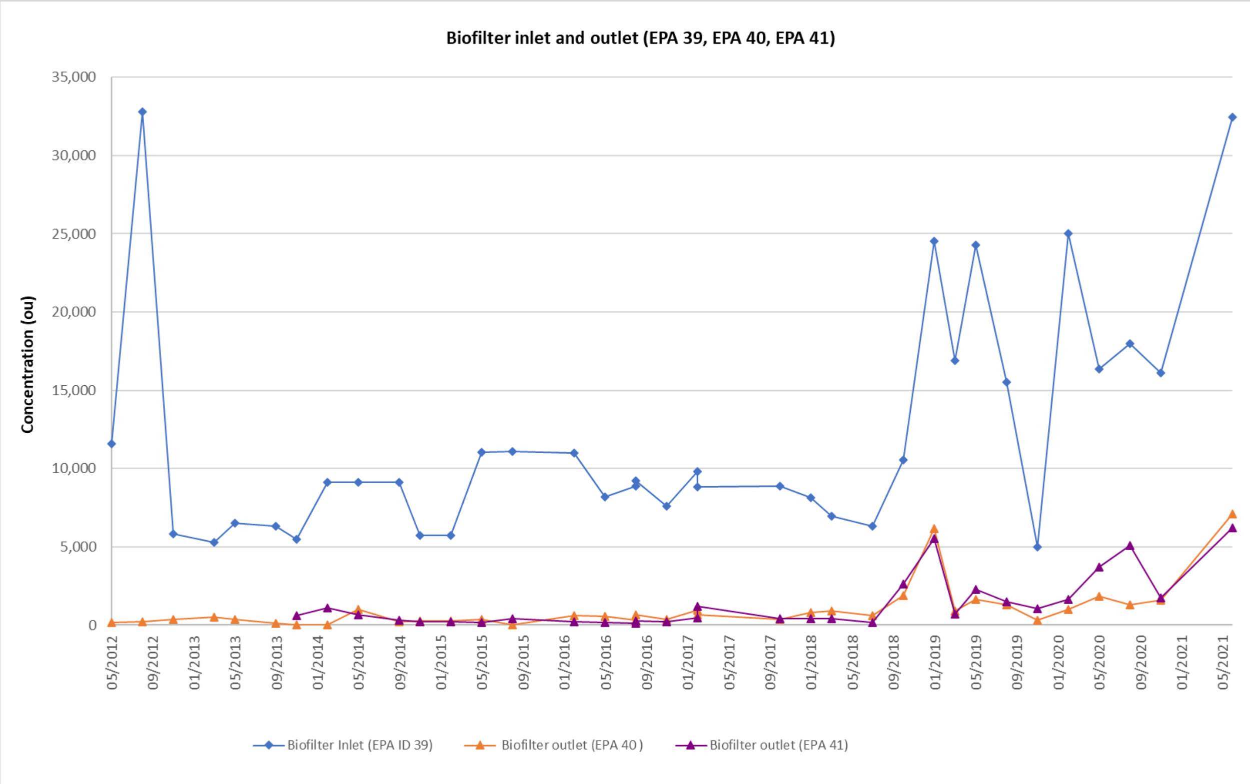
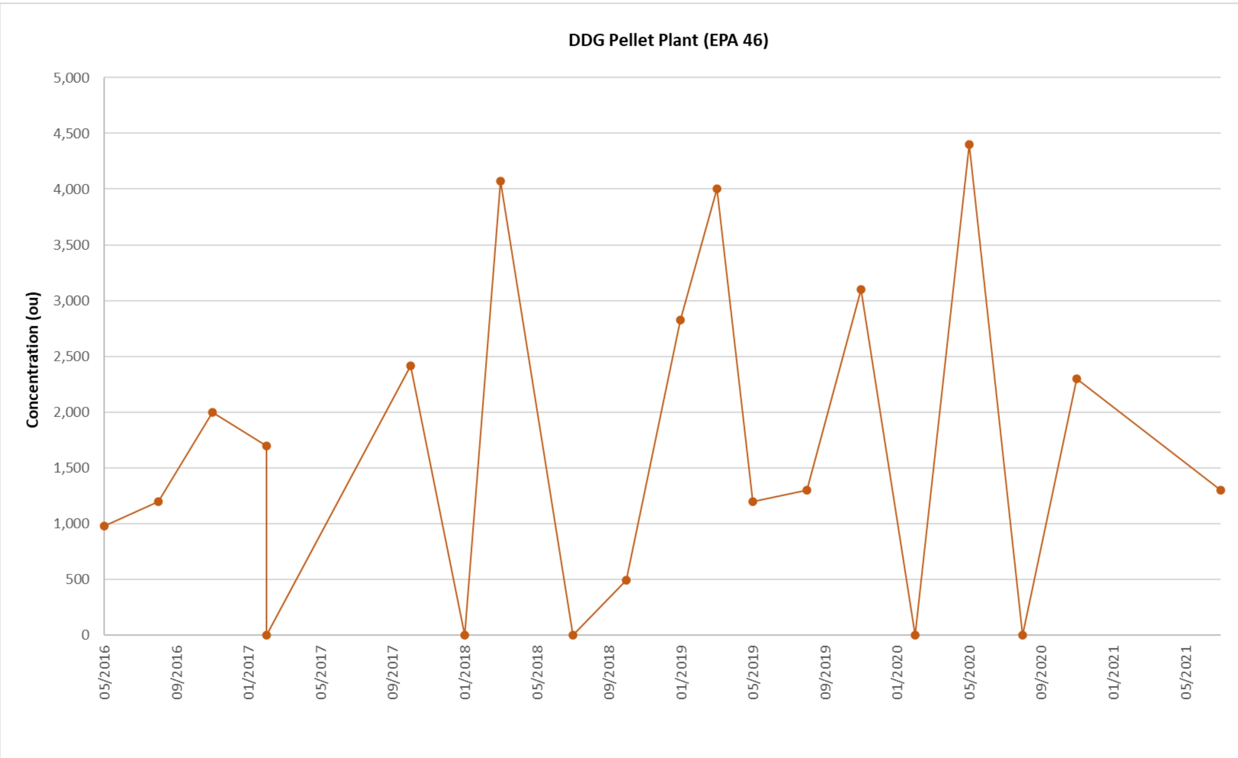


Figure 9. Biofilters (EPA 39,40, 41)



Zero result represents Biofilter not available to be sampled for that event

Figure 10. DDG Pellet Plant (EPA 46)



Zero result represents DDG Pellet Plant not sampled for that event

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Ektimo

REPORT NUMBER R011744

Odour Emission Testing Report, Quarter 2 2021-22
Manildra Group, Shoalhaven Starches Pty Ltd, Bomaderry

Document Information

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Attention:	John Studdert
Address:	160 Bolong Rd Bomaderry NSW 2541
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Zoe Parker **Air Monitoring Consultant**	NATA Accredited Laboratory No. 14601	**Steven Cooper** **Ektimo Signatory**

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

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

Table of Contents

1 Executive Summary 5
1.1 Background 5
1.2 Project Objectives 5
2 Results 6
2.1 Results Summary 6
2.2 EPA ID 8 – No. 1 Gluten Dryer Baghouse 7
2.3 EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse 8
2.4 EPA ID 10 - No. 3 Gluten Dryer Baghouse 9
2.5 EPA ID 11 - No. 4 Gluten Dryer Baghouse 10
2.6 EPA ID 12 – No. 1 Starch Dryer Scrubber 11
2.7 EPA ID 13 – No. 3 Starch Dryer Scrubber 12
2.8 EPA ID 14 – No. 4 Starch Dryer Scrubber 13
2.9 EPA ID 16 – CO2 Scrubber Outlet 14
2.10 EPA ID 35 - Combined Boiler 5 & 6 Stack 15
2.11 EPA ID 39 - Biofilter Inlet 16
2.12 EPA ID 39A - Biofilter inlet 17
2.13 EPA ID 40 - Biofilter A East 18
2.14 EPA ID 40 - Biofilter A West 19
2.15 EPA ID 41 - Biofilter B East 20
2.16 EPA ID 41 - Biofilter B West 21
2.17 EPA ID 42 - Boiler 4 22
2.18 EPA ID 44 – Fermenter 12 23
2.19 EPA ID 45 - Boiler 2 24
2.20 EPA ID 46 – DDG Pellet Plant Stack 25
2.21 EPA ID 47 - No. 5 Starch Dryer Scrubber 26
2.22 CO2 Scrubber Inlet 27
2.23 DDG Dryer 1 & 2 – Air Leakage Fan 28
2.24 DDG Dryer 3 – Air Leakage Fan 29
3 Plant Operating Conditions 30
4 Test Methods 30
5 Quality Assurance/Quality Control Information 30
6 Definitions 31
7 Appendix 1: Site Photos 32
8 Appendix 2: Historical Odour Results 37

Table of Figures

Figure 1. Starch Dryers No 1, 3 & 4 (EPA 12, EPA13, EPA14) 37

Figure 2. Gluten Dryers No 1,2,3 & 4 (EPA 8, EPA 9, EPA 10, EPA 11) 37

Figure 3. Starch Dryer 5 (EPA 47) 38

Figure 4. Fermenters (EPA 44) 38

Figure 5. Carbon dioxide Scrubber Outlet (EPA 16) 39

Figure 6. Combined Boiler 5 & 6 Stack (EPA 35) 39

Figure 7. Boiler 4 Stack (EPA 42) 40

Figure 8. Boiler 2 Stack (EPA 45) 40

Figure 9. Biofilters (EPA 39, 40, 41) 41

Figure 10. DDG Pellet Plant (EPA 46) 41

1 EXECUTIVE SUMMARY

1.1 Background

Ektimo was engaged by Manildra Group to perform odour and emission testing at their Bomaderry plant.

1.2 Project Objectives

The objectives of the project were to conduct a monitoring programme to quantify odour emissions from 21 discharge points to comply with Shoalhaven Starches' Environment Protection Licence 883.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
CO_2 Scrubber Inlet	30 September 2021	Odour, oxygen
EPA ID 16 – CO_2 Scrubber Outlet		
EPA ID 44 – Fermenter 12		Odour
EPA ID 8 – No. 1 Gluten Dryer Baghouse	5 October 2021	Odour, oxygen
EPA ID 9 – No. 2 Gluten Dryer Baghouse		
EPA ID 10 - No. 3 Gluten Dryer Baghouse		
EPA ID 11 - No. 4 Gluten Dryer Baghouse		
EPA ID 12 – No. 1 Starch Dryer Scrubber		
EPA ID 13 – No. 3 Starch Dryer Scrubber		
EPA ID 14 – No. 4 Starch Dryer Scrubber		
EPA ID 47 - No. 5 Starch Dryer Scrubber	6 October 2021	Odour, oxygen
EPA ID 40 - Biofilter A		Odour
EPA ID 41 - Biofilter B		
EPA ID 39A - Biofilter inlet		
EPA ID 46 - DDG Pellet Plant Stack		
DDG Dryer 1 & 2 – Air Leakage Fan		
DDG Dryer 3 – Air Leakage Fan		
EPA ID 39 - Biofilter Inlet		
EPA ID 35 - Combined Boilers 5 & 6 Stack	20 October 2021	Odour, oxygen
EPA ID 42 - Boiler 4		
EPA ID 45 - Boiler 2		

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

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

Plant operating conditions have been noted in the report.

2 RESULTS

2.1 Results Summary

Location	Date	Odour		Hedonic Tone	Character
		Concentration [ou]	Mass Rate [oum^3/min]		
EPA ID 8 - No. 1 Gluten Dryer Baghouse	5/10/2021	130	-	Neutral	Starch, bread dough
EPA ID 9 - No. 2 Gluten Dryer/Starch Dryer Baghouse	5/10/2021	450	420,000	Mildly unpleasant	Damp, bread
EPA ID 10 - No. 3 Gluten Dryer Baghouse	5/10/2021	310	730,000	Mildly pleasant	Starch
EPA ID 11 - No. 4 Gluten Dryer Baghouse	5/10/2021	440	710,000	Mildly unpleasant	Bread dough
EPA ID 12 - No. 1 Starch Dryer Scrubber	5/10/2021	87	110,000	Neutral	Sweet
EPA ID 13 - No. 3 Starch Dryer Scrubber	5/10/2021	79	93,000	Mildly pleasant	Starch, sweet
EPA ID 14 - No. 4 Starch Dryer Scrubber	5/10/2021	62	67,000	Neutral	Starch, bread
EPA ID 16 - CO_2 Scrubber Outlet	30/09/2021	51,000	5,900,000	Mildly pleasant	Cider, sweet
EPA ID 35 - Combined Boiler 5 & 6 Stack	20/10/2021	400	830,000	Mildly unpleasant	Sulfur, gas, combustion
EPA ID 39 - Biofilter Inlet	6/10/2021	5,400	1,200,000	Mildly pleasant	Bread, wet, grain
EPA ID 39A - Biofilter Inlet	6/10/2021	10,000	310,000	Neutral	Bread, sweet
EPA ID 40 - Biofilter A East	6/10/2021	10,000	750,000	Mildly pleasant	Vegemite, sweet, bread
EPA ID 40 - Biofilter A West	6/10/2021	7,500	550,000	Mildly unpleasant	Burnt toast, bread dough
EPA ID 41 - Biofilter B East	6/10/2021	9,600	820,000	Mildly unpleasant	Toast
EPA ID 41 - Biofilter B West	6/10/2021	9,400	680,000	Mildly unpleasant	Vegemite, bread
EPA ID 42 - Boiler 4	20/10/2021	400	310,000	Mildly unpleasant	Sulfur
EPA ID 44 - Fermenter 12	30/09/2021	11,000	93,000	Mildly pleasant	Cider, sweet
EPA ID 45 - Boiler 2	20/10/2021	520	160,000	Very unpleasant	Sulfur
EPA ID 46 - DDG Pellet Plant Stack	6/10/2021	2,000	2,100,000	Neutral	Bread, gas
EPA ID 47 - No. 5 Starch Dryer Scrubber	6/10/2021	1,600	5,800,000	Mildly pleasant	Vegemite
CO_2 Scrubber Inlet	30/09/2021	65,000	7,600,000	Mildly unpleasant	Cider, vinegar
DDG Dryer 1 & 2 - Air Leakage Fan	6/10/2021	14,000	23,000	Mildly pleasant	Wet, grain, sweet
DDG Dryer 3 - Air Leakage Fan	6/10/2021	6,200	150,000	Mildly pleasant	Bread, wet, grain

2.2 EPA ID 8 – No. 1 Gluten Dryer Baghouse

Date	5/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 8 - No. 1 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		

Sampling Plane Details	
Sampling plane dimensions	2400 x 2560 mm
Sampling plane area	6.14 m²
Sampling port size, number	Sampled from exit
Access & height of ports	Stairs & ladders 22 m
Duct orientation & shape	Horizontal Rectangular
Sample plane compliance to AS4323.1	Non-compliant

Comments

Sampling was undertaken at the exit of the stack as it was the only accessible area for the samples to be taken. No temperature or flow rate readings could be taken due to access issues.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters	
Moisture content, %v/v	
Gas molecular weight, g/g mole	29.0 (dry)
Gas density at STP, kg/m³	1.29 (dry)

Gas Analyser Results	Average
Sampling time	1227 - 1326
	Concentration %v/v
Oxygen	20.8

Odour	Results
Sampling time	1213 - 1223
	Concentration ou
Results	130
Lower uncertainty limit	94
Upper uncertainty limit	190
Hedonic tone	Neutral
Odour character	Starch, bread dough
Analysis date & time	06/10/21, 1000-1130
Holding time	22 hours
Dilution factor	1
Bag material	Nalophan
Butanol threshold (ppb)	67.1
Laboratory temp (℃)	23.15
Last calibration date	October 2020

2.3 EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse

Date	5/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 9 - No. 2 Gluten Dryer/ Starch Dryer
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	1190 mm
Sampling plane area	1.11 m²
Sampling port size, number & depth	4" BSP (x2), 90 mm
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 2 D
Upstream disturbance	Bend 0.5 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	4.5	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.94	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1120 & 1220	
Temperature, °C	62	
Temperature, K	335	
Velocity at sampling plane, m/s	19	
Volumetric flow rate, actual, m³/s	21	
Volumetric flow rate (wet STP), m³/s	16	
Volumetric flow rate (dry STP), m³/s	15	
Mass flow rate (wet basis), kg/hour	72000	
Velocity difference, %	3	

Gas Analyser Results	Average
Sampling time	1120 - 1219
	Concentration %v/v
Oxygen	20.8

Odour	Results	
Sampling time	1148 - 1158	
	Concentration ou	Mass Rate oum³/min
Results	450	420000
Lower uncertainty limit	310	
Upper uncertainty limit	630	
Hedonic tone	Mildly unpleasant	
Odour character	Damp, bread	
Analysis date & time	06/10/21, 1000-1130	
Holding time	22 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	67.1	
Laboratory temp (°C)	23.15	
Last calibration date	October 2020	

2.4 EPA ID 10 - No. 3 Gluten Dryer Baghouse

Date	5/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 10 - No. 3 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	2100 x 2400 mm
Sampling plane area	5.04 m²
Sampling port size, number	2" Ball valve (x3)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 5 D
Upstream disturbance	Change in diameter 2.5 D
No. traverses & points sampled	3 21
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The gas velocity at some or all sampling points is less than 3 m/s
The highest to lowest differential pressure ratio exceeds 9:1
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	4.4	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.00	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1340 & 1440
Temperature, °C	74
Temperature, K	347
Velocity at sampling plane, m/s	9.9
Volumetric flow rate, actual, m³/s	50
Volumetric flow rate (wet STP), m³/s	39
Volumetric flow rate (dry STP), m³/s	38
Mass flow rate (wet basis), kg/hour	180000
Velocity difference, %	<1

Gas Analyser Results	Average
Sampling time	1340 - 1439
	Concentration %v/v
Oxygen	20.7

Odour	Results	
Sampling time	1355 - 1405	
	Concentration ou	Mass Rate oum³/min
Results	310	730000
Lower uncertainty limit	220	
Upper uncertainty limit	440	
Hedonic tone	Mildly pleasant	
Odour character	Starch	
Analysis date & time	06/10/21, 1000-1130	
Holding time	20 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	67.1	
Laboratory temp (°C)	23.15	
Last calibration date	October 2020	

2.5 EPA ID 11 - No. 4 Gluten Dryer Baghouse

Date	5/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 11 - No. 4 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	1400 x 1700 mm
Sampling plane area	2.38 m²
Sampling port size, number	4" BSP (x3)
Access & height of ports	Stairs 30 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 6 D
No. traverses & points sampled	3 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	4.4	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.00	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1250 & 1350	
Temperature, °C	74	
Temperature, K	347	
Velocity at sampling plane, m/s	14	
Volumetric flow rate, actual, m³/s	34	
Volumetric flow rate (wet STP), m³/s	27	
Volumetric flow rate (dry STP), m³/s	25	
Mass flow rate (wet basis), kg/hour	120000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1250 - 1349
	Concentration % v/v
Oxygen	20.6

Odour	Results	
Sampling time	1320 - 1334	
	Concentration ou	Mass Rate oum³/min
Results	440	710000
Lower uncertainty limit	310	
Upper uncertainty limit	630	
Hedonic tone	Mildly unpleasant	
Odour character	Bread dough	
Analysis date & time	06/10/21, 1000-1130	
Holding time	21 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	67.1	
Laboratory temp (°C)	23.15	
Last calibration date	October 2020	

2.6 EPA ID 12 – No. 1 Starch Dryer Scrubber

Date	5/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 12 - No. 1 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	1500 x 1500 mm
Sampling plane area	2.25 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 25 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Silencer 0 D
No. traverses & points sampled	3 15
Sample plane compliance to AS4323.1	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The highest to lowest differential pressure ratio exceeds 9:1
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	5.8	
Gas molecular weight, g/g mole	28.4 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.11	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1138 & 1255
Temperature, °C	37
Temperature, K	310
Velocity at sampling plane, m/s	11
Volumetric flow rate, actual, m³/s	24
Volumetric flow rate (wet STP), m³/s	21
Volumetric flow rate (dry STP), m³/s	20
Mass flow rate (wet basis), kg/hour	95000
Velocity difference, %	3

Gas Analyser Results	Average
Sampling time	1140 - 1239
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1243 - 1253	
	Concentration ou	Mass Rate oum³/min
Results	87	110000
Lower uncertainty limit	61	
Upper uncertainty limit	120	
Hedonic tone	Neutral	
Odour character	Sweet	
Analysis date & time	06/10/21, 1000-1130	
Holding time	21 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	67.1	
Laboratory temp (°C)	23.15	
Last calibration date	October 2020	

2.7 EPA ID 13 – No. 3 Starch Dryer Scrubber

Date	5/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 13 - No. 3 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	1000 x 1050 mm
Sampling plane area	1.05 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	3 15
Sample plane compliance to AS4323.1	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	6.5	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.10	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1010 & 1110	
Temperature, °C	40	
Temperature, K	313	
Velocity at sampling plane, m/s	22	
Volumetric flow rate, actual, m³/s	23	
Volumetric flow rate (wet STP), m³/s	20	
Volumetric flow rate (dry STP), m³/s	18	
Mass flow rate (wet basis), kg/hour	90000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1010 - 1109
	Concentration % v/v
Oxygen	20.7

Odour	Results	
Sampling time	1046 - 1056	
	Concentration ou	Mass Rate oum³/min
Results	79	93000
Lower uncertainty limit	55	
Upper uncertainty limit	110	
Hedonic tone	Mildly pleasant	
Odour character	Starch, sweet	
Analysis date & time	06/10/21, 1000-1130	
Holding time	23 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	67.1	
Laboratory temp (°C)	23.15	
Last calibration date	October 2020	

2.8 EPA ID 14 – No. 4 Starch Dryer Scrubber

Date	5/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 14 - No. 4 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	1000 x 1050 mm
Sampling plane area	1.05 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	3 15
Sample plane compliance to AS4323.1	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	6.9	
Gas molecular weight, g/g mole	28.2 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.10	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1013 & 1113	
Temperature, °C	40	
Temperature, K	313	
Velocity at sampling plane, m/s	20	
Volumetric flow rate, actual, m³/s	21	
Volumetric flow rate (wet STP), m³/s	18	
Volumetric flow rate (dry STP), m³/s	17	
Mass flow rate (wet basis), kg/hour	82000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1013 - 1112
	Concentration %v/v
Oxygen	20.6

Odour	Results	
Sampling time	1026 - 1036	
	Concentration ou	Mass Rate oum³/min
Results	62	67000
Lower uncertainty limit	43	
Upper uncertainty limit	88	
Hedonic tone	Neutral	
Odour character	Starch, Bread	
Analysis date & time	06/10/21, 1000-1130	
Holding time	24 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	67.1	
Laboratory temp (°C)	23.15	
Last calibration date	October 2020	

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2.9 EPA ID 16 – CO2 Scrubber Outlet

Date	30/09/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 16 - CO2 Scrubber Outlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	505 mm
Sampling plane area	0.2 m²
Sampling port size, number & depth	3" BSP (x1), 60 mm
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >6 D
Upstream disturbance	Junction >10 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	1.1	
Gas molecular weight, g/g mole	42.0 (wet)	42.3 (dry)
Gas density at STP, kg/m³	1.87 (wet)	1.89 (dry)
Gas density at discharge conditions, kg/m³	1.73	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0948 & 1022	
Temperature, °C	24	
Temperature, K	297	
Velocity at sampling plane, m/s	10	
Volumetric flow rate, actual, m³/s	2.1	
Volumetric flow rate (wet STP), m³/s	1.9	
Volumetric flow rate (dry STP), m³/s	1.9	
Mass flow rate (wet basis), kg/hour	13000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	0950 - 1020
	Concentration %v/v
Oxygen	0.3

Odour	Results	
Sampling time	1007 - 1009	
	Concentration ou	Mass Rate oum³/min
Results	51000	5900000
Lower uncertainty limit	36000	
Upper uncertainty limit	74000	
Hedonic tone	Mildly pleasant	
Odour character	Cider, sweet	
Analysis date & time	01/10/21, 0900-1100	
Holding time	23 hours	
Dilution factor	9	
Bag material	Nalophan	
Butanol threshold (ppb)	67.1	
Laboratory temp (°C)	21.65	
Last calibration date	October 2020	

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2.10 EPA ID 35 - Combined Boiler 5 & 6 Stack

Date	20/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 35 - Boiler 5 & 6 Combined Stack
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Steven Cooper	**State**	NSW
Process Conditions	Please refer to client records.		211014

Sampling Plane Details	
Sampling plane dimensions	1985 mm
Sampling plane area	3.09 m²
Sampling port size, number & depth	4" BSP (x4), 100 mm
Access & height of ports	Stairs & ladders 40 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

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

Stack Parameters		
Moisture content, %v/v	5.1	
Gas molecular weight, g/g mole	29.8 (wet)	30.4 (dry)
Gas density at STP, kg/m³	1.33 (wet)	1.36 (dry)
Gas density at discharge conditions, kg/m³	0.91	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1240 & 1340	
Temperature, °C	125	
Temperature, K	399	
Velocity at sampling plane, m/s	16	
Volumetric flow rate, actual, m³/s	50	
Volumetric flow rate (wet STP), m³/s	35	
Volumetric flow rate (dry STP), m³/s	33	
Mass flow rate (wet basis), kg/hour	170000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1240 - 1340
	Concentration %v/v
Oxygen	9.4

Odour	Results	
Sampling time	1250 - 1300	
	Concentration ou	Mass Rate oum³/min
Results	400	830000
Lower uncertainty limit	280	
Upper uncertainty limit	570	
Hedonic tone	Mildly unpleasant	
Odour character	Sulfur, gas, combustion	
Analysis date & time	21/10/21, 1000-1100	
Holding time	21 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	68.1	
Laboratory temp (°C)	22.6	
Last calibration date	October 2021	

Ektimo

2.11 EPA ID 39 - Biofilter Inlet

Date	6/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 39 - Biofilter Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	600 mm
Sampling plane area	0.283 m²
Sampling port size, number & depth	1 x 1 inch port, 45 mm
Access & height of ports	Ground 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 6 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	5.7	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.03	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1135 & 1205	
Temperature, °C	38	
Temperature, K	311	
Velocity at sampling plane, m/s	16	
Volumetric flow rate, actual, m³/s	4.5	
Volumetric flow rate (wet STP), m³/s	3.6	
Volumetric flow rate (dry STP), m³/s	3.4	
Mass flow rate (wet basis), kg/hour	17000	
Velocity difference, %	<1	

Odour	Results	
Sampling time	1146 - 1156	
	Concentration ou	Mass Rate oum³/min
Results	5400	1200000
Lower uncertainty limit	3800	
Upper uncertainty limit	7700	
Hedonic tone	Mildly pleasant	
Odour character	Bread, wet, grain	
Analysis date & time	07/10/21, 0930-1130	
Holding time	21 hours	
Dilution factor	2	
Bag material	Nalophan	
Butanol threshold (ppb)	39.6	
Laboratory temp (°C)	23.25	
Last calibration date	October 2020	

2.12 EPA ID 39A - Biofilter inlet

Date	6/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 39A - Biofilter Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number	1 x 1 inch port
Access & height of ports	Ground 0.6 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1.5 D
Upstream disturbance	Inlet >2 D
No. traverses & points sampled	1 4
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	2.7	
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	1.13	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1100 & 1115
Temperature, °C	36
Temperature, K	310
Velocity at sampling plane, m/s	8
Volumetric flow rate, actual, m³/s	0.56
Volumetric flow rate (wet STP), m³/s	0.5
Volumetric flow rate (dry STP), m³/s	0.48
Mass flow rate (wet basis), kg/hour	2300
Velocity difference, %	-2

Odour	Results	
Sampling time	1106 - 1108	
	Concentration ou	Mass Rate oum³/min
Results	10000	310000
Lower uncertainty limit	7300	
Upper uncertainty limit	15000	
Hedonic tone	Neutral	
Odour character	Bread, sweet	
Analysis date & time	07/10/21, 0930-1130	
Holding time	22 hours	
Dilution factor	9	
Bag material	Nalophan	
Butanol threshold (ppb)	39.6	
Laboratory temp (°C)	23.25	
Last calibration date	October 2020	

2.13 EPA ID 40 - Biofilter A East

Client	Manildra Group	**Test Location**	EPA ID 40 - Biofilter A East
Date	6/10/2021	**Plant/Site**	Ethanol Plant
Report No.	R011744		Bomaderry, NSW
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz		*210617*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	72
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	24
Sampling Results	
Sampling time, hrs	1145 - 1158
Sample dilution	3
Odour concentration, ou	**10000**
Hedonic tone	Mildly pleasant
Odour character	Vegemite, sw eet, bread
95% Confidence Interval	7300 - 15000
Odour Flux Rate, ou/m²/min	**7500**
Odour mass rate, ou/min	**750000**

2.14 EPA ID 40 - Biofilter A West

Client	Manildra Group	**Test Location**	EPA ID 40 - Biofilter A West
Date	6/10/2021	**Plant/Site**	Ethanol Plant
Report No.	R011744		Bomaderry, NSW
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz		*210617*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	73
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	24
Sampling Results	
Sampling time, hrs	1125 - 1138
Sample dilution	5
Odour concentration, ou	**7500**
Hedonic tone	Mildly unpleasant
Odour character	Burnt toast, bread dough
95% Confidence Interval	5300 - 11000
Odour Flux Rate, ou/m²/min	**5500**
Odour mass rate, ou/min	**550000**

2.15 EPA ID 41 - Biofilter B East

Client	Manildra Group	Test Location	EPA ID 41 - Biofilter B East
Date	6/10/2021	Plant/Site	Ethanol Plant
Report No.	R011744		Bomaderry, NSW
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz		*210617*
Test Location Details			
Location Description	Biofilter Outlet		
Surface Description	Woodchip/Mulch		
Area Classification	Industrial		
Aeration rate, m^3/min	85		
Source dimensions (L x W), m	14.25 x 7		
Source area, m^2	99.75		
Sampling Method	Collection Hood (Aeration)		
Proportion of Inlet Airflow, %	28		
Sampling Results			
Sampling time, hrs	1105 - 1118		
Sample dilution	3		
Odour concentration, ou	**9600**		
Hedonic tone	Mildly unpleasant		
Odour character	Toast		
95% Confidence Interval	6700 - 14000		
Odour Flux Rate, ou/m²/min	**8200**		
Odour mass rate, ou/min	**820000**		

2.16 EPA ID 41 - Biofilter B West

Client	Manildra Group	**Test Location**	EPA ID 41 - Biofilter B West
Date	6/10/2021	**Plant/Site**	Ethanol Plant
Report No.	R011744		Bomaderry, NSW
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz		*210617*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	72
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	24
Sampling Results	
Sampling time, hrs	1042 - 1055
Sample dilution	3.5
Odour concentration, ou	**9400**
Hedonic tone	Mildly unpleasant
Odour character	Bread, vegemite
95% Confidence Interval	6600 - 13000
Odour Flux Rate, ou/m²/min	**6800**
Odour mass rate, ou/min	**680000**

2.17 EPA ID 42 - Boiler 4

Date	20/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 42 - Boiler 4
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Steven Cooper	**State**	NSW
Process Conditions	Please refer to client records.		211014

Sampling Plane Details	
Sampling plane dimensions	1140 mm
Sampling plane area	1.02 m²
Sampling port size, number & depth	4" BSP (x2), 100 mm
Access & height of ports	Stairs 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >3 D
Upstream disturbance	Change in diameter 1 D
No. traverses & points sampled	2 16
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The upstream disturbance is <2D from the sampling plane

Stack Parameters		
Moisture content, %v/v	4.8	
Gas molecular weight, g/g mole	29.1 (wet)	29.7 (dry)
Gas density at STP, kg/m³	1.30 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.82	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1118 & 1252
Temperature, °C	164
Temperature, K	437
Velocity at sampling plane, m/s	20
Volumetric flow rate, actual, m³/s	21
Volumetric flow rate (wet STP), m³/s	13
Volumetric flow rate (dry STP), m³/s	12
Mass flow rate (wet basis), kg/hour	61000
Velocity difference, %	-6

Gas Analyser Results	Average
Sampling time	1024 - 1130
	Concentration %v/v
Oxygen	14.1

Odour	Results	
Sampling time	1234 - 1244	
	Concentration ou	Mass Rate oum³/min
Results	400	310000
Lower uncertainty limit	280	
Upper uncertainty limit	570	
Hedonic tone	Mildly unpleasant	
Odour character	Sulfur	
Analysis date & time	21/10/21, 1000-1100	
Holding time	22 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	68.1	
Laboratory temp (°C)	22.6	
Last calibration date	October 2021	

2.18 EPA ID 44 – Fermenter 12

Date	30/09/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 44 - Fermenter 12
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	295 mm
Sampling plane area	0.0683 m²
Sampling port size, number & depth	3" BSP (x1), 75 mm
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 10 D
Upstream disturbance	Junction 2 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The gas velocity at some or all sampling points is less than 3 m/s

The stack or duct does not have the required number of access holes (ports)

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.6	
Gas molecular weight, g/g mole	32.4 (wet)	32.6 (dry)
Gas density at STP, kg/m³	1.45 (wet)	1.46 (dry)
Gas density at discharge conditions, kg/m³	1.31	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1025 & 1040	
Temperature, °C	29	
Temperature, K	302	
Velocity at sampling plane, m/s	2.2	
Volumetric flow rate, actual, m³/s	0.15	
Volumetric flow rate (wet STP), m³/s	0.14	
Volumetric flow rate (dry STP), m³/s	0.13	
Mass flow rate (wet basis), kg/hour	710	
Velocity difference, %	-1	

Odour	Results	
Sampling time	1035 - 1037	
	Concentration ou	Mass Rate oum³/min
Results	11000	93000
Lower uncertainty limit	7900	
Upper uncertainty limit	16000	
Hedonic tone	Mildly pleasant	
Odour character	Cider, sweet	
Analysis date & time	01/10/21, 0900-1100	
Holding time	23 hours	
Dilution factor	9	
Bag material	Nalophan	
Butanol threshold (ppb)	67.1	
Laboratory temp (°C)	21.65	
Last calibration date	October 2020	

2.19 EPA ID 45 - Boiler 2

Date	20/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 45 - Boiler 2
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Steven Cooper	**State**	NSW
Process Conditions	Please refer to client records.		211014

Sampling Plane Details	
Sampling plane dimensions	1070 mm
Sampling plane area	0.899 m²
Sampling port size, number & depth	4" Flange (x2), 180 mm
Access & height of ports	Ladders 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter 5 D
No. traverses & points sampled	2 16
Sample plane compliance to AS4323.1	Compliant but non-ideal

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

Stack Parameters		
Moisture content, %v/v	4.7	
Gas molecular weight, g/g mole	29.4 (wet)	29.9 (dry)
Gas density at STP, kg/m³	1.31 (wet)	1.33 (dry)
Gas density at discharge conditions, kg/m³	0.77	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1345 & 1445
Temperature, °C	197
Temperature, K	470
Velocity at sampling plane, m/s	9.9
Volumetric flow rate, actual, m³/s	8.9
Volumetric flow rate (wet STP), m³/s	5.2
Volumetric flow rate (dry STP), m³/s	5
Mass flow rate (wet basis), kg/hour	25000
Velocity difference, %	4

Gas Analyser Results	Average
Sampling time	1345 - 1445
	Concentration %v/v
Oxygen	12.7

Odour	Results	
Sampling time	1350 - 1400	
	Concentration ou	Mass Rate oum³/min
Results	520	160000
Lower uncertainty limit	360	
Upper uncertainty limit	740	
Hedonic tone	Very unpleasant	
Odour character	Sulfur	
Analysis date & time	21/10/21, 1000-1100	
Holding time	20 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	68.1	
Laboratory temp (°C)	22.6	
Last calibration date	October 2021	

2.20 EPA ID 46 – DDG Pellet Plant Stack

Date	6/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 46 - DDG Pellet Plant Stack
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	1460 mm
Sampling plane area	1.67 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Elevated work platform 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Junction 2.1 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	3.5	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.08	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1005 & 1035
Temperature, °C	50
Temperature, K	323
Velocity at sampling plane, m/s	12
Volumetric flow rate, actual, m³/s	20
Volumetric flow rate (wet STP), m³/s	17
Volumetric flow rate (dry STP), m³/s	17
Mass flow rate (wet basis), kg/hour	79000
Velocity difference, %	<1

Odour	Results	
Sampling time	1010 - 1023	
	Concentration ou	Mass Rate oum³/min
Results	2000	2100000
Lower uncertainty limit	1400	
Upper uncertainty limit	2900	
Hedonic tone	Neutral	
Odour character	Bread, gas	
Analysis date & time	07/10/21, 0930-1130	
Holding time	23 hours	
Dilution factor	1.5	
Bag material	Nalophan	
Butanol threshold (ppb)	39.6	
Laboratory temp (°C)	23.25	
Last calibration date	October 2020	

2.21 EPA ID 47 - No. 5 Starch Dryer Scrubber

Date	6/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	EPA ID 47 - No. 5 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	2400 mm
Sampling plane area	4.52 m²
Sampling port size, number	4" Flange (x2)
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

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

Stack Parameters		
Moisture content, %v/v	4.4	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.02	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1230 & 1330	
Temperature, °C	67	
Temperature, K	340	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/s	75	
Volumetric flow rate (wet STP), m³/s	60	
Volumetric flow rate (dry STP), m³/s	58	
Mass flow rate (wet basis), kg/hour	280000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1230 - 1329
	Concentration %v/v
Oxygen	20.3

Odour	Results	
Sampling time	1252 - 1306	
	Concentration ou	Mass Rate oum³/min
Results	1600	5800000
Lower uncertainty limit	1100	
Upper uncertainty limit	2300	
Hedonic tone	Mildly pleasant	
Odour character	Vegemite	
Analysis date & time	07/10/21, 0930-1130	
Holding time	20 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	39.6	
Laboratory temp (℃)	23.25	
Last calibration date	October 2020	

2.22 CO2 Scrubber Inlet

Date	30/09/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	CO2 Scrubber Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	1 inch ball valve, 80 mm
Access & height of ports	Ground level 1.5 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 0.5 D
Upstream disturbance	Bend 0.5 D
No. traverses & points sampled	1 2
Sample plane compliance to AS4323.1	Non-compliant

Comments

Flow measurement readings were applied from EPA ID 16, the CO2 scrubber outlet, as flow was unable to be measured at this location.

The number of traverses sampled is less than the requirement

The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The downstream disturbance is <1D from the sampling plane

The upstream disturbance is <2D from the sampling plane

The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	1.1	
Gas molecular weight, g/g mole	41.7 (wet)	42.0 (dry)
Gas density at STP, kg/m³	1.86 (wet)	1.87 (dry)
Gas density at discharge conditions, kg/m³	1.72	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0948 & 1022	
Temperature, °C	24	
Temperature, K	297	
Velocity at sampling plane, m/s	11	
Volumetric flow rate, actual, m³/s	2.1	
Volumetric flow rate (wet STP), m³/s	1.9	
Volumetric flow rate (dry STP), m³/s	1.9	
Mass flow rate (wet basis), kg/hour	13000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1030 - 1100
	Concentration %v/v
Oxygen	0.3

Odour	Results	
Sampling time	1055 - 1057	
	Concentration ou	Mass Rate oum³/min
Results	65000	7600000
Lower uncertainty limit	46000	
Upper uncertainty limit	93000	
Hedonic tone	Mildly unpleasant	
Odour character	Cider, vinegar	
Analysis date & time	01/10/21, 0900-1100	
Holding time	22 hours	
Dilution factor	8.9	
Bag material	Nalophan	
Butanol threshold (ppb)	67.1	
Laboratory temp (°C)	21.65	
Last calibration date	October 2020	

2.23 DDG Dryer 1 & 2 – Air Leakage Fan

Date	6/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	DDG Dryer 1 & 2 - Air Leakage Fan
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	145 mm
Sampling plane area	0.0165 m²
Sampling port size, number & depth	2" BSP (x1), 45 mm
Access & height of ports	Ground 1.8 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 5 D
Upstream disturbance	Bend 1.5 D
No. traverses & points sampled	1 2
Sample plane compliance to AS4323.1	Non-compliant

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

The sampling plane is deemed to be non-compliant due to the following reasons:
The gas velocity at some or all sampling points is less than 3 m/s
The upstream disturbance is <2D from the sampling plane

Stack Parameters		
Moisture content, %v/v	10	
Gas molecular weight, g/g mole	27.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.24 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.07	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1340 & 1405
Temperature, °C	45
Temperature, K	318
Velocity at sampling plane, m/s	2
Volumetric flow rate, actual, m³/s	0.033
Volumetric flow rate (wet STP), m³/s	0.029
Volumetric flow rate (dry STP), m³/s	0.026
Mass flow rate (wet basis), kg/hour	130
Velocity difference, %	-4

Odour	Results	
Sampling time	1351 - 1401	
	Concentration ou	Mass Rate oum³/min
Results	14000	23000
Lower uncertainty limit	9700	
Upper uncertainty limit	20000	
Hedonic tone	Mildly pleasant	
Odour character	Wet, grain, sweet	
Analysis date & time	07/10/21, 0930-1130	
Holding time	19 hours	
Dilution factor	4.3	
Bag material	Nalophan	
Butanol threshold (ppb)	39.6	
Laboratory temp (°C)	23.25	
Last calibration date	October 2020	

2.24 DDG Dryer 3 – Air Leakage Fan

Date	6/10/2021	**Client**	Manildra Group
Report	R011744	**Stack ID**	DDG Dryer 3 - Air Leakage Fan
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker, Steven Cooper & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	145 mm
Sampling plane area	0.0165 m²
Sampling port size, number & depth	2" BSP (x1), 45 mm
Access & height of ports	Ground 1 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 2 D
Upstream disturbance	Bend 1.5 D
No. traverses & points sampled	1 2
Sample plane compliance to AS4323.1	Non-compliant

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

The sampling plane is deemed to be non-compliant due to the following reasons:
The upstream disturbance is <2D from the sampling plane

Stack Parameters		
Moisture content, %v/v	6.3	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.01	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1315 & 1345	
Temperature, °C	60	
Temperature, K	333	
Velocity at sampling plane, m/s	30	
Volumetric flow rate, actual, m³/s	0.5	
Volumetric flow rate (wet STP), m³/s	0.4	
Volumetric flow rate (dry STP), m³/s	0.37	
Mass flow rate (wet basis), kg/hour	1800	
Velocity difference, %	-2	

Odour	Results	
Sampling time	1332 - 1342	
	Concentration ou	Mass Rate oum³/min
Results	6200	150000
Lower uncertainty limit	4400	
Upper uncertainty limit	8900	
Hedonic tone	Mildly pleasant	
Odour character	Bread, wet, grain	
Analysis date & time	07/10/21, 0930-1130	
Holding time	20 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	39.6	
Laboratory temp (°C)	23.25	
Last calibration date	October 2020	

3 PLANT OPERATING CONDITIONS

See Manildra Group records for complete process conditions.

4 TEST METHODS

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

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sampling points - Selection	NSW EPA TM-1	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW EPA TM-2	NSW EPA TM-2	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22	NSW EPA TM-22	19%	✓	✓
Molecular weight	NA	NSW EPA TM-23	not specified	NA	✓
Dry gas density	NA	NSW EPA TM-23	not specified	NA	✓
Oxygen	NSW EPA TM-25	NSW EPA TM-25	13%	✓	✓
Odour	NSW EPA OM-7	NSW EPA OM-7	refer to results	✓	✓¥
Odour characterisation	NA	direct observation	NA	NA	×
Odour from diffuse sources	NSW EPA OM-8	AS4323.3	refer to results	✓	✓¥

211103

* 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:
1 October 2021 in report ON-00098.
6 October 2021 in report ON-00099.
7 October 2021 in report ON-00100.
21 October 2021 in report ON-00102.

5 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.

6 DEFINITIONS

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

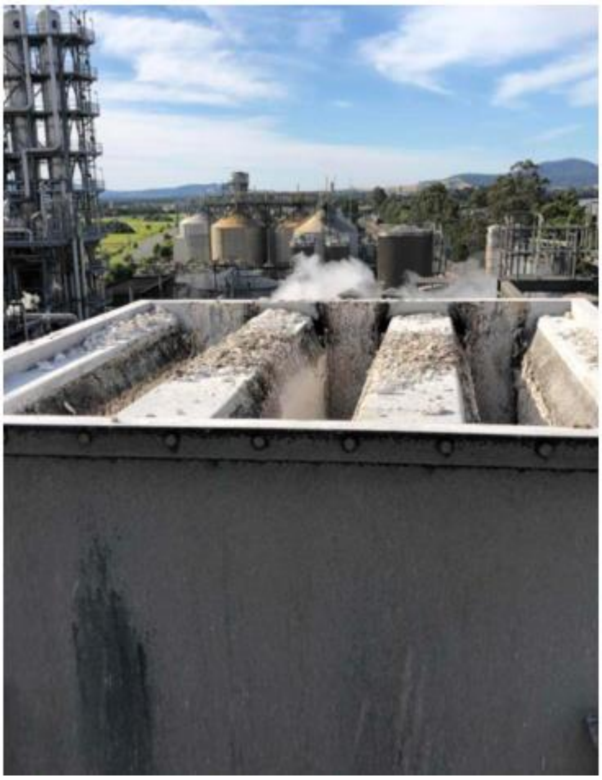
% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American Public Health Association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
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
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.

7 APPENDIX 1: SITE PHOTOS

EPA ID 9 – No. 2 Gluten Dryer Baghouse

EPA ID 10 – No. 3 Gluten Dryer Baghouse

EPA ID 11 – No. 4 Gluten Dryer Baghouse



EPA ID 12 – No. 1 Starch Dryer Scrubber

EPA ID 13 – No. 3 Starch Dryer Scrubber

EPA ID 14 – No. 4 Starch Dryer Scrubber

EPA ID 35 - Combined Boiler 5 & 6 Stack

EPA ID 39 - Biofilter Inlet

EPA ID 39A - Biofilter Inlet

EPA ID 40 - Biofilter A

EPA ID 41 - Biofilter B

EPA ID 42 - Boiler 4

EPA ID 45 - Boiler 2

EPA ID 46 – DDG Pellet Plant Stack

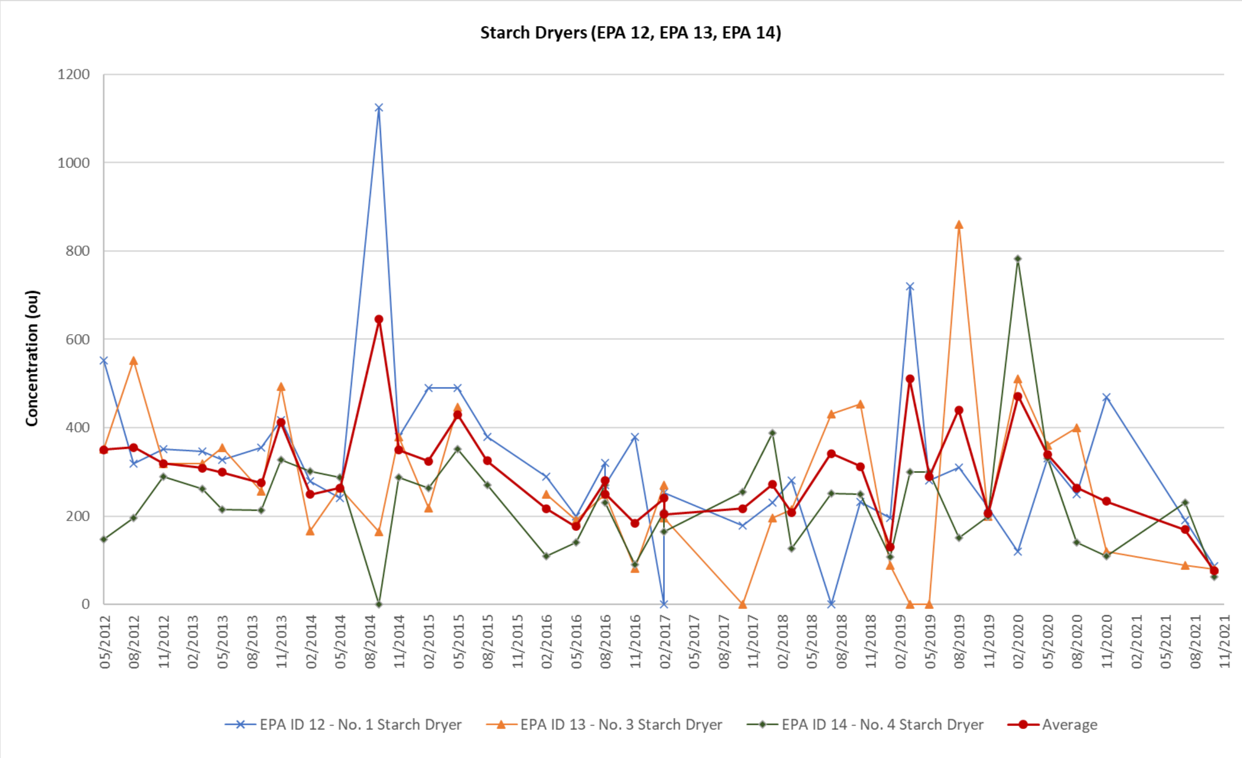
EPA ID 47 - Starch Dryer 5

DDG Dryer 1 & 2 – Air Leakage Fan

DDG 3 – Air Leakage Fan

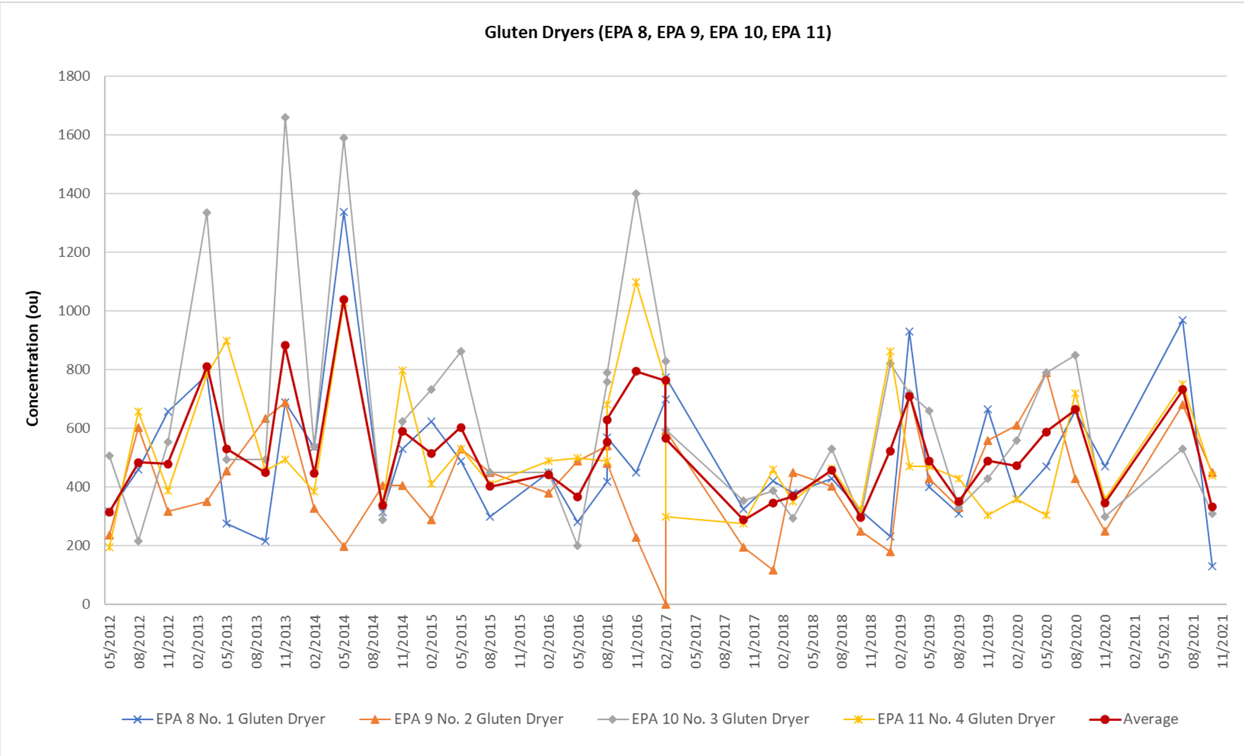
8 APPENDIX 2: HISTORICAL ODOUR RESULTS

Figure 1. Starch Dryers No 1, 3 & 4 (EPA 12, EPA13, EPA14)



Zero result represents Dryer not operating on days of testing

Figure 2. Gluten Dryers No 1,2,3 & 4 (EPA 8, EPA 9, EPA 10, EPA 11)



Zero result represents Dryer not operating on days of testing

Figure 3. Starch Dryer 5 (EPA 47)

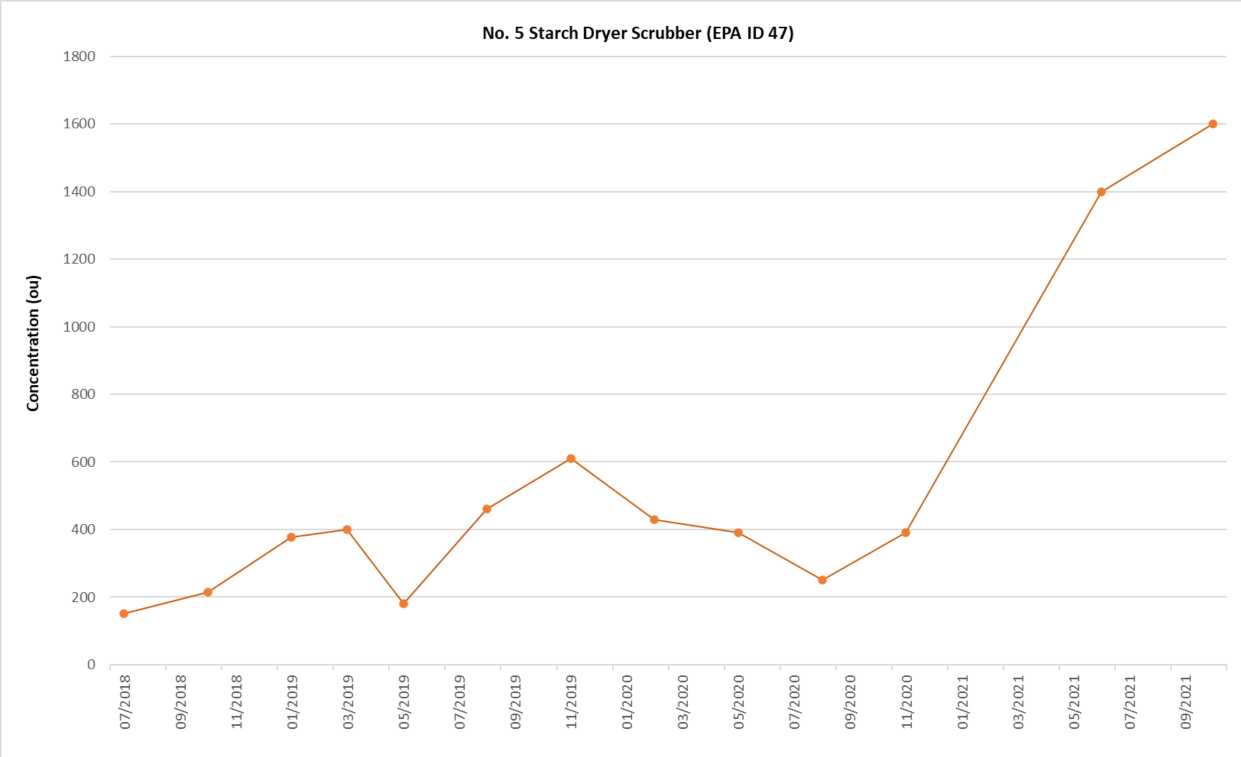
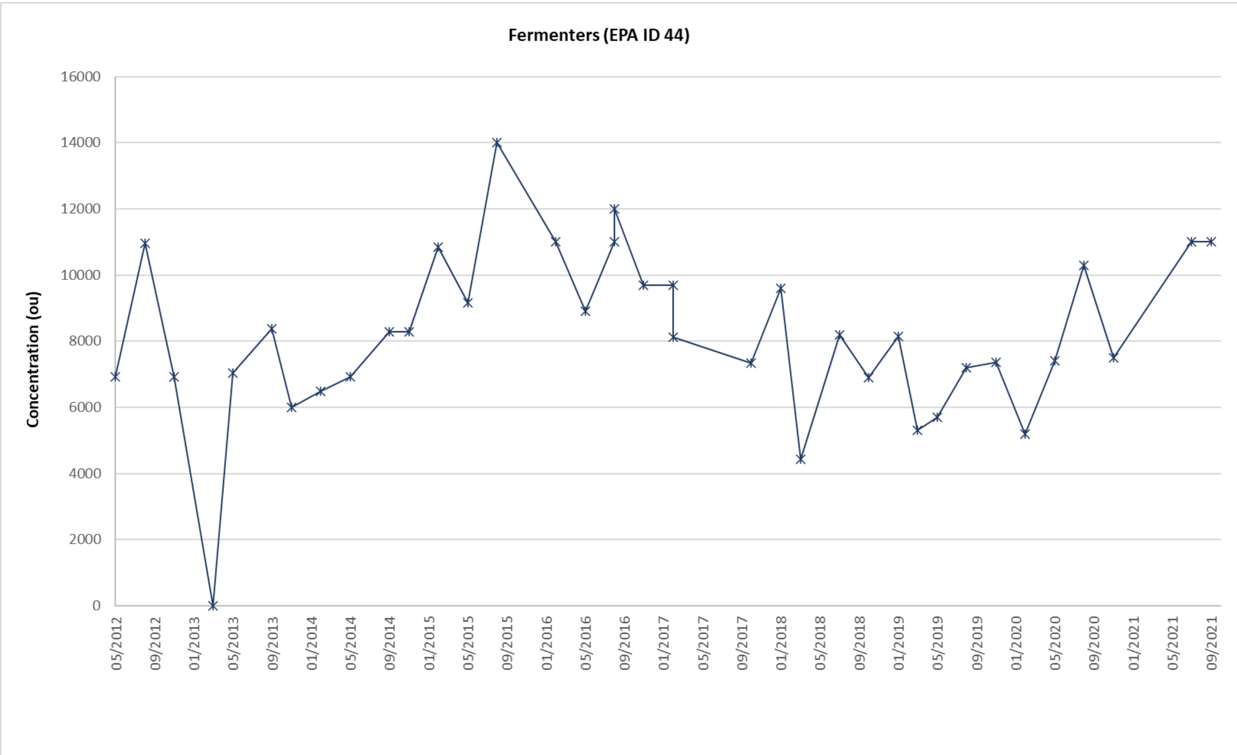


Figure 4. Fermenters (EPA 44)



Zero result represents Fermenter not operating on days of testing

Figure 5. Carbon Dioxide Scrubber Outlet (EPA 16)

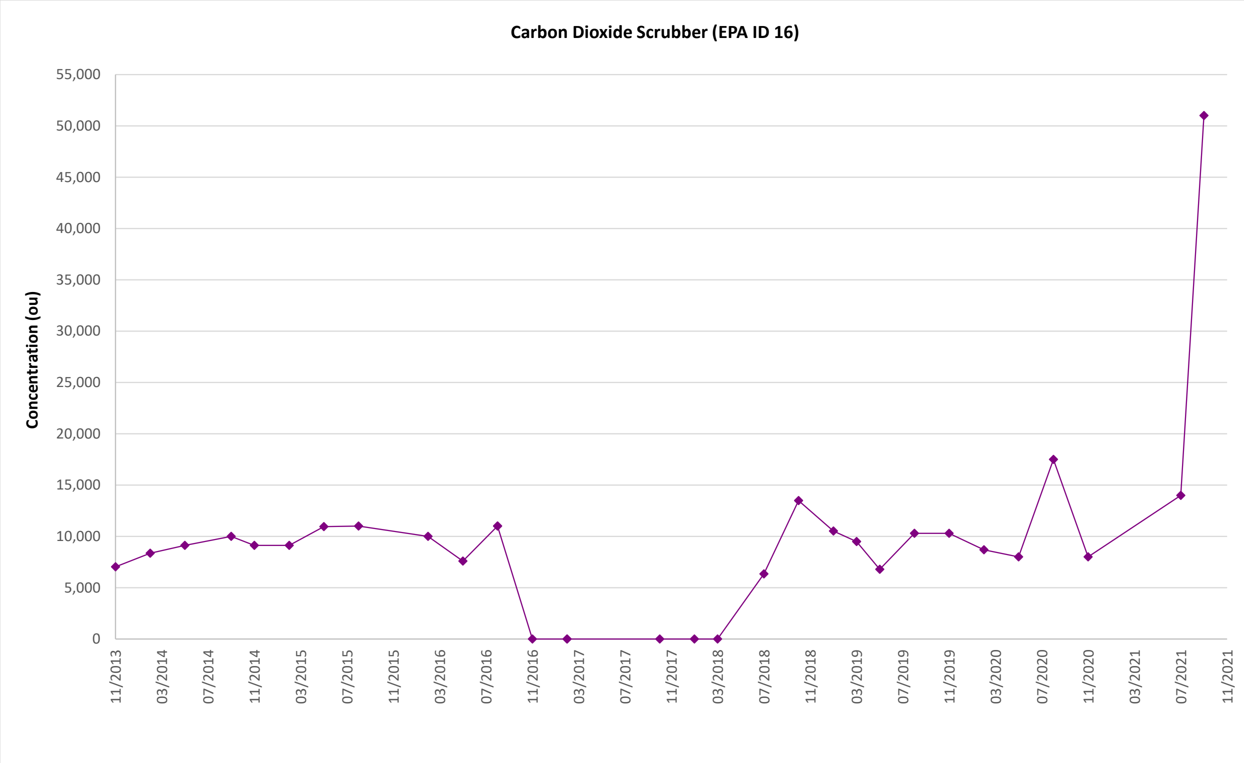


Figure 6. Combined Boiler 5 & 6 Stack (EPA 35)

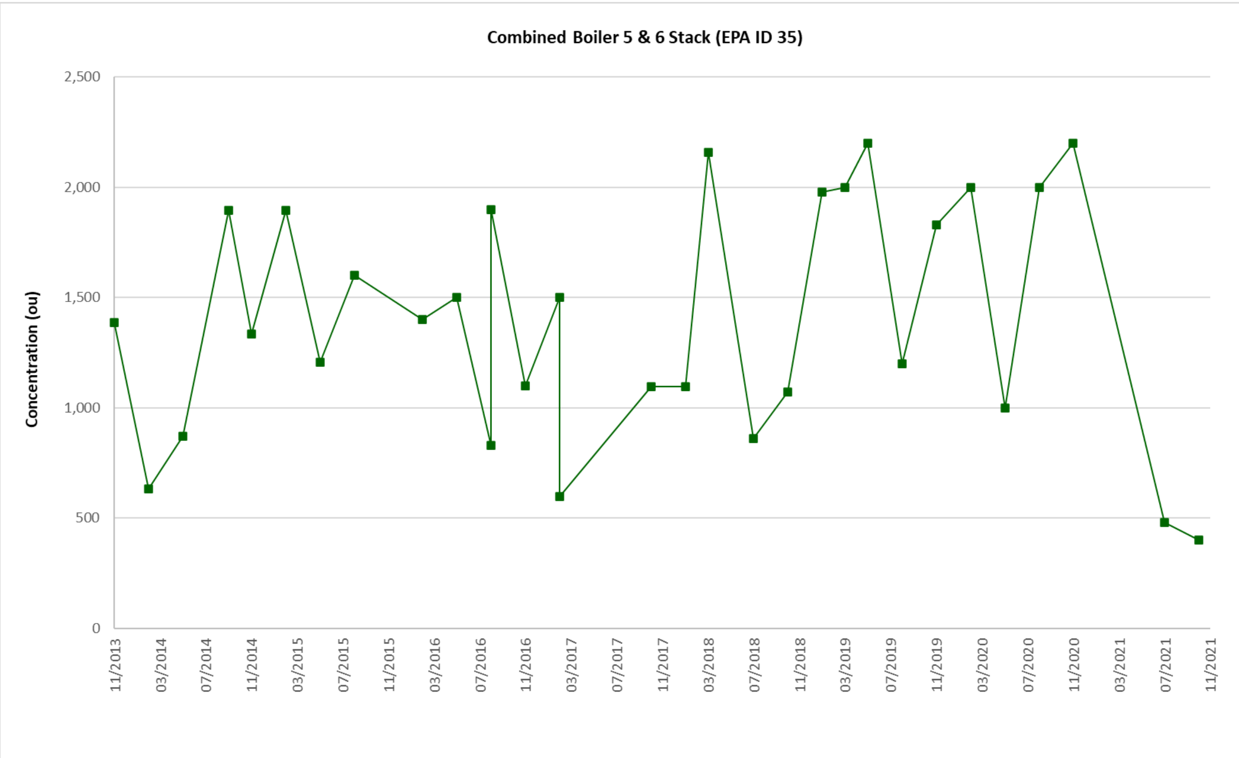


Figure 7. Boiler 4 Stack (EPA 42)

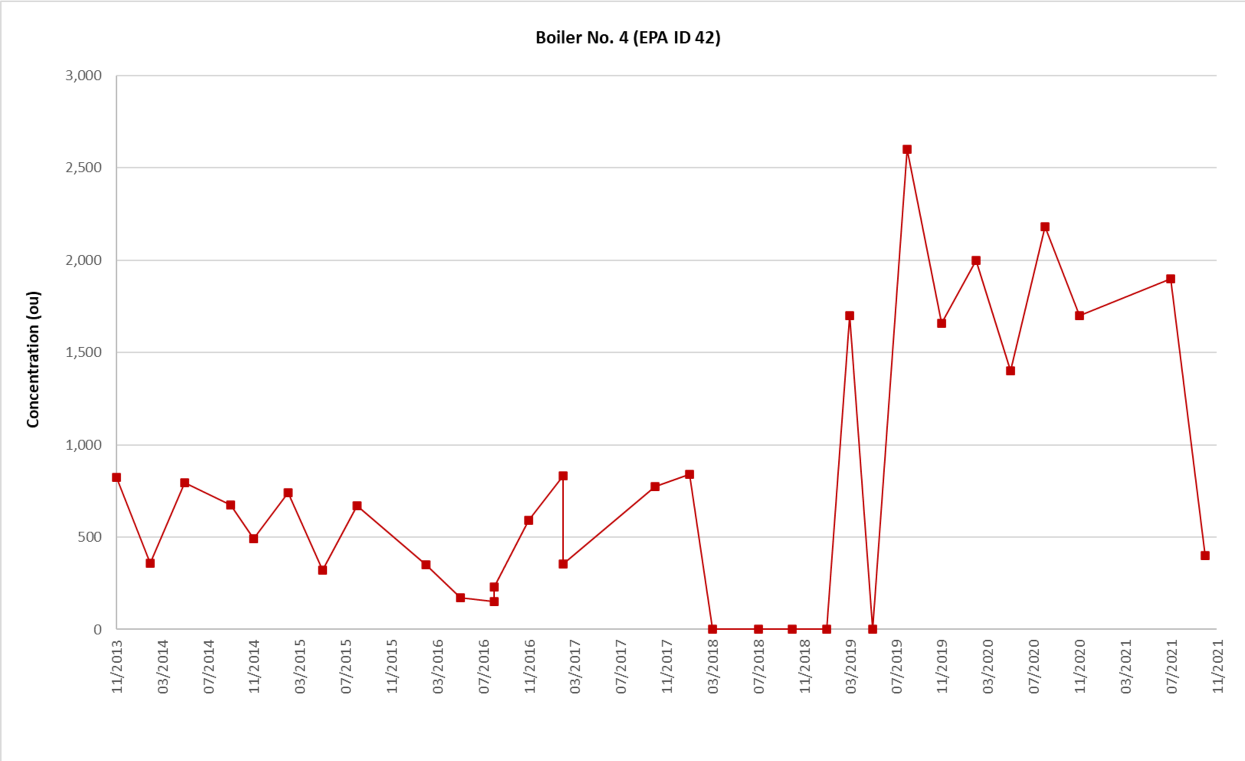


Figure 8. Boiler 2 Stack (EPA 45)

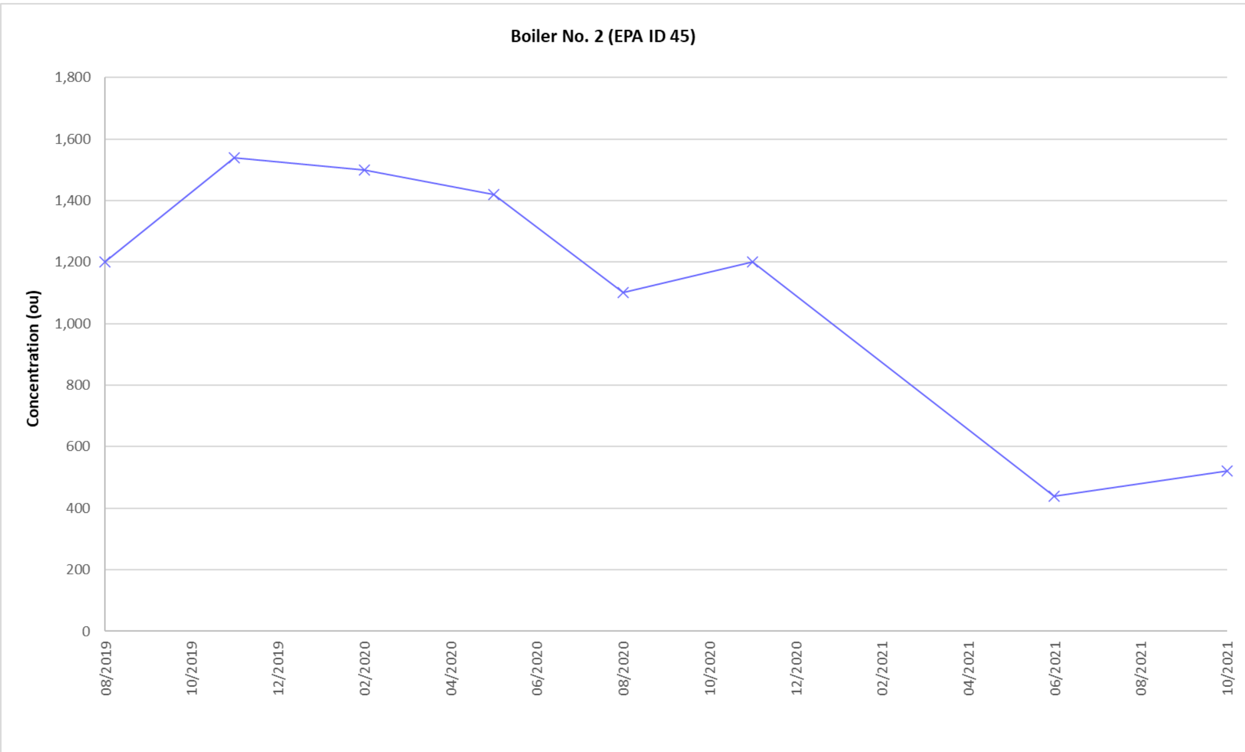
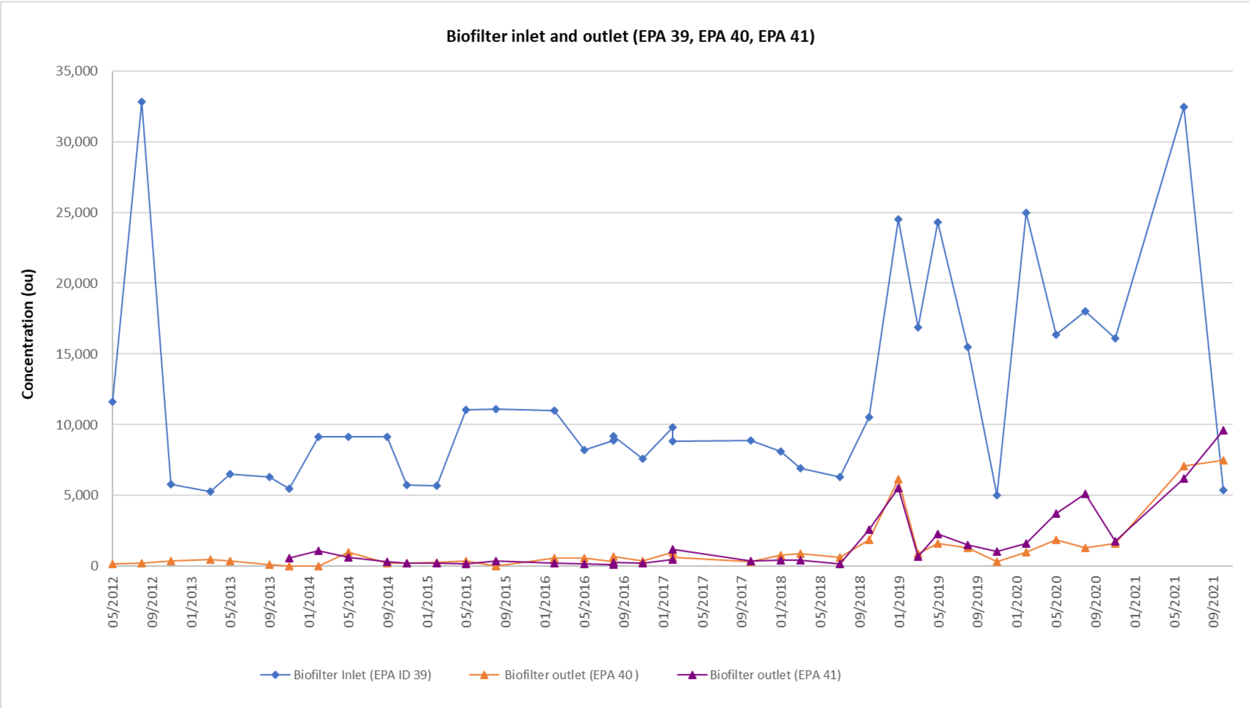
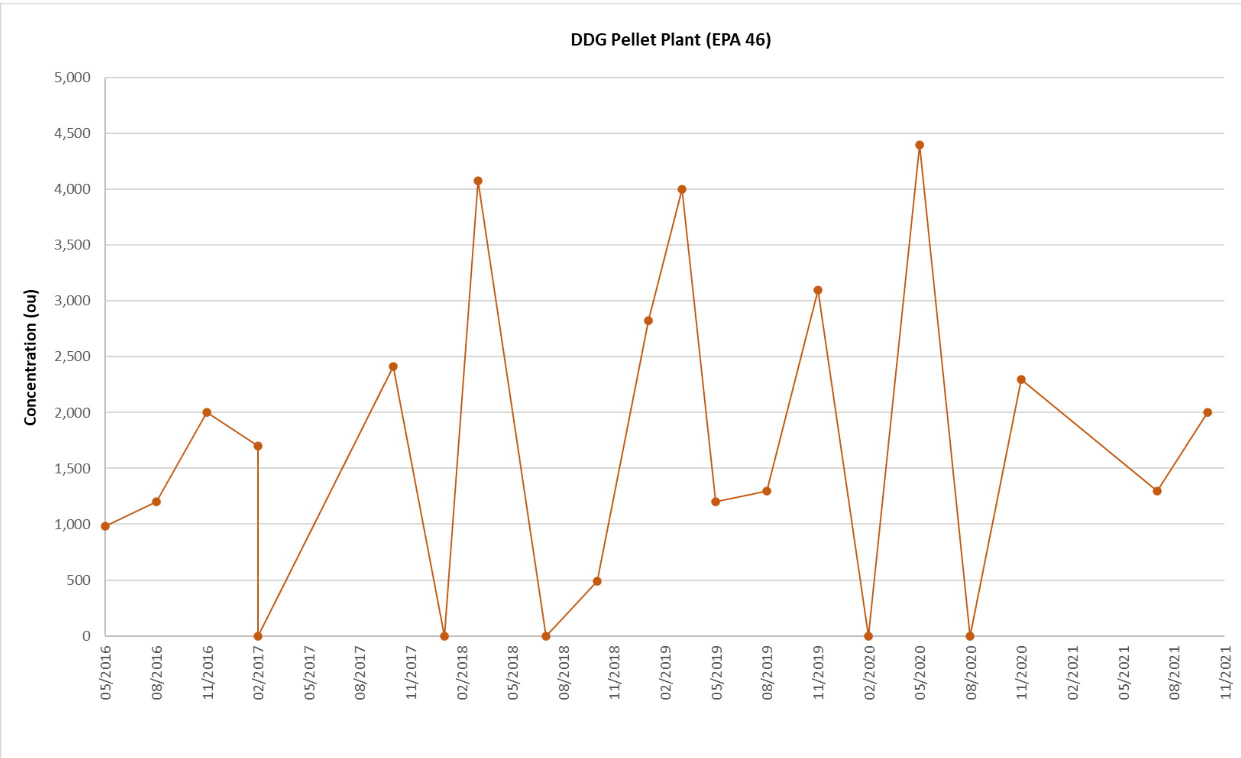


Figure 9. Biofilters (EPA 39, 40, 41)



Zero result represents Biofilter not available to be sampled for that event

Figure 10. DDG Pellet Plant (EPA 46)



Zero result represents DDG Pellet Plant not sampled for that event

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Ektimo

Manildra Group, Shoalhaven Starches Pty Ltd, Bomaderry

Odour Emission Testing Report, Quarter 3 2021 - 22
Report Number R012022

Ektimo

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Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

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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.

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Table of Contents

1 Executive Summary 5
1.1 Background 5
1.2 Project Objective 5
2 Results 6
2.1 Results Summary 6
2.2 EPA ID 8 - No. 1 Gluten Dryer Baghouse 7
2.3 EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse 8
2.4 EPA ID 10 - No. 3 Gluten Dryer Baghouse 9
2.5 EPA ID 11 - No. 4 Gluten Dryer Baghouse 10
2.6 EPA ID 12 – No. 1 Starch Dryer Scrubber 11
2.7 EPA ID 13 – No. 3 Starch Dryer Scrubber 12
2.8 EPA ID 14 – No. 4 Starch Dryer Scrubber 13
2.9 EPA ID 16 – CO_2 Scrubber Outlet 14
2.10 EPA ID 19 – Effluent Pond 1 15
2.11 EPA ID 21 – Effluent Pond 3 16
2.12 EPA ID 23 – Effluent Pond 5 17
2.13 EPA ID 24 – Effluent Pond 6 18
2.14 EPA ID 25 – Sulfur Oxidation Pond 19
2.15 EPA ID 35 - Combined Boilers 5 & 6 Stack 20
2.16 EPA ID 39 - Biofilter Inlet 21
2.17 EPA ID 39A - Biofilter inlet 22
2.18 EPA ID 40 - Biofilter A East 23
2.19 EPA ID 40 - Biofilter A West 24
2.20 EPA ID 41 - Biofilter B East 25
2.21 EPA ID 41 - Biofilter B West 26
2.22 EPA ID 44 – Fermenter 14 27
2.23 EPA ID 45 – Boiler 2 28
2.24 EPA ID 46 – DDG Pellet Plant Stack 29
2.25 EPA ID 47 - No. 5 Starch Dryer Scrubber 30
2.26 CO_2 Scrubber Inlet 31
3 Plant Operating Conditions 32
4 Test Methods 32
5 Quality Assurance/Quality Control Information 32
6 Definitions 33
7 Appendix 1: Site Location Photos 34
8 Appendix 2: Historical Odour Results 39

Table of Figures

Figure 1. Starch Dryers No 1, 3 & 4 (EPA 12, EPA 13, EPA 14) ... 39

Figure 2. Gluten Dryers No 1,2,3 & 4 (EPA 8, EPA 9, EPA 10, EPA 11) ... 39

Figure 3. Starch Dryer 5 (EPA 47) ... 40

Figure 4. Fermenters (EPA 44) ... 40

Figure 5. Carbon Dioxide Scrubber Outlet (EPA 16) ... 41

Figure 6. Combined Boiler 5 & 6 Stack (EPA 35) ... 41

Figure 7. Boiler 2 Stack (EPA 45) ... 42

Figure 8. Biofilters (EPA 39, 39A, 40, 41) ... 42

Figure 9. DDG Pellet Plant (EPA 46) ... 43

Figure 10. Effluent Storage Pond No. 1 (EPA 19) ... 43

Figure 11. Effluent Storage Pond No. 3 (EPA 21) ... 44

Figure 12. Effluent Storage Pond No. 5 (EPA 23) ... 44

Figure 13. Effluent Storage Pond No. 6 (EPA 24) ... 45

Figure 14. Sulfur Oxidation Pond (EPA 25) ... 45

1 Executive Summary

1.1 Background

Ektimo was engaged by Manildra Group to perform odour and emission testing at their Bomaderry plant.

1.2 Project Objective

The objectives of the project were to conduct a monitoring programme to quantify odour emissions from 23 discharge points to comply with Shoalhaven Starches' Environment Protection Licence 883.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
EPA ID 10 – No. 3 Gluten Dryer Baghouse	9 December 2021	Odour, oxygen
EPA ID 11 – No. 4 Gluten Dryer Baghouse		
EPA ID 45 - Boiler 2	14 December 2021	Odour, oxygen
EPA ID 35 – Combined Boilers 5 & 6 Stack		
CO_2 Scrubber Inlet		
EPA ID 16 - CO_2 Scrubber Outlet		
EPA ID 44 - Fermenter 14		Odour
EPA ID 8 – No. 1 Gluten Dryer Baghouse	15 December 2021	Odour, oxygen
EPA ID 9 – No. 2 Gluten Dryer Baghouse		
EPA ID 12 – No. 1 Starch Dryer Scrubber		
EPA ID 13 – No. 3 Starch Dryer Scrubber		
EPA ID 14 – No. 4 Starch Dryer Scrubber		
EPA ID 47 – No. 5 Starch Dryer Scrubber		
EPA ID 46 – DDG Pellet Plant Stack	16 December 2021	Odour
EPA ID 19 - Effluent Pond 1	20 December 2021	Odour
EPA ID 21 - Effluent Pond 3		
EPA ID 23 - Effluent Pond 5		
EPA ID 24 - Effluent Pond 6		
EPA ID 25 - Sulfur Oxidation Pond		
EPA ID 40 - Biofilter A	21 December 2021	Odour
EPA ID 41 - Biofilter B		
EPA ID 39A – Biofilter Inlet		
EPA ID 39 – Biofilter Inlet		Odour, oxygen

* Flow rate, velocity, temperature and moisture were also determined except at EPA ID 8

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

EPA ID 20 Effluent Pond 2 was unsafe to access for odour sampling.

EPA ID 22 Effluent Pond 4 was covered and was not able to be sampled.

EPA ID 42 Boiler 4 was not operating during the dates sampling was undertaken.

2 Results

2.1 Results Summary

Location	Date	Odour		Hedonic Tone	Character
		Concentration [ou]	Odourant Flow Rate [oum^3/min]		
EPA ID 8 – No. 1 Gluten Dryer Baghouse	15/12/2021	680	-	Neutral	Sweet, starch
EPA ID 9 – No. 2 Gluten Dryer Baghouse	15/12/2021	310	250,000	Mildly pleasant	Bread dough
EPA ID 10 – No. 3 Gluten Dryer Baghouse	9/12/2021	440	2,200,000	Pleasant	Bread, starch, vegemite
EPA ID 11 – No. 4 Gluten Dryer Baghouse	9/12/2021	340	640,000	Mildly pleasant	Bread, starch, vegemite
EPA ID 12 – No. 1 Starch Dryer Scrubber	15/12/2021	340	410,000	Pleasant	Toast, starch
EPA ID 13 – No. 3 Starch Dryer Scrubber	15/12/2021	180	220,000	Mildly pleasant	Playdough, salty, cardboard
EPA ID 14 – No. 4 Starch Dryer Scrubber	15/12/2021	260	320,000	Mildly pleasant	Bread, starch, dry dog food
EPA ID 16 - CO_2 Scrubber Outlet	14/12/2021	15,000	1,400,000	Pleasant	Cider, apple juice
EPA ID 19 - Effluent Pond 1	20/12/2021	37	4,100	Neutral	Pond water, wet
EPA ID 21 - Effluent Pond 3	20/12/2021	34	9,200	Neutral	Earthy, dirt, clay
EPA ID 23 - Effluent Pond 5	20/12/2021	57	51,000	Neutral	Dust, green waste, wet carboard
EPA ID 24 - Effluent Pond 6	20/12/2021	49	99,000	Neutral	Pond water, sweet
EPA ID 25 - Sulfur Oxidation Pond	20/12/2021	41	18,000	Neutral	Musty
EPA ID 35 - Combined Boilers 5 & 6 Stack	14/12/2021	810	1,500,000	Neutral	Gas, sulfur, paint
EPA ID 39A – Biofilter Inlet	21/12/2021	33,000	1,400,000	Neutral	Gas, sweet, bread dough
EPA ID 39 – Biofilter Inlet	21/12/2021	11,000	2,300,000	Pleasant	Sweet, bread dough, vegemite
EPA ID 40 - Biofilter A East	21/12/2021	8,000	670,000	Neutral	Gas vinegar, vegemite, yeast
EPA ID 40 - Biofilter A West	21/12/2021	7,400	610,000	Neutral	Garbage, burnt toast, vegemite
EPA ID 41 - Biofilter B East	21/12/2021	7,300	530,000	Pleasant	Sweet, burnt, vegemite
EPA ID 41 - Biofilter B West	21/12/2021	8,100	570,000	Mildly unpleasant	Vegemite
EPA ID 44 - Fermenter 14	14/12/2021	9,600	150,000	Neutral	Cider, sweet
EPA ID 45 - Boiler 2	14/12/2021	1,000	530,000	Neutral	Gas, texta
EPA ID 46 – DDG Pellet Plant Stack	16/12/2021	740	1,100,000	Neutral	Gas, bread
EPA ID 47 – No. 5 Starch Dryer Scrubber	15/12/2021	310	1,200,000	Pleasant	Burnt toast
CO_2 Scrubber Inlet	14/12/2021	25,000	2,300,000	Neutral	Cider, sweet

2.2 EPA ID 8 - No. 1 Gluten Dryer Baghouse

Date	15/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 8 - No. 1 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		

Sampling Plane Details	
Sampling plane dimensions	2400 x 2560 mm
Sampling plane area	6.14 m²
Sampling port size, number	Sampled from exit
Access & height of ports	Stairs & ladders 22 m
Duct orientation & shape	Horizontal Rectangular
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments

Sampling was undertaken at the exit of the stack as it was the only accessible area for the samples to be taken.
No temperature or flow rate readings could be taken due to access issues.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Gas Analyser Results	Average
Sampling time	1000 - 1059
	Concentration % v/v
Oxygen	20.9

Odour	Results
Sampling time	1035 - 1045
	Concentration ou
Results	680
Lower uncertainty limit	470
Upper uncertainty limit	980
Hedonic tone	Neutral
Odour character	Sweet, starch
Analysis date & time	16/12/21, 1505-1630
Holding time	29 hours
Dilution factor	1
Bag material	Nalophan
Butanol threshold (ppb)	52.3
Laboratory temp (°C)	23.2
Last calibration date	October 2021

2.3 EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse

Date	15/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 9 - No. 2 Gluten Dryer / Starch Dryer
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	1190 mm
Sampling plane area	1.11 m²
Sampling port size, number & depth	4" BSP (x2), 90 mm
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 2 D
Upstream disturbance	Bend 0.5 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	6.4	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.93	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1205 & 1304	
Temperature, °C	64	
Temperature, K	337	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/s	19	
Volumetric flow rate (wet STP), m³/s	14	
Volumetric flow rate (dry STP), m³/s	13	
Mass flow rate (wet basis), kg/hour	62000	
Velocity difference, %	1	

Gas Analyser Results	Average
Sampling time	1205 - 1304
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1220 - 1230	
	Concentration ou	Odourant Flow Rate oum³/min
Results	310	250000
Lower uncertainty limit	210	
Upper uncertainty limit	440	
Hedonic tone	Mildly pleasant	
Odour character	Bread dough	
Analysis date & time	16/12/21, 1505-1630	
Holding time	27 hours	
Dilution factor	1	
Bag material	Teflon™	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	23.2	
Last calibration date	October 2021	

2.4 EPA ID 10 - No. 3 Gluten Dryer Baghouse

Date	9/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 10 - No. 3 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		211208

Sampling Plane Details		
Sampling plane dimensions	2100 x 2400 mm	
Sampling plane area	5.04 m²	
Sampling port size, number	2" Ball valve (x3)	
Access & height of ports	Stairs	15 m
Duct orientation & shape	Vertical	Rectangular
Downstream disturbance	Exit	5 D
Upstream disturbance	Change in diameter	2.5 D
No. traverses & points sampled	3	21
Sample plane compliance to AS4323.1 (1995)	Non-compliant	

Comments

The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The stack or duct does not have the required number of access holes (ports)

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	5.3	
Gas molecular weight, g/g mole	28.4 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.01	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1045 & 1145
Temperature, °C	72
Temperature, K	345
Velocity at sampling plane, m/s	21
Volumetric flow rate, actual, m³/s	100
Volumetric flow rate (wet STP), m³/s	83
Volumetric flow rate (dry STP), m³/s	79
Mass flow rate (wet basis), kg/hour	380000
Velocity difference, %	-3

Gas Analyser Results	Average
Sampling time	1045 - 1144
	Concentration %v/v
Oxygen	20.8

Odour	Results	
Sampling time	1049 - 1109	
	Concentration ou	Odourant Flow Rate oum³/min
Results	440	2200000
Lower uncertainty limit	300	
Upper uncertainty limit	630	
Hedonic tone	Pleasant	
Odour character	Bread, starch, vegemite	
Analysis date & time	10/12/21, 1302-1357	
Holding time	26 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	20.8	
Last calibration date	October 2021	

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2.5 EPA ID 11 - No. 4 Gluten Dryer Baghouse

Date	9/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 11 - No. 4 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		211208

Sampling Plane Details	
Sampling plane dimensions	1400 x 1700 mm
Sampling plane area	2.38 m²
Sampling port size, number	4" BSP (x3)
Access & height of ports	Stairs 30 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 6 D
No. traverses & points sampled	3 12
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	5	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.01	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	0935 & 1040
Temperature, °C	72
Temperature, K	345
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/s	40
Volumetric flow rate (wet STP), m³/s	32
Volumetric flow rate (dry STP), m³/s	30
Mass flow rate (wet basis), kg/hour	150000
Velocity difference, %	-1

Gas Analyser Results	Average
Sampling time	0938 - 1037
	Concentration %v/v
Oxygen	20.7

Odour	Results	
Sampling time	0941 - 1001	
	Concentration ou	Odourant Flow Rate oum³/min
Results	340	640000
Lower uncertainty limit	230	
Upper uncertainty limit	480	
Hedonic tone	Mildly pleasant	
Odour character	Bread, starch, vegemite	
Analysis date & time	10/12/21, 1302-1357	
Holding time	27 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	20.8	
Last calibration date	October 2021	

Ektimo

2.6 EPA ID 12 – No. 1 Starch Dryer Scrubber

Date	15/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 12 - No. 1 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	1500 x 1500 mm
Sampling plane area	2.25 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 25 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Silencer 0 D
No. traverses & points sampled	3 15
Sample plane compliance to AS4323.1 (1995)	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	7.1	
Gas molecular weight, g/g mole	28.2 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.09	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1103 & 1202
Temperature, °C	42
Temperature, K	315
Velocity at sampling plane, m/s	11
Volumetric flow rate, actual, m³/s	24
Volumetric flow rate (wet STP), m³/s	21
Volumetric flow rate (dry STP), m³/s	19
Mass flow rate (wet basis), kg/hour	93000
Velocity difference, %	<1

Gas Analyser Results	Average
Sampling time	1103 - 1202
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1132 - 1142	
	Concentration ou	Odourant Flow Rate oum³/min
Results	340	410000
Lower uncertainty limit	230	
Upper uncertainty limit	480	
Hedonic tone	Pleasant	
Odour character	Toast, starch	
Analysis date & time	16/12/21, 1505-1630	
Holding time	28 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	23.2	
Last calibration date	October 2021	

2.7 EPA ID 13 – No. 3 Starch Dryer Scrubber

Date	15/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 13 - No. 3 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	1000 x 1050 mm
Sampling plane area	1.05 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	3 15
Sample plane compliance to AS4323.1 (1995)	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	9	
Gas molecular weight, g/g mole	28.0 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.25 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.07	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1415 & 1515	
Temperature, °C	44	
Temperature, K	317	
Velocity at sampling plane, m/s	22	
Volumetric flow rate, actual, m³/s	24	
Volumetric flow rate (wet STP), m³/s	20	
Volumetric flow rate (dry STP), m³/s	18	
Mass flow rate (wet basis), kg/hour	91000	
Velocity difference, %	<1	

Gas Analyser Results	Average
Sampling time	1415 - 1514
	Concentration %v/v
Oxygen	20.8

Odour	Results	
Sampling time	1444 - 1454	
	Concentration ou	Odourant Flow Rate oum³/min
Results	180	220000
Lower uncertainty limit	130	
Upper uncertainty limit	260	
Hedonic tone	Mildly pleasant	
Odour character	Playdough, salty, cardboard	
Analysis date & time	16/12/21, 1505-1630	
Holding time	24 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	23.2	
Last calibration date	October 2021	

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2.8 EPA ID 14 – No. 4 Starch Dryer Scrubber

Date	15/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 14 - No. 4 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	1000 x 1050 mm
Sampling plane area	1.05 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	3 15
Sample plane compliance to AS4323.1 (1995)	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	4.9	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.12	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1315 & 1414	
Temperature, °C	36	
Temperature, K	309	
Velocity at sampling plane, m/s	22	
Volumetric flow rate, actual, m³/s	23	
Volumetric flow rate (wet STP), m³/s	21	
Volumetric flow rate (dry STP), m³/s	20	
Mass flow rate (wet basis), kg/hour	94000	
Velocity difference, %	1	

Gas Analyser Results	Average
Sampling time	1315 - 1414
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1252 - 1302	
	Concentration ou	Odourant Flow Rate oum³/min
Results	260	320000
Lower uncertainty limit	180	
Upper uncertainty limit	370	
Hedonic tone	Mildly pleasant	
Odour character	Bread, starch, dry dog food	
Analysis date & time	16/12/21, 1505-1630	
Holding time	26 hours	
Dilution factor	1	
Bag material	Teflon™	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	23.2	
Last calibration date	October 2021	

2.9 EPA ID 16 – CO_2 Scrubber Outlet

Date	14/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 16 - CO2 Scrubber Outlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details

Sampling plane dimensions	505 mm
Sampling plane area	0.2 m²
Sampling port size, number & depth	3" BSP (x1), 60 mm
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >6 D
Upstream disturbance	Junction >10 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments

The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The stack or duct does not have the required number of access holes (ports)

Stack Parameters

Moisture content, %v/v	2.2	
Gas molecular weight, g/g mole	42.6 (wet)	43.1 (dry)
Gas density at STP, kg/m³	1.90 (wet)	1.92 (dry)
Gas density at discharge conditions, kg/m³	1.70	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1007 & 1108
Temperature, °C	32
Temperature, K	306
Velocity at sampling plane, m/s	8.6
Volumetric flow rate, actual, m³/s	1.7
Volumetric flow rate (wet STP), m³/s	1.5
Volumetric flow rate (dry STP), m³/s	1.5
Mass flow rate (wet basis), kg/hour	11000
Velocity difference, %	<1

Gas Analyser Results	Average
Sampling time	1007 - 1106
	Concentration %v/v
Oxygen	1.2

Odour	Results	
Sampling time	1050 - 1051	
	Concentration ou	Odourant Flow Rate oum³/min
Results	15000	1400000
Lower uncertainty limit	11000	
Upper uncertainty limit	22000	
Hedonic tone	Pleasant	
Odour character	Cider, apple juice	
Analysis date & time	15/12/21, 1005-1105	
Holding time	23 hours	
Dilution factor	9	
Bag material	Teflon™	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	20.9	
Last calibration date	October 2021	

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2.10 EPA ID 19 – Effluent Pond 1

Client	Manildra Group	**Test Location**	EPA ID 19 - Effluent Pond 1
Date	20/12/2021	**Plant/Site**	Bomaderry, NSW
Report No.	R012022		
Ektimo Staff	Zoe Parker & Scott Woods		*211014*

Test Location Details	
Surface Description	Ducks, algae, foam
Area Classification	Industrial
Source area, m^2	3072
Sampling Method	AS4323.4 (Flux)
Sampling Results	
Sampling time, hrs	1344 - 1354
Sample dilution	1
Odour concentration, ou	**37**
Hedonic tone	Neutral
Odour character	Pond water, wet
95% Confidence Interval	27 - 52
Odour Flux Rate, ou/m²/min	**1.3**
Odourant flow rate, oum³/min	**4100**
Flux Testing Parameters	
Equilibration time, hrs	1319 - 1344
Sweep Rate @ STP, L/min	4.55
Ambient temperature, °C	27

2.11 EPA ID 21 – Effluent Pond 3

Client	Manildra Group	**Test Location**	EPA ID 21 - Effluent Pond 3
Date	20/12/2021	**Plant/Site**	Bomaderry, NSW
Report No.	R012022		
Ektimo Staff	Zoe Parker & Scott Woods		*211014*

Test Location Details	
Surface Description	Ducks
Area Classification	Industrial
Source area, m^2	7413
Sampling Method	AS4323.4 (Flux)
Sampling Results	
Sampling time, hrs	1158 - 1208
Sample dilution	1
Odour concentration, ou	**34**
Hedonic tone	Neutral
Odour character	Earthy, dirt, clay
95% Confidence Interval	25 - 48
Odour Flux Rate, ou/m²/min	**1.2**
Odourant flow rate, oum³/min	**9200**
Flux Testing Parameters	
Equilibration time, hrs	1133 - 1158
Sweep Rate @ STP, L/min	4.57
Ambient temperature, °C	26

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2.12 EPA ID 23 – Effluent Pond 5

Client	Manildra Group	**Test Location**	EPA ID 23 - Effluent Pond 5
Date	20/12/2021	**Plant/Site**	Bomaderry, NSW
Report No.	R012022		
Ektimo Staff	Zoe Parker & Scott Woods		*211014*

Test Location Details	
Surface Description	Ducks, foam
Area Classification	Industrial
Source area, m^2	24282
Sampling Method	AS4323.4 (Flux)
Sampling Results	
Sampling time, hrs	1105 - 1116
Sample dilution	1
Odour concentration, ou	**57**
Hedonic tone	Neutral
Odour character	Dust, green waste, wet carboard
95% Confidence Interval	41 - 80
Odour Flux Rate, ou/m²/min	**2.1**
Odourant flow rate, oum³/min	**51000**
Flux Testing Parameters	
Equilibration time, hrs	1040 - 1105
Sweep Rate @ STP, L/min	4.58
Ambient temperature, °C	25

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2.13 EPA ID 24 – Effluent Pond 6

Client	Manildra Group	**Test Location**	EPA ID 24 - Effluent Pond 6
Date	20/12/2021	**Plant/Site**	Bomaderry, NSW
Report No.	R012022		
Ektimo Staff	Zoe Parker & Scott Woods		*211014*

Test Location Details	
Surface Description	Ducks, foam, green waste
Area Classification	Industrial
Source area, m^2	56404
Sampling Method	AS4323.4 (Flux)
Sampling Results	
Sampling time, hrs	1249 - 1259
Sample dilution	1
Odour concentration, ou	**49**
Hedonic tone	Neutral
Odour character	Pond water, sweet
95% Confidence Interval	35 - 68
Odour Flux Rate, ou/m²/min	**1.8**
Odourant flow rate, oum³/min	**99000**
Flux Testing Parameters	
Equilibration time, hrs	1224 - 1249
Sweep Rate @ STP, L/min	4.57
Ambient temperature, °C	26

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2.14 EPA ID 25 – Sulfur Oxidation Pond

Client	Manildra Group	**Test Location**	EPA ID 25 - Sulfur Oxidation Pond
Date	20/12/2021	**Plant/Site**	Bomaderry, NSW
Report No.	R012022		
Ektimo Staff	Zoe Parker & Scott Woods		***211014***

Test Location Details	
Surface Description	Aerated, foam
Area Classification	Industrial
Source area, m^2	12341
Sampling Method	AS4323.4 (Flux)
Sampling Results	
Sampling time, hrs	1011 - 1021
Sample dilution	1
Odour concentration, ou	**41**
Hedonic tone	Neutral
Odour character	Musty
95% Confidence Interval	29 - 57
Odour Flux Rate, ou/m²/min	**1.5**
Odourant flow rate, oum³/min	**18000**
Flux Testing Parameters	
Equilibration time, hrs	0946 - 1011
Sweep Rate @ STP, L/min	4.62
Ambient temperature, °C	23

2.15 EPA ID 35 - Combined Boilers 5 & 6 Stack

Date	14/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 35 - Boiler 5 & 6 Combined Stack
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	1985 mm
Sampling plane area	3.09 m²
Sampling port size, number & depth	4" BSP (x4), 100 mm
Access & height of ports	Stairs & ladders 40 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal

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

Stack Parameters		
Moisture content, %v/v	4.4	
Gas molecular weight, g/g mole	29.6 (wet)	30.1 (dry)
Gas density at STP, kg/m³	1.32 (wet)	1.34 (dry)
Gas density at discharge conditions, kg/m³	0.96	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1350 & 1450	
Temperature, °C	104	
Temperature, K	377	
Velocity at sampling plane, m/s	13	
Volumetric flow rate, actual, m³/s	41	
Volumetric flow rate (wet STP), m³/s	30	
Volumetric flow rate (dry STP), m³/s	29	
Mass flow rate (wet basis), kg/hour	140000	
Velocity difference, %	1	

Gas Analyser Results	Average
Sampling time	1350 - 1449
	Concentration %v/v
Oxygen	10

Odour	Results	
Sampling time	1407 - 1417	
	Concentration ou	Odourant Flow Rate oum³/min
Results	810	1500000
Lower uncertainty limit	560	
Upper uncertainty limit	1200	
Hedonic tone	Neutral	
Odour character	Gas, sulfur, paint	
Analysis date & time	15/12/21, 1005-1105	
Holding time	20 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	20.9	
Last calibration date	October 2021	

2.16 EPA ID 39 - Biofilter Inlet

Date	21/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 39 - Biofilter Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Harrison Handicott	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	600 mm
Sampling plane area	0.283 m²
Sampling port size, number & depth	1 x 1 inch port, 45 mm
Access & height of ports	Ground 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 6 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	5	
Gas molecular weight, g/g mole	28.4 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.07	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0920 & 1020	
Temperature, °C	33	
Temperature, K	306	
Velocity at sampling plane, m/s	15	
Volumetric flow rate, actual, m³/s	4.3	
Volumetric flow rate (wet STP), m³/s	3.7	
Volumetric flow rate (dry STP), m³/s	3.5	
Mass flow rate (wet basis), kg/hour	17000	
Velocity difference, %	3	

Gas Analyser Results	Average
Sampling time	0923 - 1022
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	0935 - 0943	
	Concentration ou	Odourant Flow Rate oum³/min
Results	11000	2300000
Lower uncertainty limit	7600	
Upper uncertainty limit	15000	
Hedonic tone	Pleasant	
Odour character	Sweet, bread dough, vegemite	
Analysis date & time	22/12/21, 1010-1130	
Holding time	25 hours	
Dilution factor	2	
Bag material	Teflon™	
Butanol threshold (ppb)	62.3	
Laboratory temp (°C)	24.25	
Last calibration date	October 2021	

2.17 EPA ID 39A - Biofilter inlet

Date	21/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 39A - Biofilter Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Harrison Handicott	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number	1 x 1 inch port
Access & height of ports	Ground 0.6 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1.5 D
Upstream disturbance	Inlet >2 D
No. traverses & points sampled	1 4
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	4.9	
Gas molecular weight, g/g mole	28.4 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.13	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1000 & 1010
Temperature, °C	33
Temperature, K	306
Velocity at sampling plane, m/s	11
Volumetric flow rate, actual, m³/s	0.78
Volumetric flow rate (wet STP), m³/s	0.7
Volumetric flow rate (dry STP), m³/s	0.66
Mass flow rate (wet basis), kg/hour	3200
Velocity difference, %	1

Odour	Results	
Sampling time	1003 - 1005	
	Concentration ou	Odourant Flow Rate oum³/min
Results	33000	1400000
Lower uncertainty limit	24000	
Upper uncertainty limit	46000	
Hedonic tone	Neutral	
Odour character	Gas, sweet, bread dough	
Analysis date & time	22/12/21, 1010-1130	
Holding time	24 hours	
Dilution factor	9	
Bag material	Teflon™	
Butanol threshold (ppb)	62.3	
Laboratory temp (°C)	24.25	
Last calibration date	October 2021	

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2.18 EPA ID 40 - Biofilter A East

Client	Manildra Group	**Test Location**	EPA ID 40 - Biofilter A East
Date	21/12/2021	**Plant/Site**	Ethanol Plant
Report No.	R012022		Bomaderry, NSW
Ektimo Staff	Zoe Parker & Harrison Handicott		*211014*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	83
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	27
Sampling Results	
Sampling time, hrs	1013 - 1021
Sample dilution	2
Odour concentration, ou	**8000**
Hedonic tone	Neutral
Odour character	Gas vinegar, vegemite, yeast
95% Confidence Interval	5800 - 11000
Odour Flux Rate, ou/m²/min	**6700**
Odourant flow rate, oum³/min	**670000**

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2.19 EPA ID 40 - Biofilter A West

Client	Manildra Group	**Test Location**	EPA ID 40 - Biofilter A West
Date	21/12/2021	**Plant/Site**	Ethanol Plant
Report No.	R012022		Bomaderry, NSW
Ektimo Staff	Zoe Parker & Harrison Handicott		*211014*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	82
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	27
Sampling Results	
Sampling time, hrs	1028 - 1036
Sample dilution	2
Odour concentration, ou	**7400**
Hedonic tone	Neutral
Odour character	Garbage, burnt toast, vegemite
95% Confidence Interval	5400 - 10000
Odour Flux Rate, ou/m²/min	**6100**
Odourant flow rate, oum³/min	**610000**

2.20 EPA ID 41 - Biofilter B East

Client	Manildra Group	**Test Location**	EPA ID 41 - Biofilter B East
Date	21/12/2021	**Plant/Site**	Ethanol Plant
Report No.	R012022		Bomaderry, NSW
Ektimo Staff	Zoe Parker & Harrison Handicott		*211014*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	73
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	24
Sampling Results	
Sampling time, hrs	1044 - 1052
Sample dilution	2
Odour concentration, ou	**7300**
Hedonic tone	Pleasant
Odour character	Sweet, burnt, vegemite
95% Confidence Interval	5300 - 10000
Odour Flux Rate, ou/m²/min	**5300**
Odourant flow rate, oum³/min	**530000**

2.21 EPA ID 41 - Biofilter B West

Client	Manildra Group	**Test Location**	EPA ID 41 - Biofilter B West
Date	21/12/2021	**Plant/Site**	Ethanol Plant
Report No.	R012022		Bomaderry, NSW
Ektimo Staff	Zoe Parker & Harrison Handicott		*211014*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	70
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	23
Sampling Results	
Sampling time, hrs	1059 - 1107
Sample dilution	2
Odour concentration, ou	**8100**
Hedonic tone	Mildly unpleasant
Odour character	Vegemite
95% Confidence Interval	5800 - 11000
Odour Flux Rate, ou/m²/min	**5700**
Odourant flow rate, oum³/min	**570000**

2.22 EPA ID 44 – Fermenter 14

Date	14/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 44 - Fermenter 14
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	295 mm
Sampling plane area	0.0683 m²
Sampling port size, number & depth	3" BSP (x1), 75 mm
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 10 D
Upstream disturbance	Junction 2 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments
The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	3.8	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.15	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1003 & 1010	
Temperature, °C	31	
Temperature, K	304	
Velocity at sampling plane, m/s	4.3	
Volumetric flow rate, actual, m³/s	0.29	
Volumetric flow rate (wet STP), m³/s	0.26	
Volumetric flow rate (dry STP), m³/s	0.25	
Mass flow rate (wet basis), kg/hour	1200	
Velocity difference, %	<1	

Odour	Results	
Sampling time	1005 - 1009	
	Concentration ou	Odourant Flow Rate oum³/min
Results	9600	150000
Lower uncertainty limit	6700	
Upper uncertainty limit	14000	
Hedonic tone	Neutral	
Odour character	Cider, sweet	
Analysis date & time	15/12/21, 1005-1105	
Holding time	24 hours	
Dilution factor	2	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	20.9	
Last calibration date	October 2021	

2.23 EPA ID 45 – Boiler 2

Date	14/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 45 - Boiler 2
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	1070 mm
Sampling plane area	0.899 m²
Sampling port size, number & depth	4" Flange (x2), 180 mm
Access & height of ports	Ladders 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter 5 D
No. traverses & points sampled	2 16
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal

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

Stack Parameters		
Moisture content, %v/v	6.4	
Gas molecular weight, g/g mole	29.2 (wet)	29.9 (dry)
Gas density at STP, kg/m³	1.30 (wet)	1.34 (dry)
Gas density at discharge conditions, kg/m³	0.72	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1240 & 1340	
Temperature, °C	222	
Temperature, K	495	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/s	15	
Volumetric flow rate (wet STP), m³/s	8.6	
Volumetric flow rate (dry STP), m³/s	8	
Mass flow rate (wet basis), kg/hour	40000	
Velocity difference, %	-3	

Gas Analyser Results	Average
Sampling time	1240 - 1339
	Concentration %v/v
Oxygen	10.7

Odour	Results	
Sampling time	1320 - 1330	
	Concentration ou	Odourant Flow Rate oum³/min
Results	1000	530000
Lower uncertainty limit	710	
Upper uncertainty limit	1500	
Hedonic tone	Neutral	
Odour character	Gas, texta	
Analysis date & time	15/12/21, 1005-1105	
Holding time	21 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	20.9	
Last calibration date	October 2021	

Ektimo

2.24 EPA ID 46 – DDG Pellet Plant Stack

Date	16/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 46 - DDG Pellet Plant Stack
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	1460 mm
Sampling plane area	1.67 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Elevated work platform 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Junction 2.1 D
No. traverses & points sampled	1 8
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.9	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.08	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1020 & 1150	
Temperature, °C	54	
Temperature, K	327	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/s	29	
Volumetric flow rate (wet STP), m³/s	24	
Volumetric flow rate (dry STP), m³/s	24	
Mass flow rate (wet basis), kg/hour	110000	
Velocity difference, %	10	

Odour	Results	
Sampling time	1116 - 1126	
	Concentration ou	Odourant Flow Rate oum³/min
Results	740	1100000
Lower uncertainty limit	510	
Upper uncertainty limit	1100	
Hedonic tone	Neutral	
Odour character	Gas, bread	
Analysis date & time	16/12/21, 1505-1630	
Holding time	4 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	23.2	
Last calibration date	October 2021	

2.25 EPA ID 47 - No. 5 Starch Dryer Scrubber

Date	15/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	EPA ID 47 - No. 5 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	2400 mm
Sampling plane area	4.52 m²
Sampling port size, number	4" Flange (x2)
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest differential pressure ratio exceeds 9:1
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	7.9	
Gas molecular weight, g/g mole	28.1 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.02	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1515 & 1625	
Temperature, °C	62	
Temperature, K	336	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/s	78	
Volumetric flow rate (wet STP), m³/s	64	
Volumetric flow rate (dry STP), m³/s	59	
Mass flow rate (wet basis), kg/hour	290000	
Velocity difference, %	4	

Gas Analyser Results	Average
Sampling time	1523 - 1622
	Concentration %v/v
Oxygen	20.8

Odour	Results	
Sampling time	1553 - 1603	
	Concentration ou	Odourant Flow Rate oum³/min
Results	310	1200000
Lower uncertainty limit	210	
Upper uncertainty limit	440	
Hedonic tone	Pleasant	
Odour character	Burnt toast	
Analysis date & time	16/12/21, 1505-1630	
Holding time	23 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	23.2	
Last calibration date	October 2021	

2.26 CO_2 Scrubber Inlet

Date	14/12/2021	**Client**	Manildra Group
Report	R012022	**Stack ID**	CO2 Scrubber Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Adnan Latif	**State**	NSW
Process Conditions	Please refer to client records.		211203

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	1 inch ball valve, 80 mm
Access & height of ports	Ground level 1.5 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 0.5 D
Upstream disturbance	Bend 0.5 D
No. traverses & points sampled	1 2
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments

Flow measurement readings were applied from EPA ID 16, the CO2 scrubber outlet, as flow was unable to be measured at this location.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	2.2	
Gas molecular weight, g/g mole	42.7 (wet)	43.3 (dry)
Gas density at STP, kg/m³	1.91 (wet)	1.93 (dry)
Gas density at discharge conditions, kg/m³	1.71	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1007 & 1108	
Temperature, °C	32	
Temperature, K	305	
Velocity at sampling plane, m/s	8.5	
Volumetric flow rate, actual, m³/s	1.7	
Volumetric flow rate (wet STP), m³/s	1.5	
Volumetric flow rate (dry STP), m³/s	1.5	
Mass flow rate (wet basis), kg/hour	10000	
Velocity difference, %	1	

Gas Analyser Results	Average
Sampling time	1110 - 1210
	Concentration %v/v
Oxygen	0.7

Odour	Results	
Sampling time	1139 - 1140	
	Concentration ou	Odourant Flow Rate oum³/min
Results	25000	2300000
Lower uncertainty limit	17000	
Upper uncertainty limit	36000	
Hedonic tone	Neutral	
Odour character	Cider, sweet	
Analysis date & time	15/12/21, 1005-1105	
Holding time	23 hours	
Dilution factor	9	
Bag material	Nalophan	
Butanol threshold (ppb)	52.3	
Laboratory temp (°C)	20.9	
Last calibration date	October 2021	

3 Plant Operating Conditions

See Manildra Group records for complete process conditions.

4 Test Methods

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

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sampling points - Selection	NSW EPA TM-1	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW EPA TM-2	NSW EPA TM-2	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22	NSW EPA TM-22	19%	✓	✓
Molecular weight	NA	NSW EPA TM-23	not specified	NA	✓
Dry gas density	NA	NSW EPA TM-23	not specified	NA	✓
Oxygen	NSW EPA TM-25	NSW EPA TM-25	13%	✓	✓
Particulate matter (PM_{10} and $PM_{2.5}$)	USEPA Method 201A	USEPA Method 201A	9%	✓	✓††
Solid particles (total)	NSW EPA TM-15	NSW EPA TM-15	3%	✓	✓††
Odour	NSW EPA OM-7	NSW EPA OM-7	refer to results	✓	✓¥
Odour characterisation	NA	direct observation	NA	NA	×
Odour from diffuse sources	NSW EPA OM-8	AS4323.3	refer to results	✓	✓¥

211109

* 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:
10 December 2021 in report ON-00106.
15 December 2021 in report ON-00107.
16 December 2021 in report ON-00109.
21 December 2021 in report ON-00112.
22 December 2021 in report ON-00113.

5 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.

6 Definitions

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

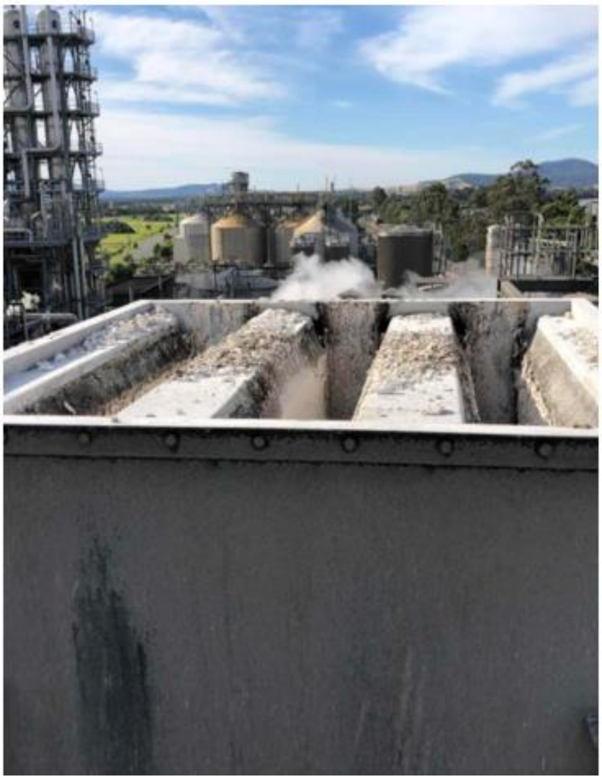
% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American Public Health Association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
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.

7 Appendix 1: Site Location Photos

EPA ID 9 – No. 2 Gluten Dryer Baghouse

EPA ID 10 – No. 3 Gluten Dryer Baghouse

EPA ID 11 – No. 4 Gluten Dryer Baghouse



EPA ID 12 – No. 1 Starch Dryer Scrubber

EPA ID 13 – No. 3 Starch Dryer Scrubber

EPA ID 14 – No. 4 Starch Dryer Scrubber

EPA 19 – Effluent Pond 1

EPA 21 – Effluent Pond 3

EPA 23 – Effluent Pond 5

EPA 24 – Effluent Pond 6

EPA 25 – Sulfur Oxidation Pond

EPA ID 35 - Combined Boilers 5 & 6 Stack

EPA ID 39 - Biofilter Inlet

EPA ID 39A - Biofilter Inlet

EPA ID 40 - Biofilter A

EPA ID 41 - Biofilter B

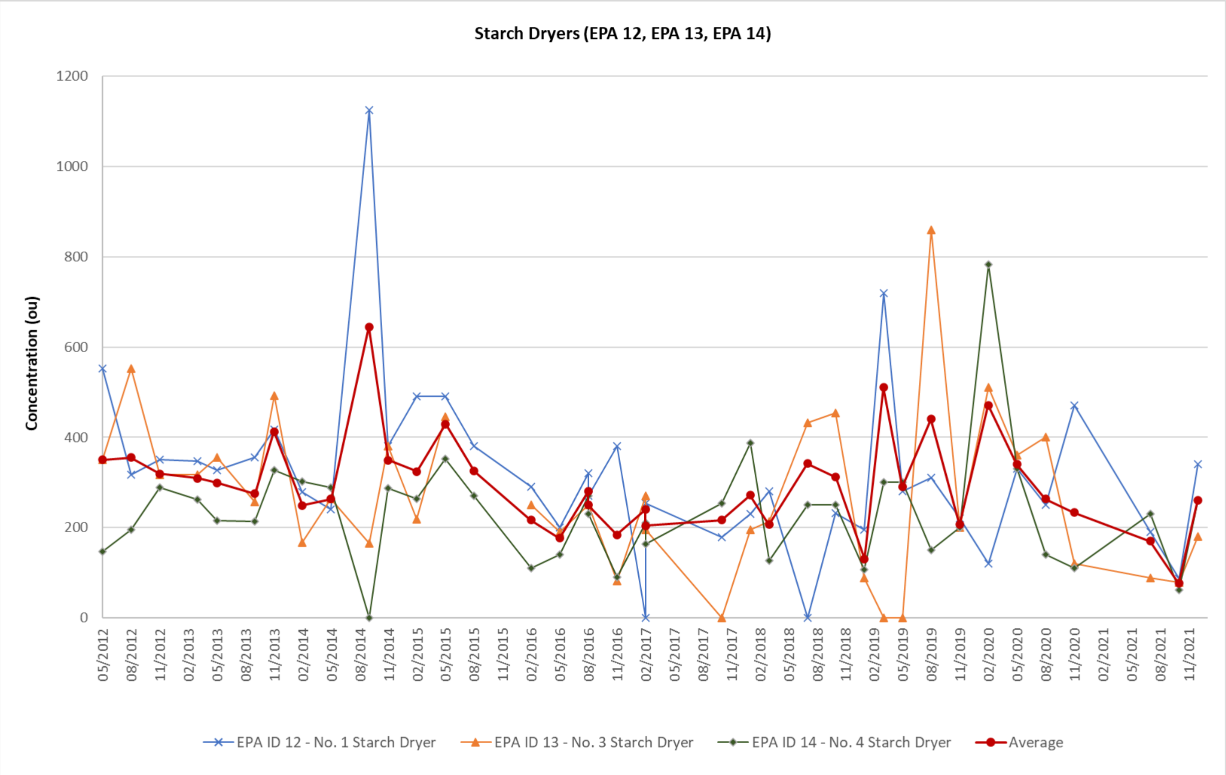
EPA ID 47 - Starch Dryer 5

EPA ID 45 - Boiler 2

EPA ID 46 – DDG Pellet Plant Stack

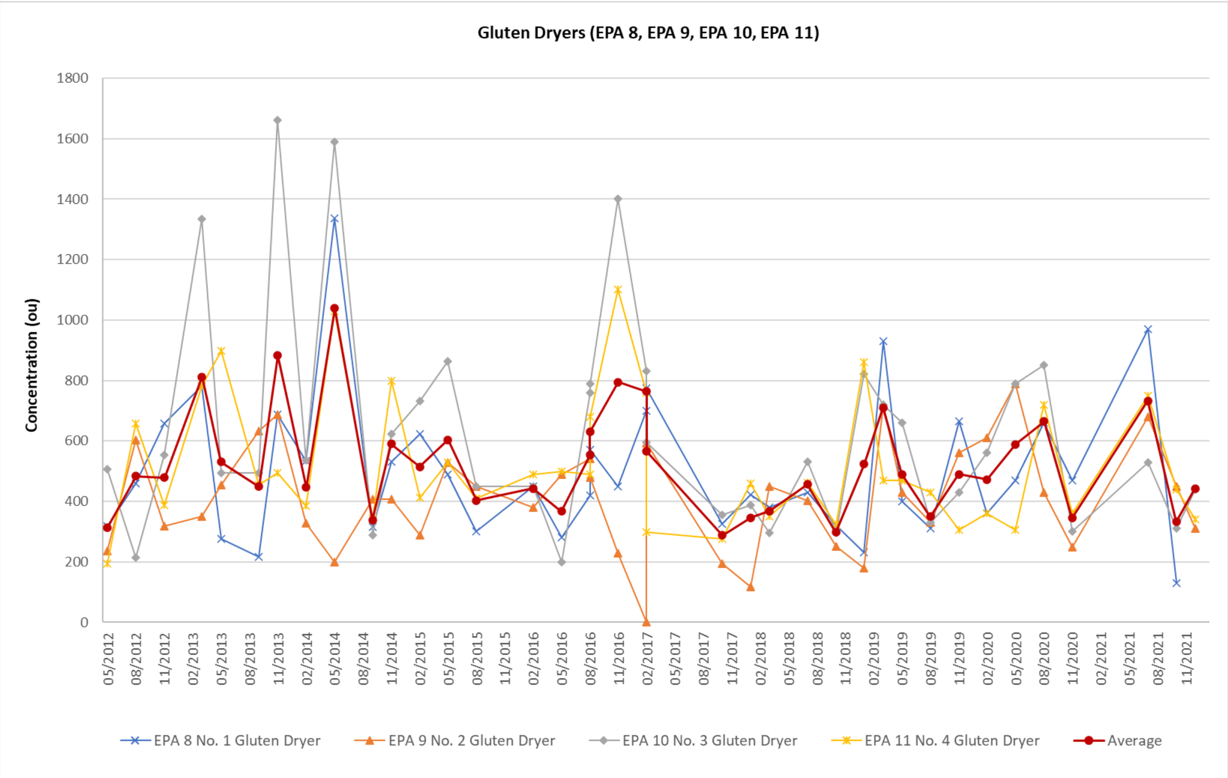
8 Appendix 2: Historical Odour Results

Figure 1. Starch Dryers No 1, 3 & 4 (EPA 12, EPA 13, EPA 14)



Zero result represents Dryer not operating on days of testing.

Figure 2. Gluten Dryers No 1, 2 ,3 & 4 (EPA 8, EPA 9, EPA 10, EPA 11)



Zero result represents Dryer not operating on days of testing.

Figure 3. Starch Dryer 5 (EPA 47)

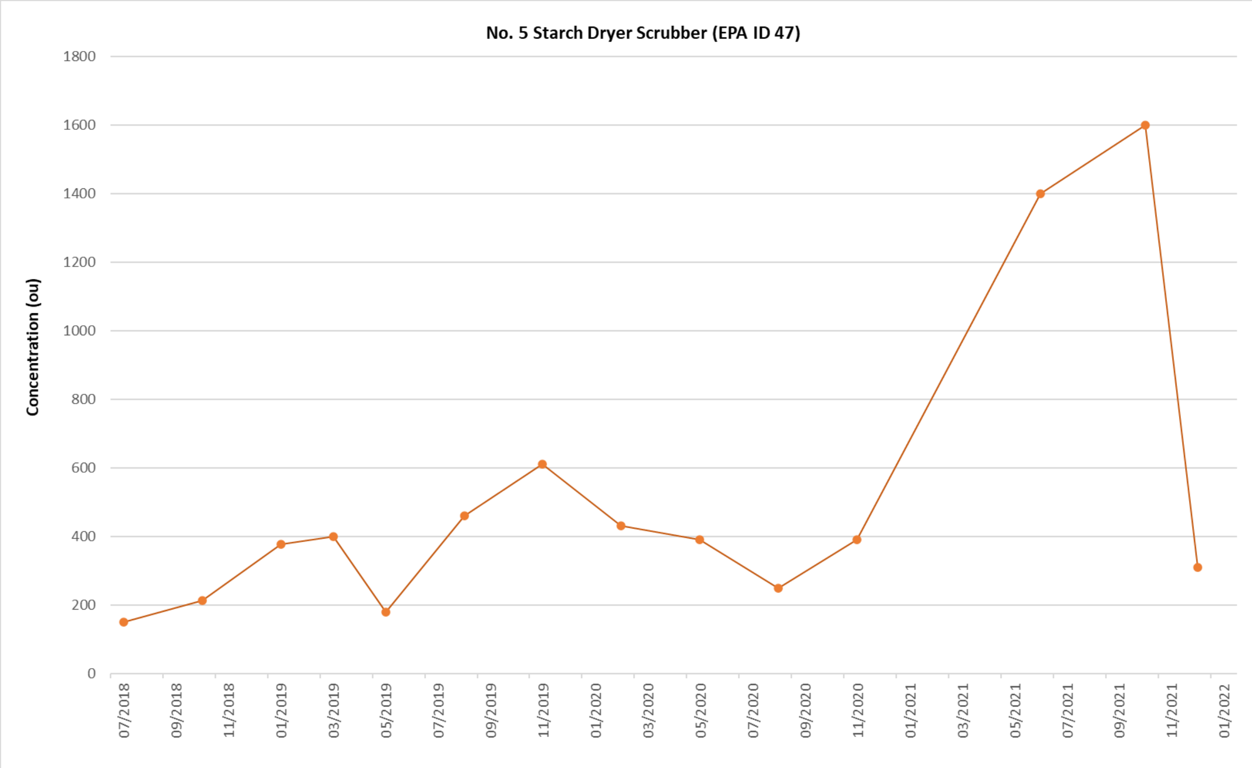
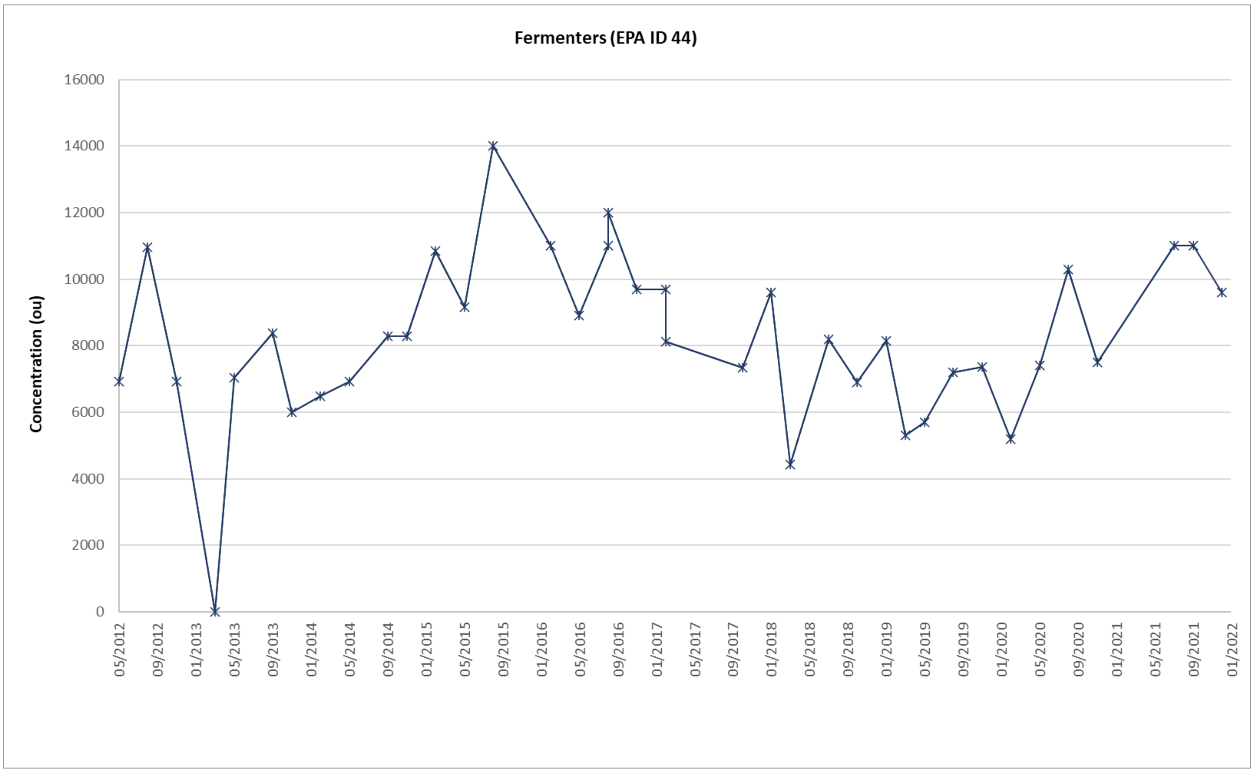


Figure 4. Fermenters (EPA 44)



Zero result represents Fermenter not operating on days of testing.

Figure 5. Carbon Dioxide Scrubber Outlet (EPA 16)

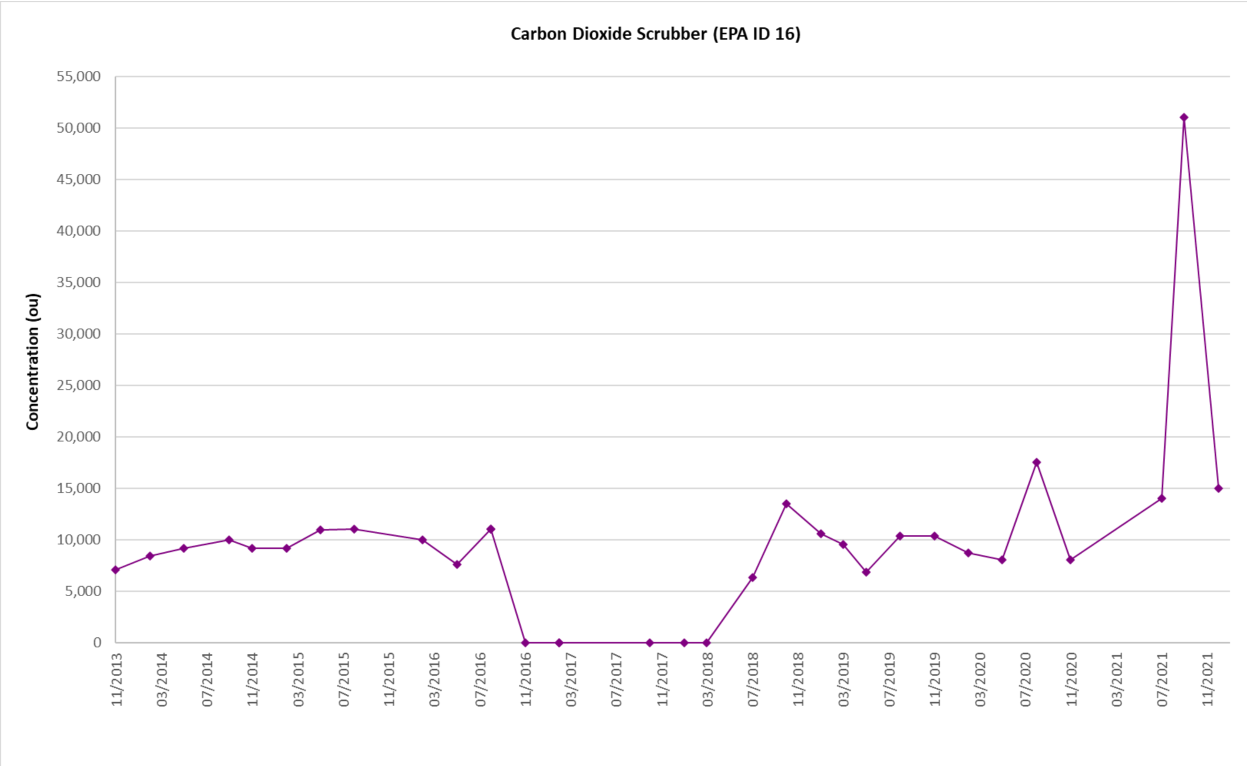


Figure 6. Combined Boiler 5 & 6 Stack (EPA 35)

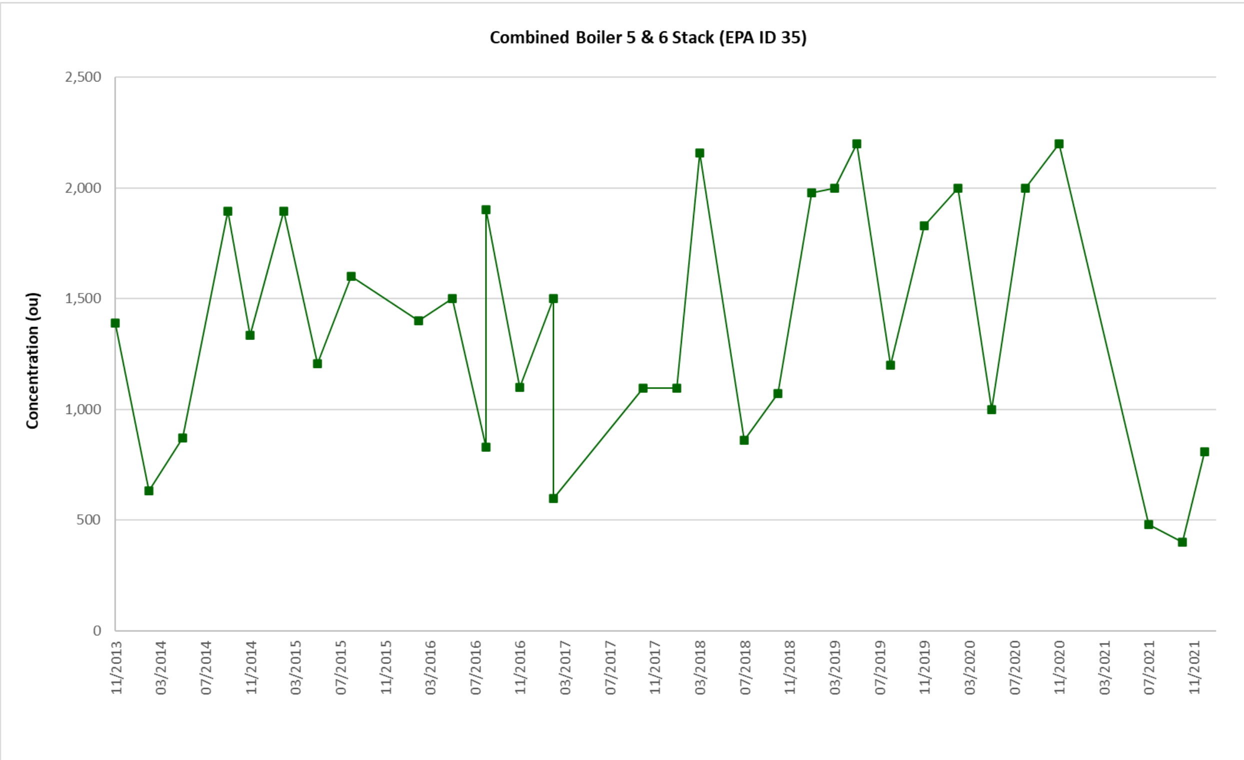


Figure 7. Boiler 2 Stack (EPA 45)

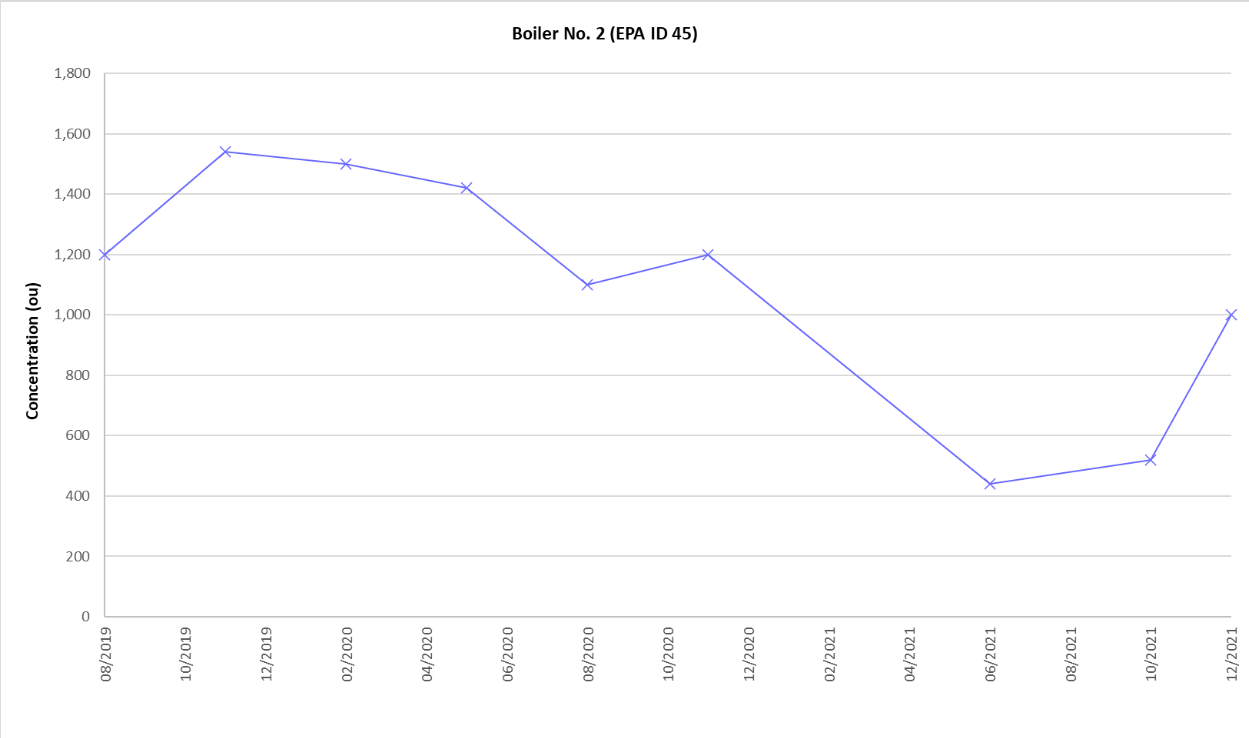
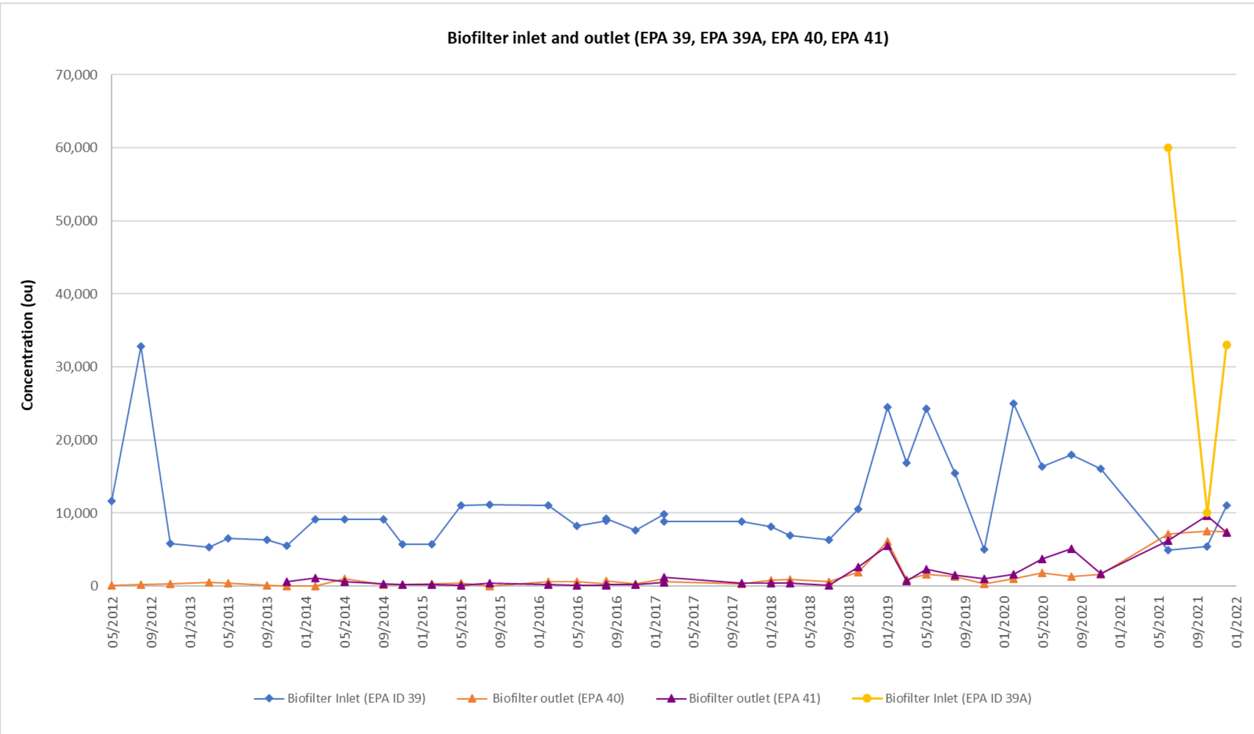
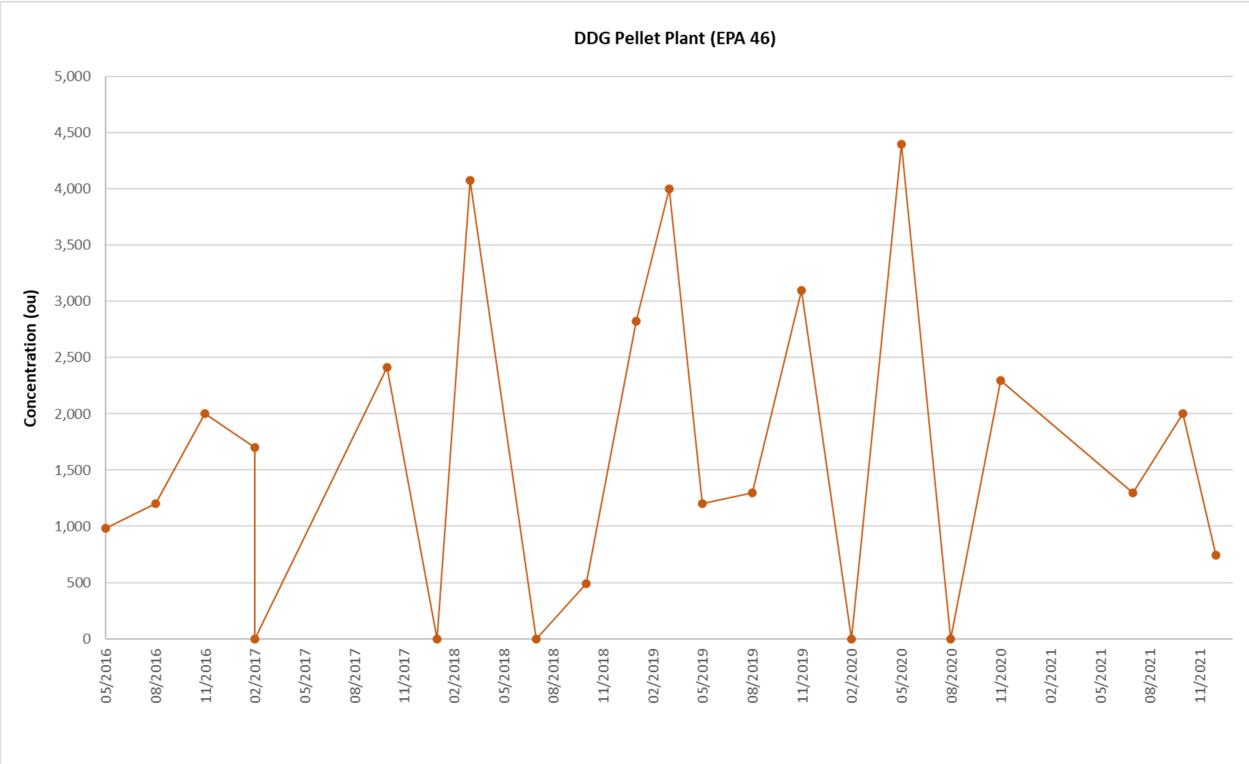


Figure 8. Biofilters (EPA 39, 39A, 40, 41)



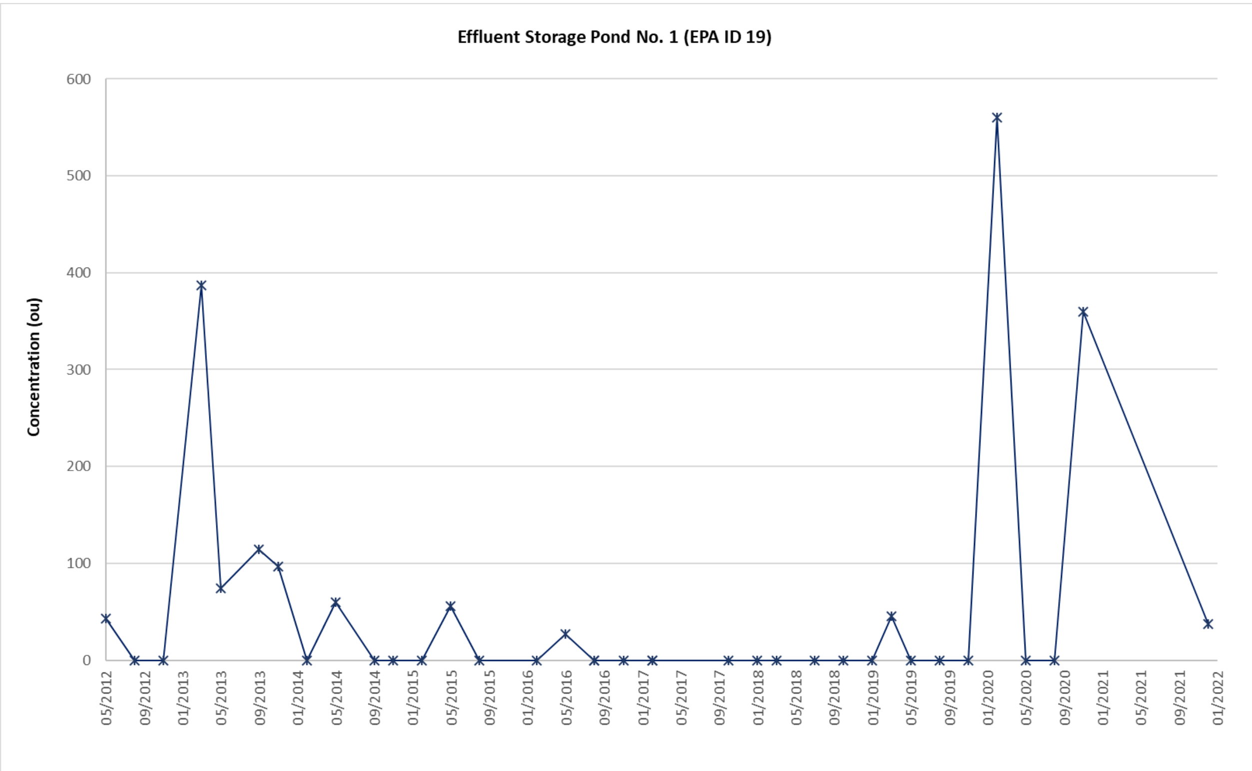
Zero result represents Biofilter not available to be sampled for that event

Figure 9. DDG Pellet Plant (EPA 46)



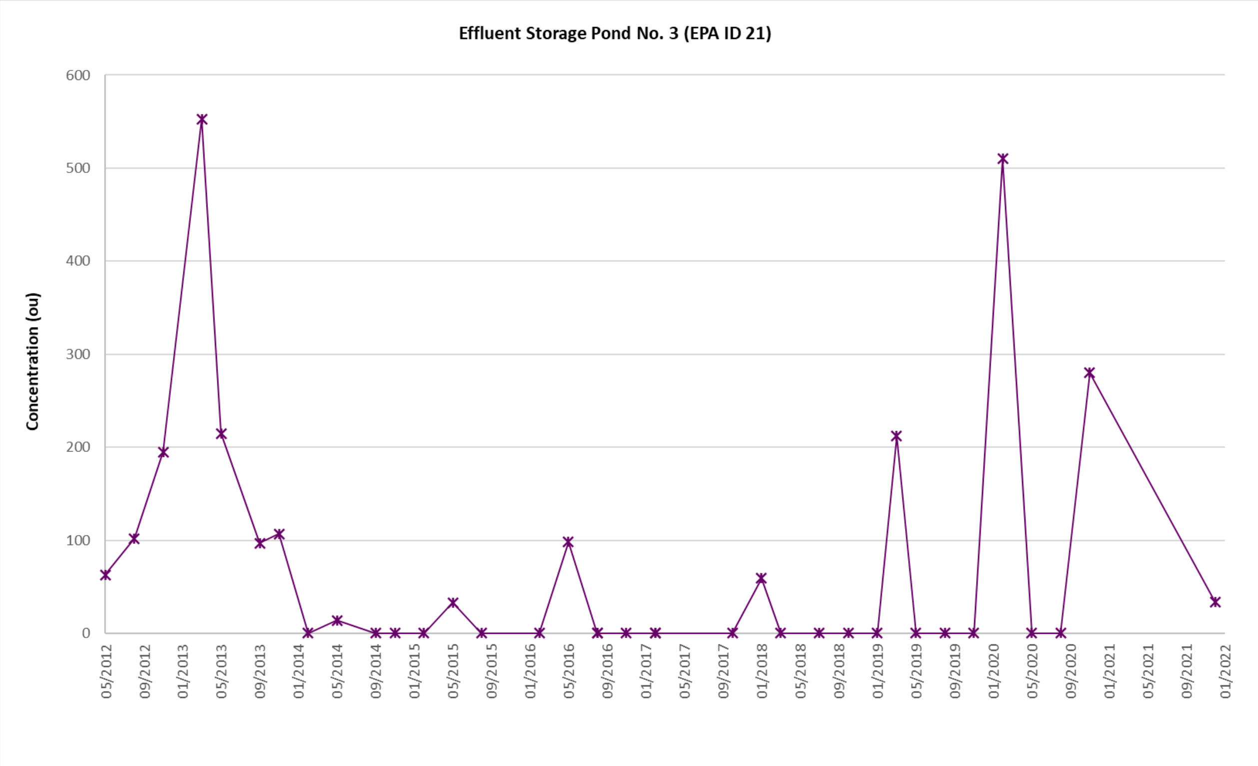
Zero result represents DDG Pellet Plant not sampled for that event.

Figure 10. Effluent Storage Pond No. 1 (EPA 19)



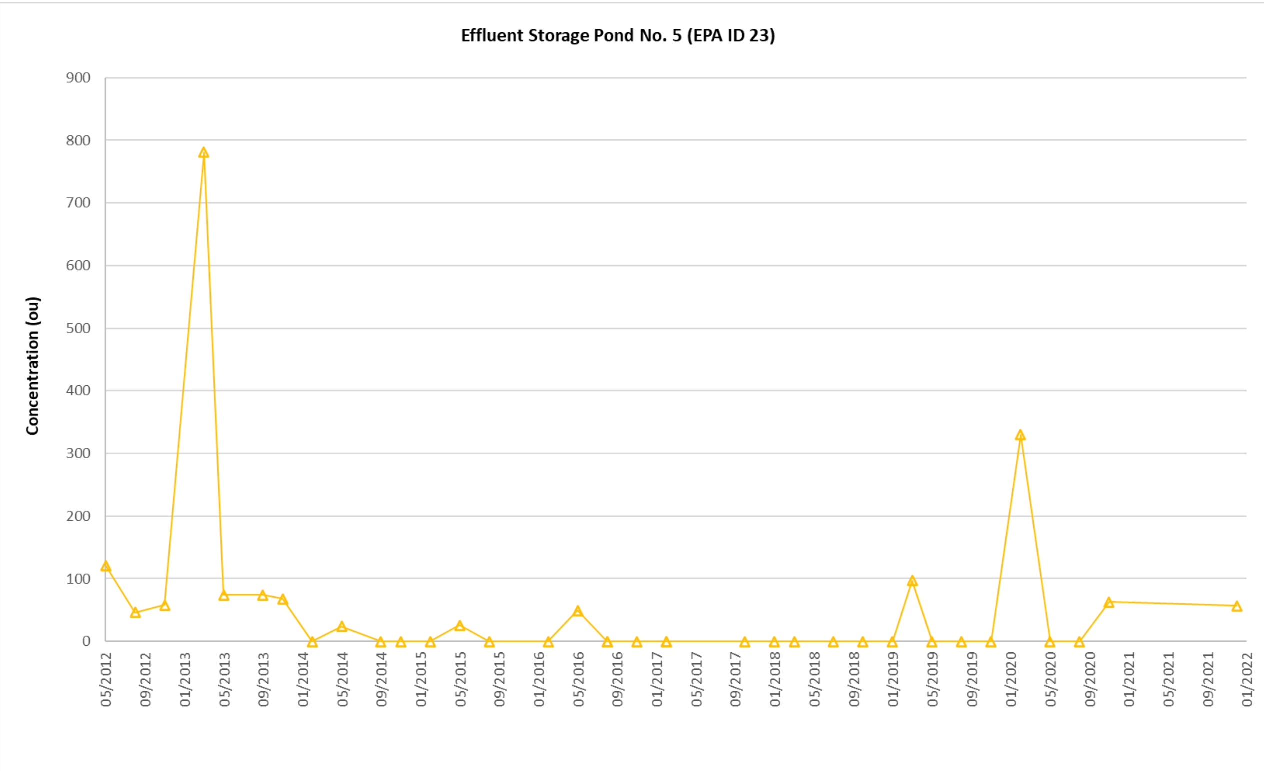
Zero results represent insufficient volume to perform sampling.

Figure 11. Effluent Storage Pond No. 3 (EPA 21)



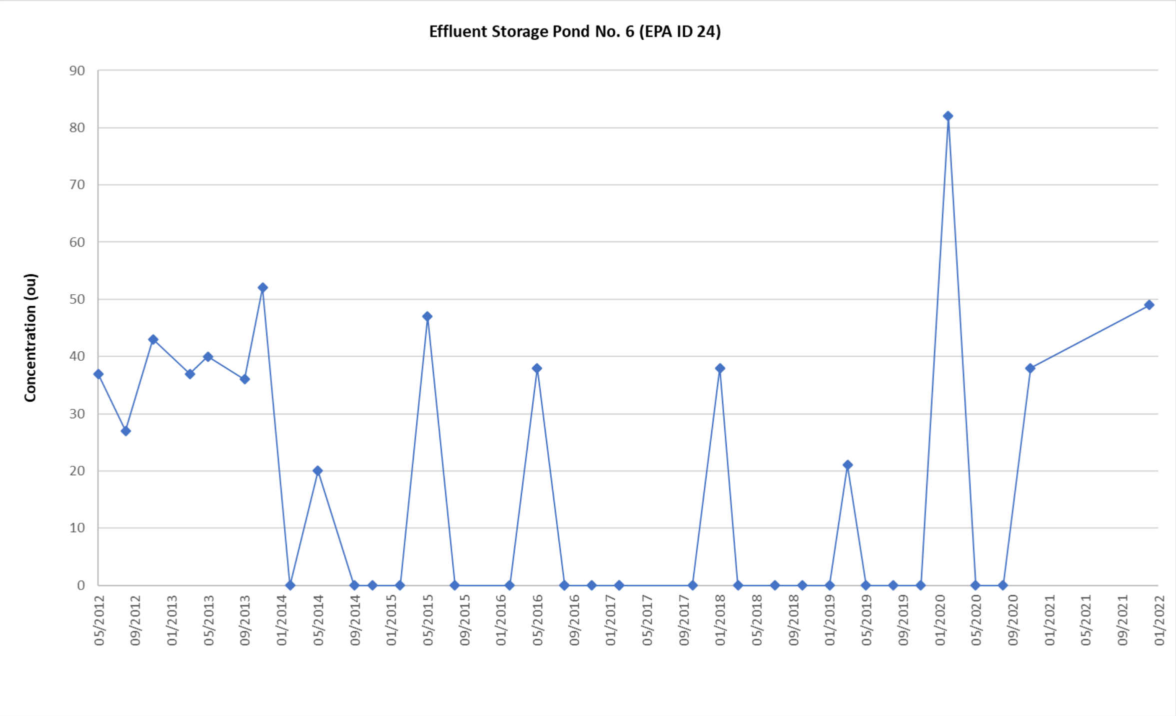
Zero results represent insufficient volume to perform sampling.

Figure 12. Effluent Storage Pond No. 5 (EPA 23)



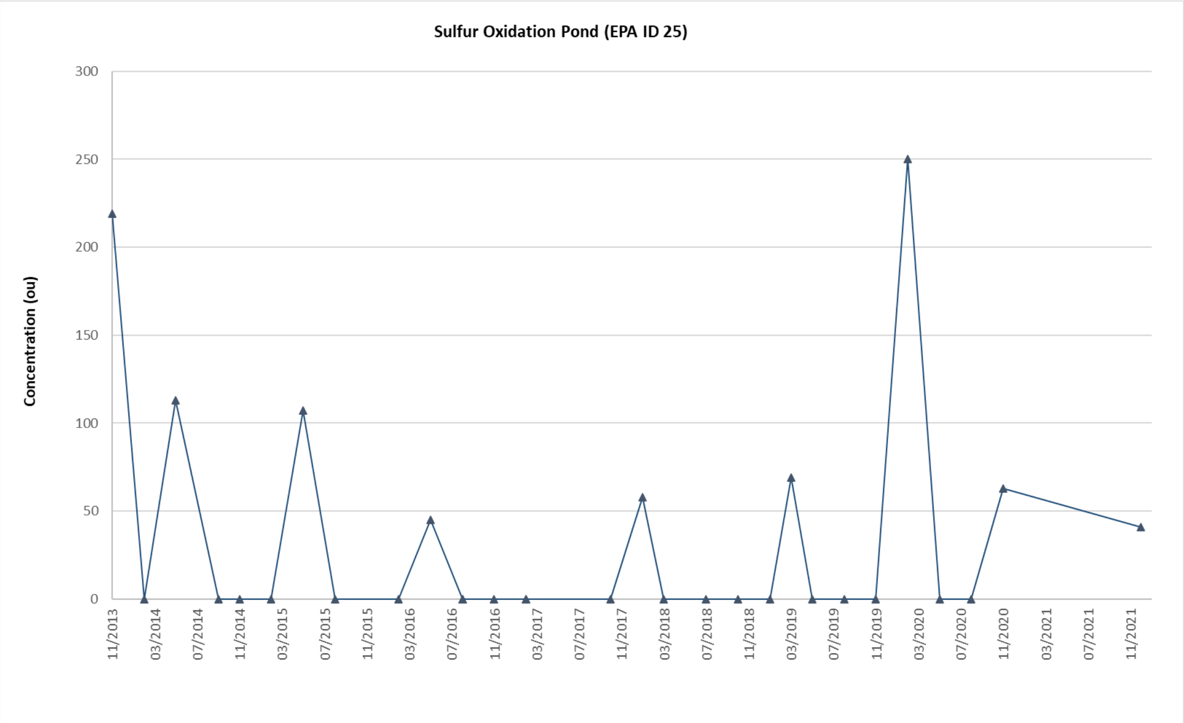
Zero results represent insufficient volume to perform sampling.

Figure 13. Effluent Storage Pond No. 6 (EPA 24)



Zero results represent insufficient volume to perform sampling.

Figure 14. Sulfur Oxidation Pond (EPA 25)



Zero results represent insufficient volume to perform sampling.

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Odour Emission Testing Report, Quarter 4 2021-22

Report Number R012511

Document Information

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Date of Issue:	19 April 2022
Attention:	John Studdert
Address:	160 Bolong Rd Bomaderry NSW 2541
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Zoe Parker **Air Monitoring Consultant**	NATA Accredited Laboratory No. 14601	**Steven Cooper** **Ektimo Signatory**

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

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Table of Contents

1 Executive Summary 5

1.1 Background 5

1.2 Project Objective 5

2 Results 6

2.1 Results Summary 6

2.2 EPA ID 8 – No. 1 Gluten Dryer Baghouse 7

2.3 EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse 8

2.4 EPA ID 10 – No. 3 Gluten Dryer Baghouse 9

2.5 EPA ID 11 – No. 4 Gluten Dryer Baghouse 10

2.6 EPA ID 12 – No. 1 Starch Dryer Scrubber 11

2.7 EPA ID 13 – No. 3 Starch Dryer Scrubber 12

2.8 EPA ID 14 – No. 4 Starch Dryer Scrubber 13

2.9 EPA ID 16 – CO_2 Scrubber Outlet 14

2.10 EPA ID 35 – Combined Boiler 5 & 6 Stack 15

2.11 EPA ID 39 – Biofilter Inlet 16

2.12 EPA ID 40 – Biofilter A East 17

2.13 EPA ID 40 – Biofilter A West 18

2.14 EPA ID 41 – Biofilter B East 19

2.15 EPA ID 41 – Biofilter B West 20

2.16 EPA ID 42 – Boiler 4 21

2.17 EPA ID 44 - Fermenter 12 22

2.18 EPA ID 45 – Boiler 2 23

2.19 EPA ID 47 – No. 5 Starch Dryer Scrubber 24

2.20 CO2 Scrubber Inlet 25

3 Plant Operating Conditions 26

4 Test Methods 26

5 Quality Assurance/Quality Control Information 26

6 Definitions 27

7 Appendix 1: Site Photos 28

8 Appendix 2: Historical Odour Results 32

Table of Figures

Figure 1. Starch Dryers No 1, 3 & 4 (EPA 12, EPA 13, EPA 14) 32

Figure 2. Gluten Dryers No 1, 2 ,3 & 4 (EPA 8, EPA 9, EPA 10, EPA 11) 32

Figure 3. Starch Dryer 5 (EPA 47) 33

Figure 4. Fermenters (EPA 44) 33

Figure 5. Carbon Dioxide Scrubber Outlet (EPA 16) 34

Figure 6. Combined Boiler 5 & 6 Stack (EPA 35) 34

Figure 7. Boiler 2 Stack (EPA 45) 35

Figure 8. Biofilters (EPA 39, EPA 39A, EPA 40, EPA 41) 35

Figure 9. Boiler 4 Stack (EPA 42) 36

1 Executive Summary

1.1 Background

Ektimo was engaged by Manildra Group to perform odour and emission testing at their Bomaderry plant.

1.2 Project Objective

The objectives of the project were to conduct a monitoring programme to quantify odour emissions from 17 discharge points to comply with Shoalhaven Starches' Environment Protection Licence 883.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
EPA ID 8 – No. 1 Gluten Dryer Baghouse	17 March 2022	Odour, oxygen
EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse		
EPA ID 10 – No. 3 Gluten Dryer Baghouse		
EPA ID 11 – No. 4 Gluten Dryer Baghouse		
EPA ID 12 – No. 1 Starch Dryer Scrubber		
EPA ID 13 – No. 3 Starch Dryer Scrubber		
EPA ID 14 – No. 4 Starch Dryer Scrubber		
EPA ID 44 - Fermenter 12	21 March 2022	Odour
EPA ID 16 – CO_2 Scrubber Outlet		Odour, oxygen
CO_2 Scrubber Inlet		
EPA ID 35 – Combined Boiler 5 & 6 Stack		
EPA ID 42 – Boiler 4		
EPA ID 45 – Boiler 2		
EPA ID 40 – Biofilter A	22 March 2022	Odour
EPA ID 41 – Biofilter B		
EPA ID 47 – No. 5 Starch Dryer Scrubber		Odour, oxygen
EPA ID 39 – Biofilter Inlet		

* Flow rate, velocity, temperature and moisture were also determined except at EPA ID 8 No. 1 Gluten Dryer Baghouse.

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

EPA ID 39A Biofilter Inlet duct had a blockage that prevented odour sampling.

EPA ID 46 DDG Pellet Plant Stack was not sampled due to the unavailability of the elevated work platform to access the sampling ports.

2 Results

2.1 Results Summary

Location	Date	Odour		Hedonic Tone	Character
		Concentration [ou]	Odourant Flow Rate [oum^3/min]		
EPA ID 8 – No. 1 Gluten Dryer Baghouse	17/03/2022	480	-	Mildly pleasant	Yeast, vegemite, sour
EPA ID 9 – No. 2 Gluten Dryer Baghouse	17/03/2022	340	330,000	Mildly pleasant	Hot bread, Burnt Rubber
EPA ID 10 – No. 3 Gluten Dryer Baghouse	17/03/2022	310	860,000	Mildly unpleasant	Bread, Chemical, Playdough
EPA ID 11 – No. 4 Gluten Dryer Baghouse	17/03/2022	480	960,000	Neutral	Bread flour, Playdough, Gas
EPA ID 12 – No. 1 Starch Dryer Scrubber	17/03/2022	520	700,000	Neutral	Bakery, Bread Dough, Sweet
EPA ID 13 – No. 3 Starch Dryer Scrubber	17/03/2022	88	93,000	Mildly pleasant	Bread, Playdough, Rubber
EPA ID 14 – No. 4 Starch Dryer Scrubber	17/03/2022	74	83,000	Neutral	Chlorine, Gas
EPA ID 16 - CO_2 Scrubber Outlet	21/03/2022	7,200	500,000	Mildly unpleasant	Nail polish remover, Wine, Sweet
EPA ID 35 - Combined Boilers 5 & 6 Stack	21/03/2022	610	1,100,000	Mildly unpleasant	Chlorine, Gas, Diesel
EPA ID 39 – Biofilter Inlet	22/03/2022	5,200	1,000,000	Very unpleasant	Vegemite, Off dough
EPA ID 40 - Biofilter A East	22/03/2022	1,200	76,000	Mildly unpleasant	Dirty nappy, Green organic waste
EPA ID 40 - Biofilter A West	22/03/2022	2,500	160,000	Mildly unpleasant	Pepper, Peanuts, Green organic waste
EPA ID 41 - Biofilter B East	22/03/2022	4,500	240,000	Mildly unpleasant	Vegemite, Green organic waste
EPA ID 41 - Biofilter B West	22/03/2022	4,500	280,000	Mildly unpleasant	Vegemite, Green organic waste
EPA ID 42 - Boiler 4	21/03/2022	940	760,000	Mildly unpleasant	Plane fuel, Gas, Diesel
EPA ID 44 - Fermenter 12	21/03/2022	2,300	24,000	Mildly unpleasant	Compost, Green waste bin, Organic waste
EPA ID 45 - Boiler 2	21/03/2022	940	270,000	Mildly unpleasant	Chlorine, Gas
EPA ID 47 – No. 5 Starch Dryer Scrubber	22/03/2022	160	500,000	Neutral	Vegemite, Bread dough
CO_2 Scrubber Inlet	21/03/2022	6,600	420,000	Mildly pleasant	Sweet, Apple cider, Organic waste

2.2 EPA ID 8 – No. 1 Gluten Dryer Baghouse

Date	17/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 8 - No. 1 Gluten Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Harrison Handicott	**State**	NSW
Process Conditions	Please refer to client records.		

Sampling Plane Details

Sampling plane dimensions	2400 x 2560 mm
Sampling plane area	6.14 m²
Sampling port size, number	Sampled from exit
Access & height of ports	Stairs & ladders 22 m
Duct orientation & shape	Horizontal Rectangular
Sample plane conformance to AS4323.1 (2021)	Non-conforming

Comments

Sampling was undertaken at the exit of the stack as it was the only accessible area for the samples to be taken.
No temperature or flow rate readings could be taken due to access issues.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-conforming due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Gas Analyser Results	Average
Sampling time	1155 - 1254
	Concentration % v/v
Oxygen	20.9

Odour	Results
Sampling time	1207 - 1217
	Concentration ou
Results	480
Lower uncertainty limit	350
Upper uncertainty limit	660
Hedonic tone	Mildly pleasant
Odour character	Yeast, Vegemite, Sour
Analysis date & time	18/03/22, 1505-1600
Holding time	27 hours
Dilution factor	1
Bag material	Nalophan
Butanol threshold (ppb)	57.1
Laboratory temp (°C)	24.15
Last calibration date	October 2021

2.3 EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse

Date	17/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 9 - No. 2 Gluten Dryer / Starch Dryer
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Harrison Handicott	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details		
Sampling plane dimensions	1190 mm	
Sampling plane area	1.11 m²	
Sampling port size, number & depth	4" BSP (x2), 90 mm	
Access & height of ports	Stairs & ladders	20 m
Duct orientation & shape	Horizontal	Circular
Downstream disturbance	Bend	2 D
Upstream disturbance	Bend	0.5 D
No. traverses & points sampled	1	8
Sample plane conformance to AS4323.1 (2021)	Non-conforming	

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-conforming due to the following reasons:
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Stack Parameters		
Moisture content, %v/v	5.9	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.95	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1230 & 1330	
Temperature, °C	62	
Temperature, K	335	
Velocity at sampling plane, m/s	20	
Volumetric flow rate, actual, m³/s	22	
Volumetric flow rate (wet STP), m³/s	16	
Volumetric flow rate (dry STP), m³/s	15	
Mass flow rate (wet basis), kg/hour	75000	

Gas Analyser Results	Average
Sampling time	1230 - 1329
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1303 - 1313	
	Concentration ou	Odourant Flow Rate oum³/min
Results	340	330000
Lower uncertainty limit	240	
Upper uncertainty limit	460	
Hedonic tone	Mildly pleasant	
Odour character	Hot bread, Burnt Rubber	
Analysis date & time	18/03/22, 1505-1600	
Holding time	26 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	57.1	
Laboratory temp (°C)	24.15	
Last calibration date	October 2021	

2.4 EPA ID 10 – No. 3 Gluten Dryer Baghouse

Date	17/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 10 - No. 3 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Harrison Handicott	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	2100 x 2400 mm
Sampling plane area	5.04 m²
Sampling port size, number	2" Ball valve (x3)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 5 D
Upstream disturbance	Change in diameter 2.5 D
No. traverses & points sampled	3 21
Sample plane conformance to AS4323.1 (2021)	Non-conforming

Comments

The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-conforming due to the following reasons:

The highest to lowest differential pressure ratio exceeds 9:1 or the highest to lowest gas velocity ratio exceeds 3:1

The stack or duct does not have the required number of access holes (ports)

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	6.3	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.00	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1340 & 1440	
Temperature, °C	76	
Temperature, K	349	
Velocity at sampling plane, m/s	12	
Volumetric flow rate, actual, m³/s	59	
Volumetric flow rate (wet STP), m³/s	46	
Volumetric flow rate (dry STP), m³/s	43	
Mass flow rate (wet basis), kg/hour	210000	

Gas Analyser Results	Average
Sampling time	1340 - 1439
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1412 - 1422	
	Concentration ou	Odourant Flow Rate oum³/min
Results	310	860000
Lower uncertainty limit	220	
Upper uncertainty limit	420	
Hedonic tone	Mildly unpleasant	
Odour character	Bread, Chemical, Playdough	
Analysis date & time	18/03/22, 1505-1600	
Holding time	25 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	57.1	
Laboratory temp (°C)	24.15	
Last calibration date	October 2021	

Ektimo

2.5 EPA ID 11 – No. 4 Gluten Dryer Baghouse

Date	17/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 11 - No. 4 Gluten Dryer Baghouse
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Harrison Handicott	**State**	NSW
Process Conditions	Please refer to client records.		*220322*

Sampling Plane Details	
Sampling plane dimensions	1400 x 1700 mm
Sampling plane area	2.38 m²
Sampling port size, number	4" BSP (x3)
Access & height of ports	Stairs 30 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 6 D
No. traverses & points sampled	3 12
Sample plane conformance to AS4323.1 (2021)	Conforming but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	4.3	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.01	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1333 & 1433	
Temperature, °C	73	
Temperature, K	346	
Velocity at sampling plane, m/s	18	
Volumetric flow rate, actual, m³/s	42	
Volumetric flow rate (wet STP), m³/s	33	
Volumetric flow rate (dry STP), m³/s	32	
Mass flow rate (wet basis), kg/hour	150000	

Gas Analyser Results	Average
Sampling time	1333 - 1432
	Concentration % v/v
Oxygen	20.7

Odour	Results	
Sampling time	1342 - 1352	
	Concentration ou	Odourant Flow Rate oum³/min
Results	480	960000
Lower uncertainty limit	350	
Upper uncertainty limit	660	
Hedonic tone	Neutral	
Odour character	Bread flour, Playdough, Gas	
Analysis date & time	18/03/22, 1505-1600	
Holding time	25 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	57.1	
Laboratory temp (°C)	24.15	
Last calibration date	October 2021	

2.6 EPA ID 12 – No. 1 Starch Dryer Scrubber

Date	17/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 12 - No. 1 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Harrison Handicott	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	1500 x 1500 mm
Sampling plane area	2.25 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 25 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Silencer 0 D
No. traverses & points sampled	3 15
Sample plane conformance to AS4323.1 (2021)	Non-conforming

The sampling plane is deemed to be non-conforming due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	4.3	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.11	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1123 & 1223
Temperature, °C	41
Temperature, K	315
Velocity at sampling plane, m/s	11
Volumetric flow rate, actual, m³/s	25
Volumetric flow rate (wet STP), m³/s	22
Volumetric flow rate (dry STP), m³/s	21
Mass flow rate (wet basis), kg/hour	100000

Gas Analyser Results	Average
Sampling time	1123 - 1222
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1152 - 1202	
	Concentration ou	Odourant Flow Rate oum³/min
Results	520	700000
Lower uncertainty limit	380	
Upper uncertainty limit	720	
Hedonic tone	Neutral	
Odour character	Bakery, Bread Dough, Sweet	
Analysis date & time	18/03/22, 1505-1600	
Holding time	27 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	57.1	
Laboratory temp (°C)	24.15	
Last calibration date	October 2021	

2.7 EPA ID 13 – No. 3 Starch Dryer Scrubber

Date	17/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 13 - No. 3 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Harrison Handicott	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	1000 x 1050 mm
Sampling plane area	1.05 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	3 15
Sample plane conformance to AS4323.1 (2021)	Non-conforming

The sampling plane is deemed to be non-conforming due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	5.5	
Gas molecular weight, g/g mole	28.4 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.10	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0940 & 1040	
Temperature, °C	44	
Temperature, K	317	
Velocity at sampling plane, m/s	19	
Volumetric flow rate, actual, m³/s	20	
Volumetric flow rate (wet STP), m³/s	18	
Volumetric flow rate (dry STP), m³/s	17	
Mass flow rate (wet basis), kg/hour	80000	

Gas Analyser Results	Average
Sampling time	0940 - 1039
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	0958 - 1018	
	Concentration ou	Odourant Flow Rate oum³/min
Results	88	93000
Lower uncertainty limit	64	
Upper uncertainty limit	120	
Hedonic tone	Mildly pleasant	
Odour character	Bread, Playdough, Rubber	
Analysis date & time	18/03/22, 1505-1600	
Holding time	29 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	57.1	
Laboratory temp (°C)	24.15	
Last calibration date	October 2021	

Ektimo

2.8 EPA ID 14 – No. 4 Starch Dryer Scrubber

Date	17/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 14 - No. 4 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Harrison Handicott	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	1000 x 1050 mm
Sampling plane area	1.05 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Stairs & ladders 20 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	3 15
Sample plane conformance to AS4323.1 (2021)	Non-conforming

The sampling plane is deemed to be non-conforming due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	5	
Gas molecular weight, g/g mole	28.4 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.14	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0942 & 1042	
Temperature, °C	35	
Temperature, K	308	
Velocity at sampling plane, m/s	20	
Volumetric flow rate, actual, m³/s	21	
Volumetric flow rate (wet STP), m³/s	19	
Volumetric flow rate (dry STP), m³/s	18	
Mass flow rate (wet basis), kg/hour	85000	

Gas Analyser Results	Average
Sampling time	0942 - 1041
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1025 - 1035	
	Concentration ou	Odourant Flow Rate oum³/min
Results	74	83000
Lower uncertainty limit	54	
Upper uncertainty limit	100	
Hedonic tone	Neutral	
Odour character	Chlorine, Gas	
Analysis date & time	18/03/22, 1505-1600	
Holding time	29 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	57.1	
Laboratory temp (°C)	24.15	
Last calibration date	October 2021	

Ektimo

2.9 EPA ID 16 – CO_2 Scrubber Outlet

Date	21/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 16 - CO2 Scrubber Outlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	505 mm
Sampling plane area	0.2 m²
Sampling port size, number & depth	3" BSP (x1), 60 mm
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >6 D
Upstream disturbance	Junction >10 D
No. traverses & points sampled	1 8
Sample plane conformance to AS4323.1 (2021)	Non-conforming

Comments
The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-conforming due to the following reasons:
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	2.2	
Gas molecular weight, g/g mole	41.2 (wet)	41.7 (dry)
Gas density at STP, kg/m³	1.84 (wet)	1.86 (dry)
Gas density at discharge conditions, kg/m³	1.68	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0935 & 1035	
Temperature, °C	27	
Temperature, K	300	
Velocity at sampling plane, m/s	6.3	
Volumetric flow rate, actual, m³/s	1.3	
Volumetric flow rate (wet STP), m³/s	1.2	
Volumetric flow rate (dry STP), m³/s	1.1	
Mass flow rate (wet basis), kg/hour	7600	

Gas Analyser Results	Average
Sampling time	0935 - 1034
	Concentration %v/v
Oxygen	0.2

Odour	Results	
Sampling time	0942 - 0944	
	Concentration ou	Odourant Flow Rate oum³/min
Results	7200	500000
Lower uncertainty limit	5200	
Upper uncertainty limit	10000	
Hedonic tone	Mildly unpleasant	
Odour character	Nail polish remover, Wine, Sweet	
Analysis date & time	22/03/22, 0930-1030	
Holding time	24 hours	
Dilution factor	9	
Bag material	Nalophan	
Butanol threshold (ppb)	68.1	
Laboratory temp (°C)	20	
Last calibration date	October 2021	

Ektimo

2.10 EPA ID 35 – Combined Boiler 5 & 6 Stack

Date	21/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 35 - Boiler 5 & 6 Combined Stack
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		*220322*

Sampling Plane Details	
Sampling plane dimensions	1985 mm
Sampling plane area	3.09 m²
Sampling port size, number & depth	4" BSP (x4), 100 mm
Access & height of ports	Stairs & ladders 40 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 20
Sample plane conformance to AS4323.1 (2021)	Conforming but non-ideal

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

Stack Parameters		
Moisture content, %v/v	5.8	
Gas molecular weight, g/g mole	29.4 (wet)	30.1 (dry)
Gas density at STP, kg/m³	1.31 (wet)	1.34 (dry)
Gas density at discharge conditions, kg/m³	0.94	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1215 & 1315
Temperature, °C	111
Temperature, K	385
Velocity at sampling plane, m/s	14
Volumetric flow rate, actual, m³/s	42
Volumetric flow rate (wet STP), m³/s	30
Volumetric flow rate (dry STP), m³/s	29
Mass flow rate (wet basis), kg/hour	140000

Gas Analyser Results	Average
Sampling time	1215 - 1314
	Concentration %v/v
Oxygen	9.7

Odour	Results	
Sampling time	1228 - 1238	
	Concentration ou	Odourant Flow Rate oum³/min
Results	610	1100000
Lower uncertainty limit	440	
Upper uncertainty limit	840	
Hedonic tone	Mildly unpleasant	
Odour character	Chlorine, Gas, Diesel	
Analysis date & time	22/03/22, 0930-1030	
Holding time	21 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	68.1	
Laboratory temp (°C)	20	
Last calibration date	October 2021	

2.11 EPA ID 39 – Biofilter Inlet

Date	22/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 39 - Biofilter Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Steven Cooper & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	600 mm
Sampling plane area	0.283 m²
Sampling port size, number & depth	1 x 1 inch port, 45 mm
Access & height of ports	Ground 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 6 D
No. traverses & points sampled	1 6
Sample plane conformance to AS4323.1 (2021)	Non-conforming

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-conforming due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	4.2	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.04	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1030 & 1135
Temperature, °C	46
Temperature, K	319
Velocity at sampling plane, m/s	14
Volumetric flow rate, actual, m³/s	4
Volumetric flow rate (wet STP), m³/s	3.2
Volumetric flow rate (dry STP), m³/s	3.1
Mass flow rate (wet basis), kg/hour	15000

Gas Analyser Results	Average
Sampling time	1033 - 1132
	Concentration %v/v
Oxygen	20.9

Odour	Results	
Sampling time	1043 - 1056	
	Concentration ou	Odourant Flow Rate oum³/min
Results	5200	1000000
Lower uncertainty limit	3800	
Upper uncertainty limit	7200	
Hedonic tone	Very unpleasant	
Odour character	Vegemite, Off dough	
Analysis date & time	23/03/22, 0900-1030	
Holding time	22 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	62.3	
Laboratory temp (°C)	215	
Last calibration date	October 2021	

2.12 EPA ID 40 – Biofilter A East

Client	Manildra Group	**Test Location**	EPA ID 40 - Biofilter A East
Date	22/03/2022	**Plant/Site**	Ethanol Plant
Report No.	R012511		Bomaderry, NSW
Ektimo Staff	Steven Cooper & Scott Woods		*211014*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	62
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	26
Sampling Results	
Sampling time, hrs	1243 - 1247
Sample dilution	4
Odour concentration, ou	**1200**
Hedonic tone	Mildly unpleasant
Odour character	Dirty nappy, Green organic w aste
95% Confidence Interval	890 - 1700
Odour Flux Rate, ou/m²/min	**760**
Odourant flow rate, oum³/min	**76000**

2.13 EPA ID 40 – Biofilter A West

Client	Manildra Group	**Test Location**	EPA ID 40 - Biofilter A West
Date	22/03/2022	**Plant/Site**	Ethanol Plant
Report No.	R012511		Bomaderry, NSW
Ektimo Staff	Steven Cooper & Scott Woods		*211014*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	26
Sampling Results	
Sampling time, hrs	1233 - 1237
Sample dilution	4
Odour concentration, ou	**2500**
Hedonic tone	Mildly unpleasant
Odour character	Pepper, Peanuts, Green organic w aste
95% Confidence Interval	1800 - 3400
Odour Flux Rate, ou/m²/min	**1600**
Odourant flow rate, oum³/min	**160000**

2.14 EPA ID 41 – Biofilter B East

Client	Manildra Group	**Test Location**	EPA ID 41 - Biofilter B East
Date	22/03/2022	**Plant/Site**	Ethanol Plant
Report No.	R012511		Bomaderry, NSW
Ektimo Staff	Steven Cooper & Scott Woods		***211014***

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	52
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of Inlet Airflow, %	22
Sampling Results	
Sampling time, hrs	1221 - 1225
Sample dilution	4
Odour concentration, ou	**4500**
Hedonic tone	Mildly unpleasant
Odour character	Vegemite, Green organic w aste
95% Confidence Interval	3300 - 6200
Odour Flux Rate, ou/m²/min	**2400**
Odourant flow rate, oum³/min	**240000**

2.15 EPA ID 41 – Biofilter B West

Client	Manildra Group	**Test Location**	EPA ID 41 - Biofilter B West
Date	22/03/2022	**Plant/Site**	Ethanol Plant
Report No.	R012511		Bomaderry, NSW
Ektimo Staff	Steven Cooper & Scott Woods		*211014*

Test Location Details	
Location Description	Biofilter Outlet
Surface Description	Woodchip/Mulch
Area Classification	Industrial
Aeration rate, m^3/min	63
Source dimensions (L x W), m	14.25 x 7
Source area, m^2	99.75
Sampling Method	Collection Hood (Aeration)
Proportion of inlet Airflow, %	26
Sampling Results	
Sampling time, hrs	1156 - 1200
Sample dilution	4
Odour concentration, ou	**4500**
Hedonic tone	Mildly unpleasant
Odour character	Vegemite, Green organic waste
95% Confidence Interval	3200 - 6200
Odour Flux Rate, ou/m²/min	**2800**
Odourant flow rate, oum³/min	**280000**

2.16 EPA ID 42 – Boiler 4

Date	21/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 42 - Boiler 4
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	1140 mm
Sampling plane area	1.02 m²
Sampling port size, number & depth	4" BSP (x2), 100 mm
Access & height of ports	Stairs 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >3 D
Upstream disturbance	Change in diameter 1 D
No. traverses & points sampled	2 16
Sample plane conformance to AS4323.1 (2021)	Non-conforming

The sampling plane is deemed to be non-conforming due to the following reasons:
The upstream disturbance is <2D from the sampling plane

Stack Parameters		
Moisture content, %v/v	5	
Gas molecular weight, g/g mole	28.9 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.83	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1235 & 1325	
Temperature, °C	156	
Temperature, K	429	
Velocity at sampling plane, m/s	20	
Volumetric flow rate, actual, m³/s	21	
Volumetric flow rate (wet STP), m³/s	13	
Volumetric flow rate (dry STP), m³/s	13	
Mass flow rate (wet basis), kg/hour	62000	

Gas Analyser Results	Average
Sampling time	1235 - 1334
	Concentration % v/v
Oxygen	15.9

Odour	Results	
Sampling time	1248 - 1258	
	Concentration ou	Odourant Flow Rate oum³/min
Results	940	760000
Lower uncertainty limit	680	
Upper uncertainty limit	1300	
Hedonic tone	Mildly unpleasant	
Odour character	Plane fuel, gas, diesel	
Analysis date & time	22/03/22, 0930-1030	
Holding time	20 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	68.1	
Laboratory temp (°C)	20	
Last calibration date	October 2021	

Ektimo

2.17 EPA ID 44 - Fermenter 12

Date	21/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 44 - Fermenter 12
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	295 mm
Sampling plane area	0.0683 m²
Sampling port size, number & depth	3" BSP (x1), 75 mm
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 10 D
Upstream disturbance	Junction 2 D
No. traverses & points sampled	1 8
Sample plane conformance to AS4323.1 (2021)	Non-conforming

Comments

The number of traverses sampled is less than the requirement

The sampling plane is deemed to be non-conforming due to the following reasons:

The stack or duct does not have the required number of access holes (ports)

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	3.5	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.17	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0935 & 0942	
Temperature, °C	28	
Temperature, K	301	
Velocity at sampling plane, m/s	2.8	
Volumetric flow rate, actual, m³/s	0.19	
Volumetric flow rate (wet STP), m³/s	0.18	
Volumetric flow rate (dry STP), m³/s	0.17	
Mass flow rate (wet basis), kg/hour	810	

Odour	Results	
Sampling time	0938 - 0940	
	Concentration ou	Odourant Flow Rate oum³/min
Results	2300	24000
Lower uncertainty limit	1700	
Upper uncertainty limit	3200	
Hedonic tone	Mildly unpleasant	
Odour character	Compost, Green waste bin, Organic waste	
Analysis date & time	22/03/22, 0930-1030	
Holding time	24 hours	
Dilution factor	9	
Bag material	Nalophan	
Butanol threshold (ppb)	68.1	
Laboratory temp (°C)	20	
Last calibration date	October 2021	

2.18 EPA ID 45 – Boiler 2

Date	21/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 45 - Boiler 2
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	1070 mm
Sampling plane area	0.899 m²
Sampling port size, number & depth	4" Flange (x2), 180 mm
Access & height of ports	Ladders 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter 5 D
No. traverses & points sampled	2 16
Sample plane conformance to AS4323.1 (2021)	Conforming but non-ideal

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

Stack Parameters		
Moisture content, %v/v	8	
Gas molecular weight, g/g mole	28.8 (wet)	29.8 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.33 (dry)
Gas density at discharge conditions, kg/m³	0.78	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1345 & 1445	
Temperature, °C	179	
Temperature, K	452	
Velocity at sampling plane, m/s	8.7	
Volumetric flow rate, actual, m³/s	7.8	
Volumetric flow rate (wet STP), m³/s	4.8	
Volumetric flow rate (dry STP), m³/s	4.4	
Mass flow rate (wet basis), kg/hour	22000	

Gas Analyser Results	Average
Sampling time	1345 - 1444
	Concentration % v/v
Oxygen	12.3

Odour	Results	
Sampling time	1358 - 1408	
	Concentration ou	Odourant Flow Rate oum³/min
Results	940	270000
Lower uncertainty limit	680	
Upper uncertainty limit	1300	
Hedonic tone	Mildly unpleasant	
Odour character	Chlorine, Gas	
Analysis date & time	22/03/22, 0930-1030	
Holding time	19 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	68.1	
Laboratory temp (°C)	20	
Last calibration date	October 2021	

2.19 EPA ID 47 – No. 5 Starch Dryer Scrubber

Date	22/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	EPA ID 47 - No. 5 Starch Dryer Scrubber
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Steven Cooper & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	2400 mm
Sampling plane area	4.52 m²
Sampling port size, number	4" Flange (x2)
Access & height of ports	Stairs 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter 3 D
No. traverses & points sampled	2 20
Sample plane conformance to AS4323.1 (2021)	Conforming but non-ideal

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

Stack Parameters		
Moisture content, %v/v	7.8	
Gas molecular weight, g/g mole	28.2 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.01	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	0922 & 1026
Temperature, °C	65
Temperature, K	338
Velocity at sampling plane, m/s	14
Volumetric flow rate, actual, m³/s	63
Volumetric flow rate (wet STP), m³/s	50
Volumetric flow rate (dry STP), m³/s	47
Mass flow rate (wet basis), kg/hour	230000

Gas Analyser Results	Average
Sampling time	0923 - 1022
	Concentration % v/v
Oxygen	20.8

Odour	Results	
Sampling time	1012 - 1021	
	Concentration ou	Odourant Flow Rate oum³/min
Results	160	500000
Lower uncertainty limit	120	
Upper uncertainty limit	230	
Hedonic tone	Neutral	
Odour character	Vegemite, Bread dough	
Analysis date & time	23/03/22, 0900-1030	
Holding time	23 hours	
Dilution factor	1	
Bag material	Nalophan	
Butanol threshold (ppb)	62.3	
Laboratory temp (°C)	21.5	
Last calibration date	October 2021	

2.20 CO2 Scrubber Inlet

Date	21/03/2022	**Client**	Manildra Group
Report	R012511	**Stack ID**	CO2 Scrubber Inlet
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		220322

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	1 inch ball valve, 80 mm
Access & height of ports	Ground level 1.5 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 0.5 D
Upstream disturbance	Bend 0.5 D
No. traverses & points sampled	1 2
Sample plane conformance to AS4323.1 (2021)	Non-conforming

Comments

Flow measurement readings were applied from EPA ID 16, the CO2 scrubber outlet, as flow was unable to be measured at this location.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-conforming due to the following reasons:

The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	2.6	
Gas molecular weight, g/g mole	40.9 (wet)	41.5 (dry)
Gas density at STP, kg/m³	1.83 (wet)	1.85 (dry)
Gas density at discharge conditions, kg/m³	1.67	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0935 & 1035	
Temperature, °C	28	
Temperature, K	301	
Velocity at sampling plane, m/s	5.9	
Volumetric flow rate, actual, m³/s	1.2	
Volumetric flow rate (wet STP), m³/s	1.1	
Volumetric flow rate (dry STP), m³/s	1	
Mass flow rate (wet basis), kg/hour	6900	

Gas Analyser Results	Average
Sampling time	0955 - 1054
	Concentration % v/v
Oxygen	0.2

Odour	Results	
Sampling time	1031 - 1033	
	Concentration ou	Odourant Flow Rate oum³/min
Results	6600	420000
Lower uncertainty limit	4800	
Upper uncertainty limit	9100	
Hedonic tone	Mildly pleasant	
Odour character	Sweet, Apple cider, Organic waste	
Analysis date & time	22/03/22, 0930-1030	
Holding time	23 hours	
Dilution factor	9	
Bag material	Nalophan	
Butanol threshold (ppb)	68.1	
Laboratory temp (°C)	20	
Last calibration date	October 2021	

3 Plant Operating Conditions

See Manildra Group records for complete process conditions.

4 Test Methods

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

Parameter	Sampling method	Analysis method	Uncertainty*	NATA accredited Sampling	NATA accredited Analysis
Sampling points - Selection	NSW EPA TM-1 (AS 4323.1)	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW EPA TM-2 (USEPA Method 2)	NSW EPA TM-2 (USEPA Method 2)	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22 (USEPA Alt-Method 008)	NSW EPA TM-22 (USEPA Alt-Method 008)	19%	✓	✓
Molecular weight	NA	NSW EPA TM-23 (USEPA Method 3)	not specified	NA	✓
Dry gas density	NA	NSW EPA TM-23 (USEPA Method 3)	not specified	NA	✓
Oxygen	NSW EPA TM-25 (USEPA Method 3A)	NSW EPA TM-25 (USEPA Method 3A)	13%	✓	✓
Odour	NSW EPA OM-7 (AS 4323.3)	NSW EPA OM-7 (AS 4323.3)	refer to results	✓	✓¥
Odour characterisation	NA	direct observation	NA	NA	×
Odour from diffuse sources	NSW EPA OM-8 (AS 4323.4)	NSW EPA OM-8 (AS 4323.4)	refer to results	✓	✓¥

220329

* 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:
18 March 2022 in report ON-00124.
22 March 2022 in report ON-00126.
23 March 2022 in report ON-00127.

5 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.

6 Definitions

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

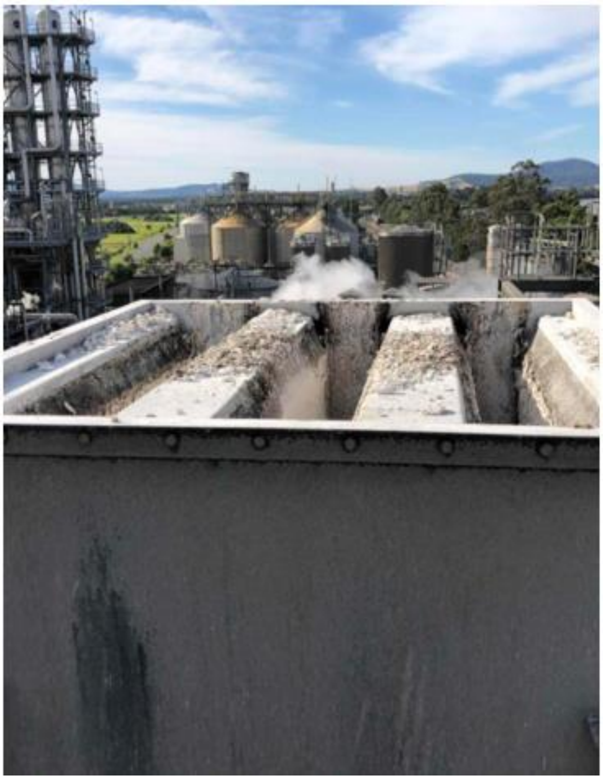
% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
DECC	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.
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
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.
RATA	Relative accuracy test audit
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.
XRD	X-ray diffractometry
Upper bound	When an analyte is not present above the detection limit, the result is assumed to be equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

7 Appendix 1: Site Photos

EPA ID 9 – No. 2 Gluten Dryer / Starch Dryer Baghouse

EPA ID 10 – No. 3 Gluten Dryer Baghouse

EPA ID 11 – No. 4 Gluten Dryer Baghouse



EPA ID 12 – No. 1 Starch Dryer Scrubber

EPA ID 13 – No. 3 Starch Dryer Scrubber

EPA ID 14 – No. 4 Starch Dryer Scrubber

EPA ID 35 - Combined Boilers 5 & 6 Stack

EPA ID 39 - Biofilter Inlet

EPA ID 40 - Biofilter A

EPA ID 41 - Biofilter B

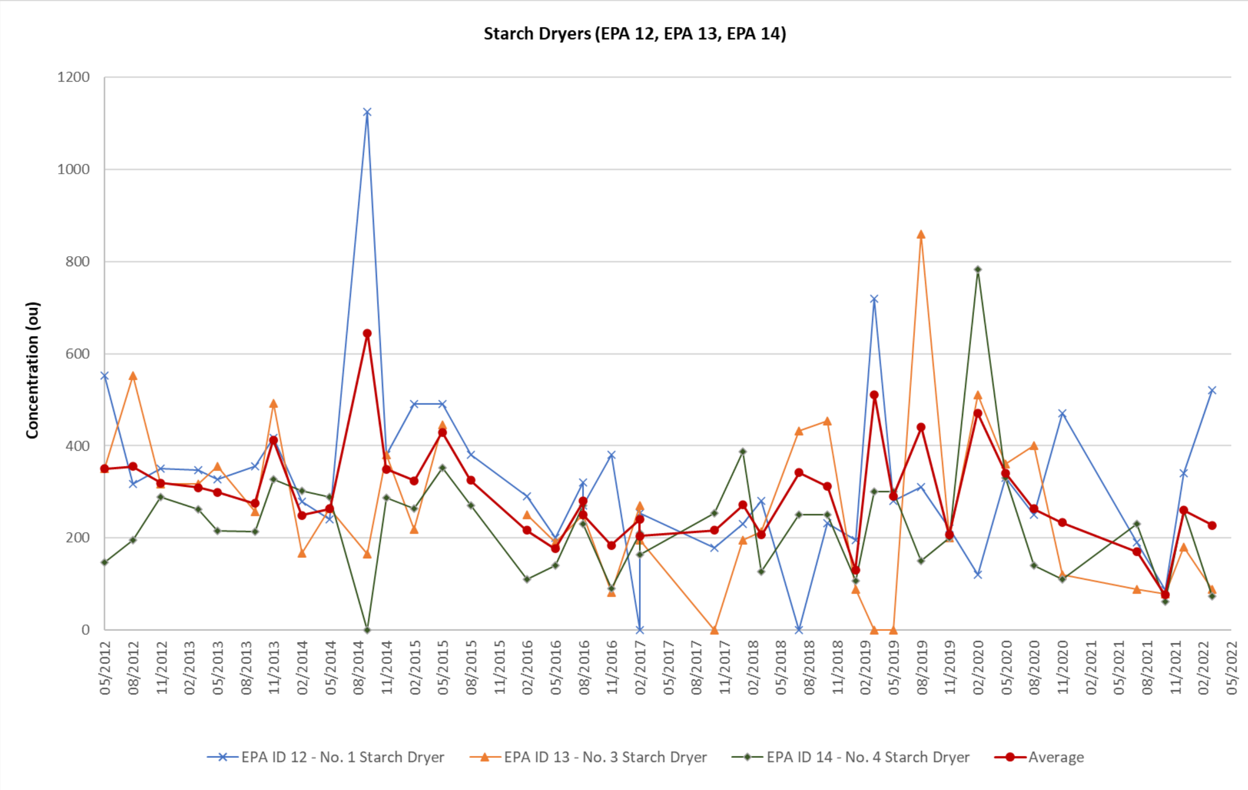
EPA ID 42 - Boiler 4

EPA ID 45 - Boiler 2

EPA ID 47 - Starch Dryer 5

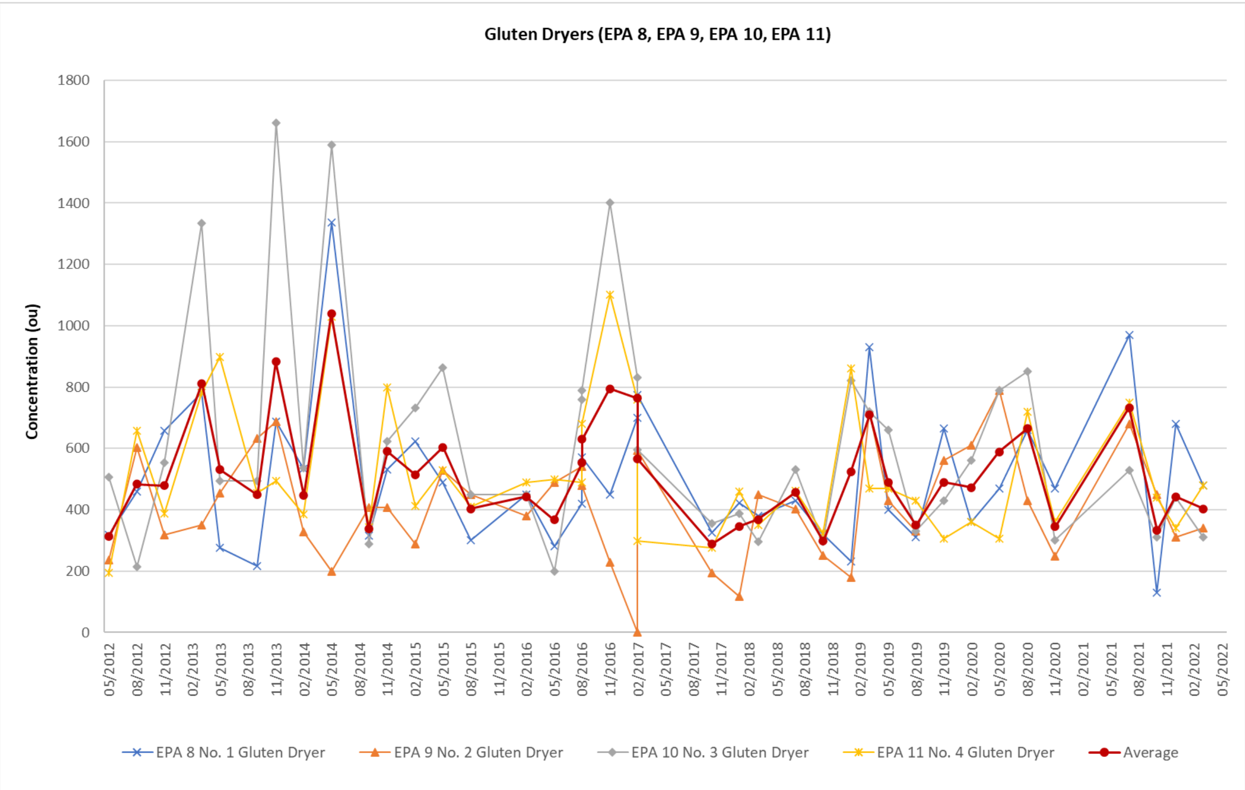
8 Appendix 2: Historical Odour Results

Figure 1. Starch Dryers No 1, 3 & 4 (EPA 12, EPA 13, EPA 14)



Zero result represents Dryer not operating on days of testing.

Figure 2. Gluten Dryers No 1, 2 ,3 & 4 (EPA 8, EPA 9, EPA 10, EPA 11)



Zero result represents Dryer not operating on days of testing.

Figure 3. Starch Dryer 5 (EPA 47)

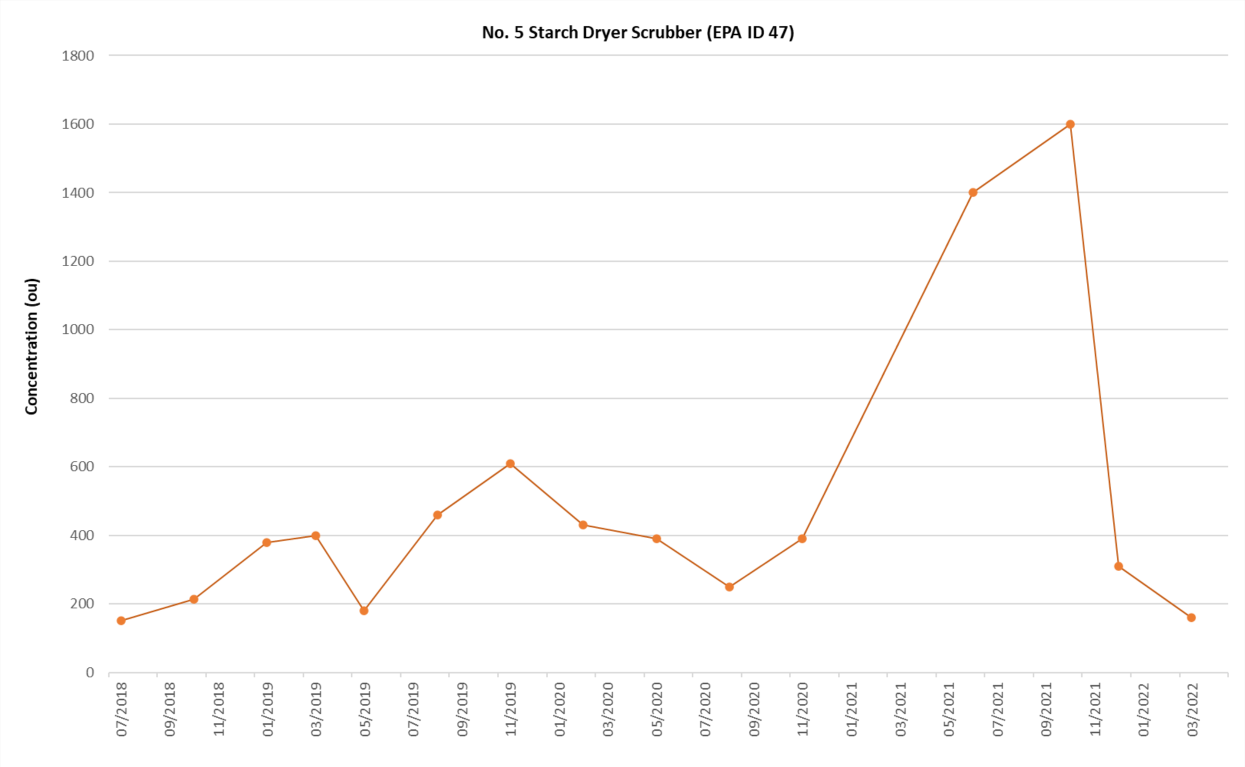
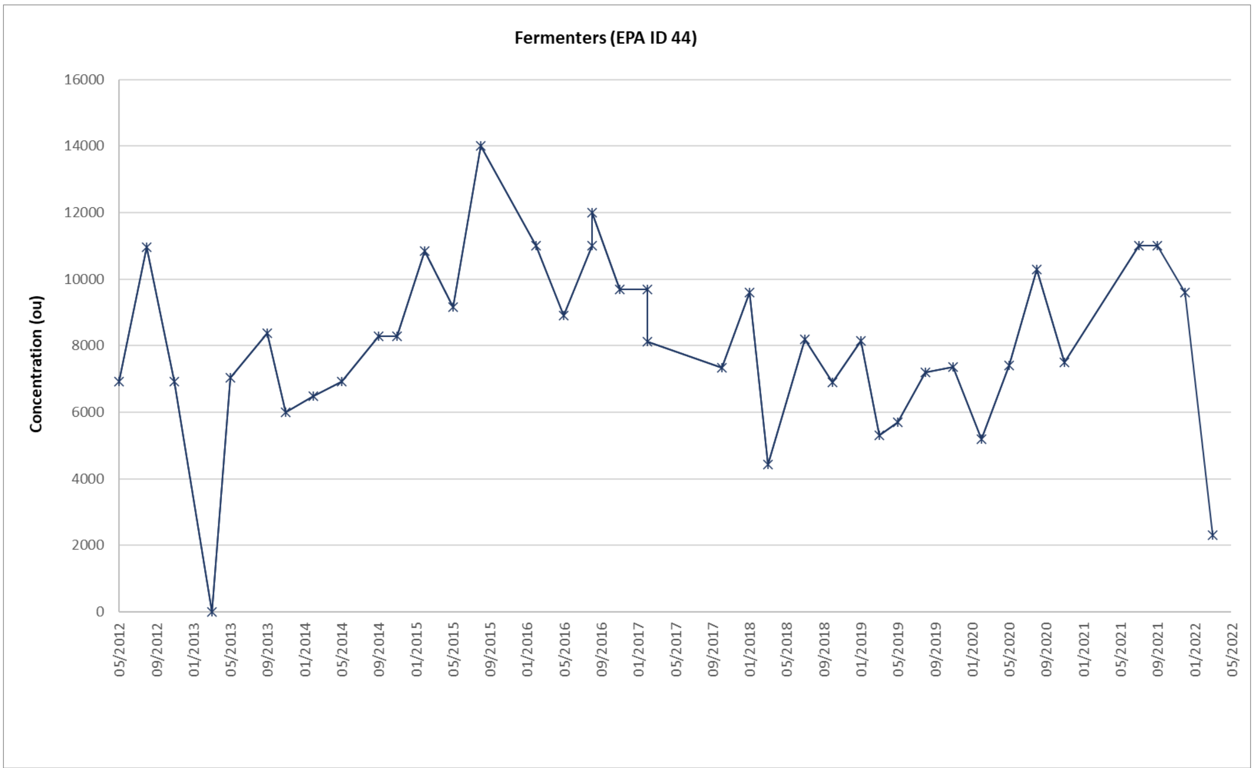
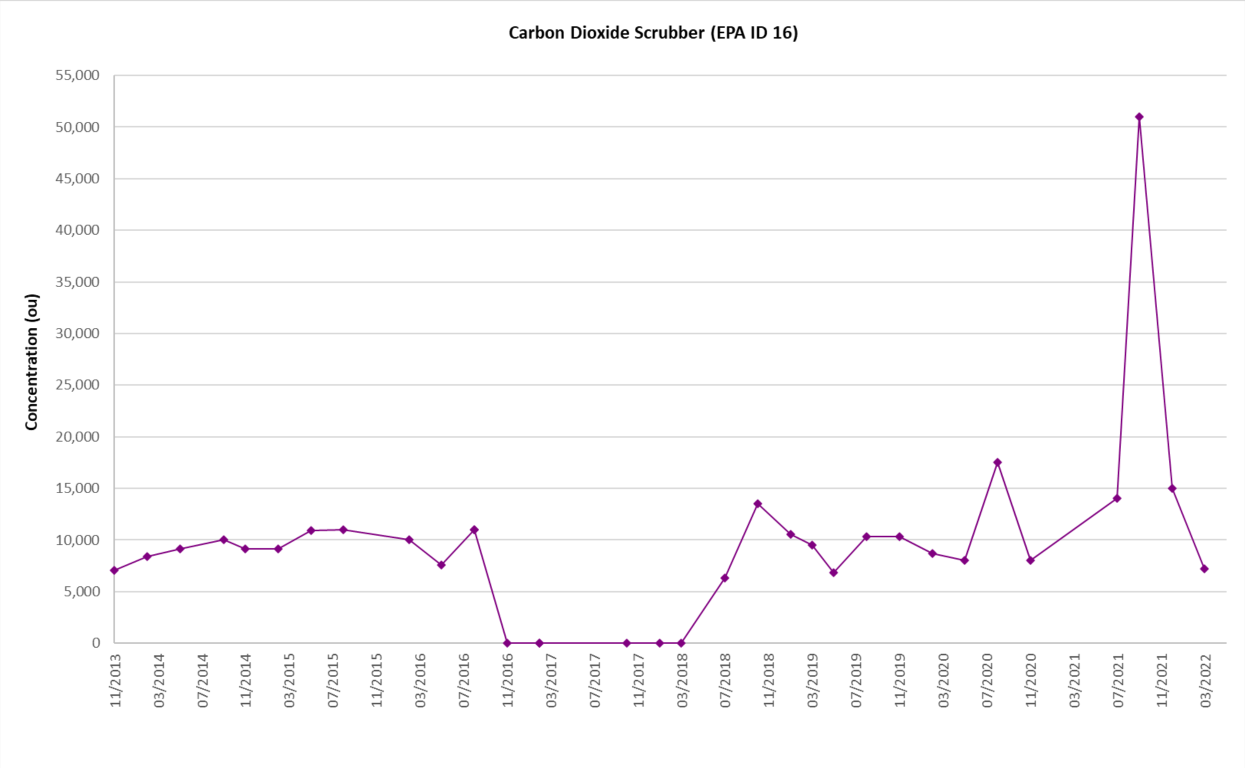


Figure 4. Fermenters (EPA 44)



Zero result represents Fermenter not operating on days of testing.

Figure 5. Carbon Dioxide Scrubber Outlet (EPA 16)



Zero result represents Fermenter not operating on days of testing.

Figure 6. Combined Boiler 5 & 6 Stack (EPA 35)

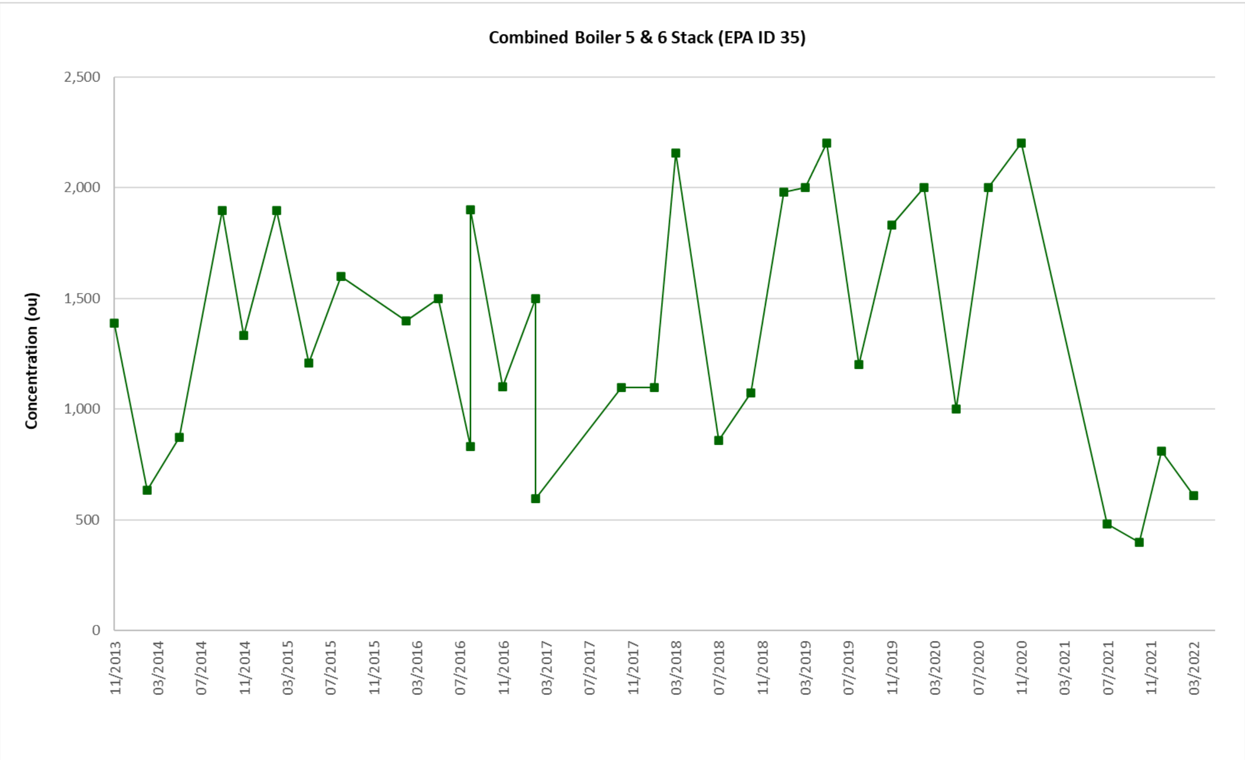


Figure 7. Boiler 2 Stack (EPA 45)

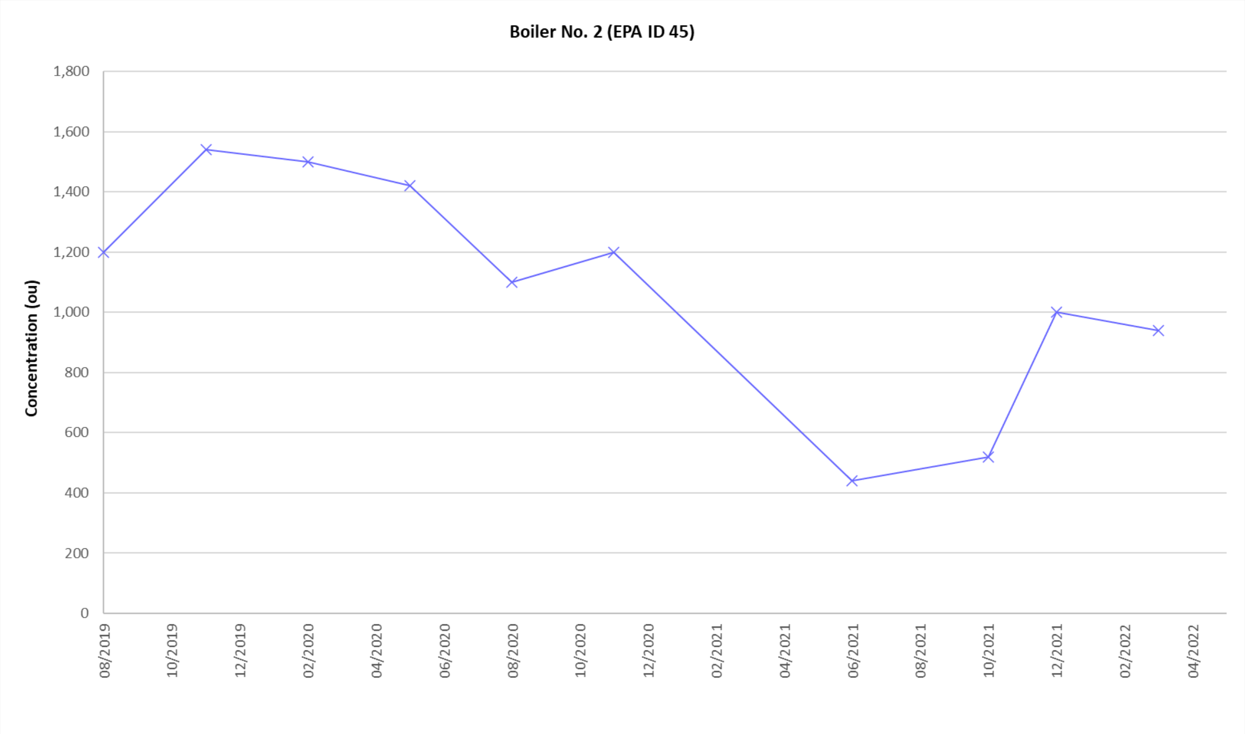
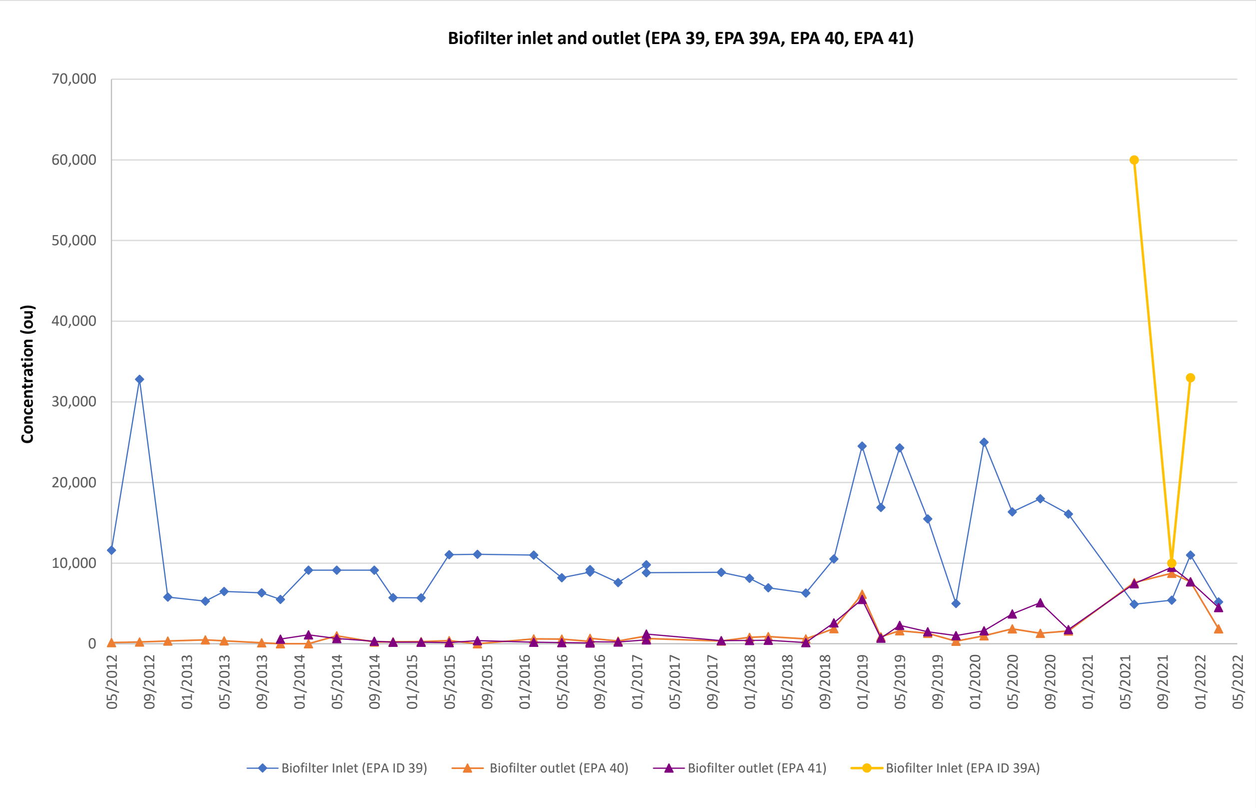
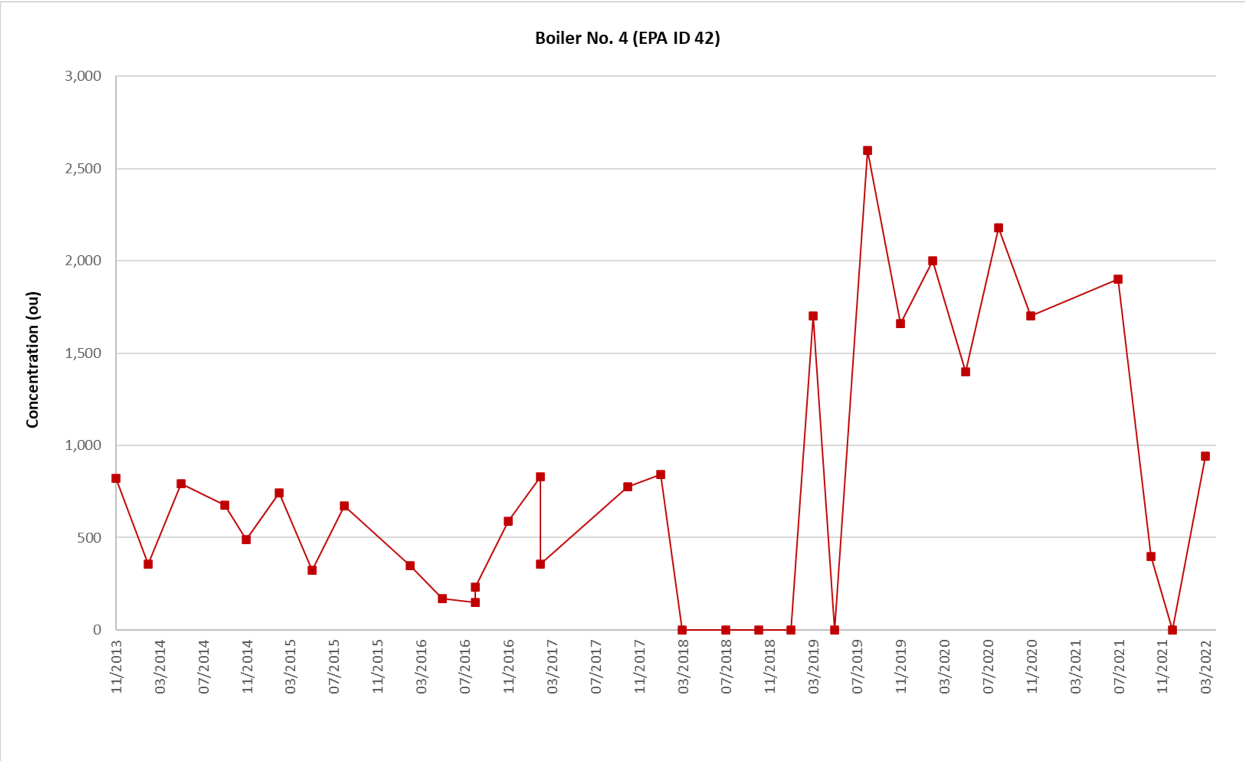


Figure 8. Biofilters (EPA 39, EPA 39A, EPA 40, EPA 41)



Zero result represents Biofilter not available to be sampled for that event

Figure 9. Boiler 4 Stack (EPA 42)



Zero result represents Biofilter not available to be sampled for that event

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APPENDIX E – ODOUR MODELLING ASSESSMENT REPORTS

Shoalhaven Starches Modification 21 – Proposed Modification to Packing Plant and other works

Air Quality Assessment

Manildra Group

22 November 2021

→ **The Power of Commitment**

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Contents

1.	**Introduction**		**1**
	1.1	Overview	1
	1.2	Background	1
	1.3	Current proposal: Modification 21	4
	1.4	Scope	5
	1.5	Assumptions	5
	1.6	Report structure	5
	1.7	Limitations	6
2.	**Site location and context**		**7**
	2.1	Site description	7
	2.2	Nearby sensitive receptors	7
3.	**Operation description**		**11**
	3.1	General overview	11
	3.2	Flour mill	11
	3.3	Starch plant	11
	3.4	Glucose plant	12
	3.5	Ethanol and distillation plants	12
	3.6	DDG plant	12
	3.7	Steam production	12
	3.8	Environmental farm	12
	3.9	Packing plant (proposed)	13
	3.10	Other activities	13
		3.10.1 Product load-out areas	13
		3.10.2 Cooling towers	13
		3.10.3 Biofilters	13
	3.11	Proposed modifications	14
		3.11.1 Mod 11, 12, 13, 16, 17 and 19	14
		3.11.2 Mod 21	14
	3.12	Summary of odour controls	16
		3.12.1 Odour control status	16
		3.12.2 Odour reduction efficiency	19
4.	**Criteria for assessment**		**22**
	4.1	Odour	22
		4.1.1 Odour Concentration	22
		4.1.2 Measurement of Odour	22
		4.1.3 EPA Criterion for Odour	22
		4.1.4 Other air quality impacts	23
5.	**Meteorological data**		**25**
	5.1	Overview	25
	5.2	Meteorological modelling	25
		5.2.1 Representative year discussion	26
6.	**Background air quality**		**28**
	6.1	Background data	28

6.2 Odour complaint history 30
6.2.1 Community engagement 31
7. Odour assessment 38
7.1 Approach 38
7.1.1 Additional recommended odour mitigation 38
7.2 Emissions inventory 39
7.2.1 Source identification 39
7.2.2 Changes to baseline odour model 40
7.2.3 Source summary and comparison 40
7.3 Dispersion modelling 47
7.4 Predicted odour impacts 47
7.5 Summary of source contributions to odour impacts 50
7.5.1 Source contribution overview 50
7.5.2 Source contribution to 99th percentile 50
7.5.3 Maximum source contribution 53
8. Air quality assessment 55
8.1 Emissions inventory 55
8.1.1 Boiler emissions 55
8.1.2 Product dryer emissions 56
8.1.3 Gas turbines 57
8.1.4 Other emission sources 57
8.2 Dispersion modelling 63
8.3 Predicted air quality impacts 63
8.3.1 Particulates 63
8.3.1.1 Incremental particulate matter 63
8.3.1.2 Cumulative particulate matter (base scenario) 64
8.3.1.3 Cumulative particulate matter (mitigation scenario) 70
8.3.2 Products of combustion 76
8.3.3 PAH, VOCs and metals 82
9. Conclusions 85
A1 Meteorology 88
A1.1 Data Available 88
A1.2 Data Application 88
A2 Prognostic Meteorological Modelling 88
A2.1 Wind Distribution 89
A3 Diagnostic Meteorological Model - CALMET 92
A3.1 Site-specific meteorology 92
B1 Shoalhaven Starches Community Consultation Activities 98
B1.1 Community Group Talks 98
B1.2 Shoalhaven Starches Community Newsletter 98
B1.3 Community Consultative Committee 98

Table index

Table 1.1 Summary of recent proposed modifications on site (2015-2020) 2
Table 2.1 Location of identified sensitive receptors 8
Table 3.1 Summary of odour controls 16
Table 3.2 Biofilter odour inflow and outflows 19

Table 3.3 Boiler 5/6 odour inflows 20
Table 3.4 Boiler 5/6 odour outflows 21
Table 4.1 Odour criterion for the assessment of odour 22
Table 4.2 Air quality impact assessment criteria – other pollutants 24
Table 6.1 Background Air Quality Data – Albion Park South (2016) 28
Table 6.2 Review of particulate monitoring at Albion Park South and Wollongong, $\mu g/m^3$ 29
Table 6.3 Summary of odour complaints in last 5 years 32
Table 7.1 Comparison of odour emissions from previous mods to current mod 42
Table 7.2 Predicted peak (99th percentile, short term averaged) odour impact at nearby receptors 48
Table 7.3 Source group odour character review 50
Table 7.4 Ranked source contribution to 99th percentile for residential receptors (Mod 21 (Q2), 99th percentile, 1 second average, OU) 52
Table 7.5 Ranked source contribution to 99th percentile for commercial receptors (Mod 21 (Q2), 99th percentile, 1 second average, OU) 52
Table 7.6 Ranked maximum source contribution for residential receptors (Mod 21 (Q2), 1 second average, OU) 54
Table 7.7 Ranked maximum source contribution for commercial receptors (Mod 21 (Q2), 1 second average, OU) 54
Table 8.1 Boiler emissions estimation 55
Table 8.2 Emission inventory – Particulate matter 57
Table 8.3 Emission inventory – Products of combustion (Base scenario) 59
Table 8.4 Emission inventory – Products of combustion (Mitigation scenario) 61
Table 8.5 Maximum predicted incremental ground level TSP, PM_{10} and $PM_{2.5}$ concentrations (base and mitigation scenario) 63
Table 8.6 Summary of highest measured and predicted PM_{10} levels, $\mu g/m^3$ (at receptor R1) 65
Table 8.7 Summary of highest measured and predicted $PM_{2.5}$ levels, $\mu g/m^3$ (at receptor R1) 65
Table 8.8 Summary of highest measured and predicted PM_{10} levels, $\mu g/m^3$ (at receptor C6) 66
Table 8.9 Summary of highest measured and predicted $PM_{2.5}$ levels, $\mu g/m^3$ (at receptor C6) 66
Table 8.10 Summary of highest measured and predicted PM_{10} levels, $\mu g/m^3$ (at receptor R1) 71
Table 8.11 Summary of highest measured and predicted $PM_{2.5}$ levels, $\mu g/m^3$ (at receptor R1) 71
Table 8.12 Summary of highest measured and predicted PM_{10} levels, $\mu g/m^3$ (at receptor C6) 72
Table 8.13 Summary of highest measured and predicted $PM_{2.5}$ levels, $\mu g/m^3$ (at receptor C6) 72
Table 8.14 Maximum predicted ground level Sulfur Dioxide concentrations (base scenario) 77
Table 8.15 Maximum predicted ground level Sulfur Dioxide concentrations (mitigation scenario) 77
Table 8.16 Maximum predicted ground level Nitrogen Dioxide concentrations (base scenario) 78
Table 8.17 Maximum predicted ground level Nitrogen Dioxide concentrations (mitigation scenario) 78
Table 8.18 Maximum predicted ground level Carbon Monoxide concentrations (base scenario) 79
Table 8.19 Maximum predicted ground level Carbon Monoxide concentrations (mitigation scenario) 79
Table 8.20 Maximum predicted ground level Hydrogen Fluoride concentrations (base scenario) 80

Table 8.21	Maximum predicted ground level Hydrogen Fluoride concentrations (mitigation scenario)	80
Table 8.22	99.9 percentile predicted ground level Hydrogen Chloride concentrations (base scenario)	81
Table 8.23	99.9 percentile predicted ground level Hydrogen Chloride concentrations (mitigation scenario)	81
Table 8.24	Maximum predicted ground level PAH, VOC and metals concentrations (base scenario)	83
Table 8.25	Maximum predicted ground level PAH, VOC and metals concentrations (mitigation scenario)	84
Table A.1	Atmospheric Stability Classes and Distribution	95
Table C.1	Complete odour emission inventory (Mod 21 Q2)	100
Table C.2	Complete odour emission inventory (Mod 21 Q3)	105

Figure index

Figure 2-1	Site context	9
Figure 2-2	Site location and layout	10
Figure 3-1	Site layout and major odour sources	15
Figure 3-2	Odour sampling results from biofilters (Source: Ektimo 2021)	20
Figure 3-3	Odour sampling from boiler 5/6 (Source: Ektimo 2021)	21
Figure 4-1	Factors for estimating peak concentrations (Extract from NSW Approved Methods)	23
Figure 5-1	CALMET wind rose for the factory	26
Figure 5-2	Comparison of site weather station observations and CALMET meteorological	27
Figure 6-1	Number of odour complaints per calendar year in the last 5 years	30
Figure 7-1	Review of biofilter outlet odour concentrations (average of biofilter A and B)	39
Figure 7-2	Odour impacts, 99th percentile, short term averaged – Modification 21	49
Figure 7-3	Source group contribution to 99th percentile (Mod 21 (Q2))	51
Figure 8-1	Maximum Predicted Incremental Ground Level PM_{10} Concentrations (24-hour Average) (base scenario)	67
Figure 8-2	Maximum Predicted Cumulative Ground Level PM_{10} Concentrations (24-hour Average) (base scenario)	68
Figure 8-3	Maximum Predicted Cumulative Ground Level $PM_{2.5}$ Concentrations (24-hour Average) (base scenario)	69
Figure 8-4	Maximum Predicted Incremental Ground Level PM_{10} Concentrations (24-hour Average) (mitigation scenario)	73
Figure 8-5	Maximum Predicted Cumulative Ground Level PM_{10} Concentrations (24-hour Average) (mitigation scenario)	74
Figure 8-6	Maximum Predicted Cumulative Ground Level $PM_{2.5}$ Concentrations (24-hour Average) (mitigation scenario)	75
Figure A1	Scatter Plot of Observed and Predicted Ambient Temperature	89
Figure A2	Nowra AWS - Annual Wind Roses (Year 2004)	90
Figure A3	Farm AWS - Annual Wind Roses (year 2004)	91
Figure A4	Wind Speed Distribution – TAPM and Farm AWS	92
Figure A5	Factory Annual Wind Rose - Year 2004	93
Figure A6	Factory Seasonal Wind Roses - Year 2004	94
Figure A7	Factory Annual Stability Rose - Year 2008	96

Appendices

Appendix A	Meteorological analysis
Appendix B	Shoalhaven Starches Community Consultation Activities
Appendix C	Complete odour emission inventory
Appendix D	Site sampling reports

1. Introduction

1.1 Overview

GHD was engaged by Shoalhaven Starches Pty Ltd (Manildra) to conduct an air quality impact assessment for a proposed modification to the approved Shoalhaven Starches Expansion Project (SSEP) (Modification 21 or Mod 21). The Shoalhaven Starches factory is located at Bolong Road in Bomaderry, New South Wales.

This report describes the background and scope of the proposed modifications, the pollutant inventory for odorous and non-odorous emission sources and the predicted air quality impacts at identified sensitive receptors.

1.2 Background

Flour and grains are processed at the factory to produce ethanol, starch, gluten, glucose and distiller's dried grain (DDG). Shoalhaven Starches is the holder of Environment Protection Licence number 883 issued for the plant by the NSW EPA.

The Shoalhaven Starches Bomaderry plant currently produces around 225 million litres (ML) of ethanol per year (production quantity fluctuates year to year based on demand). On 28 January 2009 the (then) Minister for Planning issued Project Approval MP 06_0228 for the Shoalhaven Starches Expansion Project. The Project Approval for the SSEP enabled Shoalhaven Starches, subject to certain conditions, to increase ethanol production in a staged manner at its Bomaderry Plant from the previous approved level of 126 million litres per year to 300 million litres per year. Following the Minister's determination Shoalhaven Starches have been implementing and commissioning works in accordance with this approval. Work on the change in operations has been completed, coupled to quarterly testing (independent audits) of emissions from licensed discharge points (a condition of the Licence), with the purpose to validate the predicted impacts against the original predictions in 2008 for the ethanol expansion.

The increase in ethanol production associated with the SSEP Project Approval was made in response to the NSW Government's ethanol mandate which increased the mandated ethanol content by volume in petrol in NSW from 2% to 6% in October 2011. The SSEP sought to increase ethanol production capacity at the Shoalhaven Starches site to meet the expected increase in demand for ethanol arising from this site. The increase in ethanol production required upgrades to the Stillage Recovery Plant including six additional Dried Distillers Grains Syrup (DDGS) dryers.

However, the anticipated increase in demand for ethanol has not occurred. In response, Manildra have undertaken a series of modifications to the site with a focus on exploring alternative options. These are summarised in Table 1.1.

Modifications 11, 12, 13, 16, 17 and 19 were assessed by GHD in the following documents:

- Shoalhaven Starches expansion project – Modification 11 and 12 (Project approval MP_06_0228) Revised odour and air quality assessment (GHD 2017)
- Shoalhaven Starches Mod 13 Air Quality Assessment Cumulative odour assessment (GHD 2017)
- Shoalhaven Starches Mod 13 Air Quality Assessment Updated Cumulative Air Quality Assessment (GHD 2017).
- Shoalhaven Starches Proposed modification application MP 06_0228 Shoalhaven Starches Expansion Project, Proposed new speciality processing facility, new gluten dryer and other associated works at 22, 24 and 171 Bolong Rd, Bomaderry, NSW (Mod 16) (GHD, February 2019).
- Manildra Group Air Quality Assessment Mod 17, 2019 (GHD, 2020)
- Manildra Modification 19 Air Quality Assessment (GHD, 2020)

Modification 14 did not require an air quality assessment. Modification 15 was separately assessed by GHD for SupaGas in 2017.

Table 1.1 Summary of recent proposed modifications on site (2015-2020)

Modification	Summary of changes
Modification 11	– Reducing the number of approved DDGS Dryers from six to four. – A minor modification to the footprint of the four DDG dryers. – Relocation of the cooling towers in the DDG Plant. – A Mill Feed Silo and structure to feed DDG dryers. – Expanded use of the existing coal and woodchip storage area within the SS Environmental farm. – The addition of two biofilters to cope with the increased number of DDG Dryers. – A forklift maintenance building adjacent to the relocated DDG dryers, along with a container preparation area adjacent to the relocated DDG Dryers.
Modification 12	Modifications to the existing Ethanol Distillery Plant to: – increase the proportion of 'beverage" grade ethanol that is able to be produced on the site. This modification will enable increased flexibility in terms of the range of types of ethanol produced at the site (i.e. between fuel, industrial and beverage grade ethanol) to meet market demands; and – modify the type and location of the Water Balance Recovery Evaporator that has been previously approved under MOD 2 adjacent to the Ethanol Plant.
Modification 13	– Modification of boilers 2 and 4, with the conversion of boiler 4 from gas fired to coal fired. – Installation of an additional baghouse on boiler 6.
Modification 14	– Modifications to the former paper mill site.
Modification 15	– Construction of the SupaGas CO2 plant at the former Dairy Farmers factory site.
Modification 16/17	Modification 16 comprised of the following: – Installation of a third flour mill C within the existing flour mill B building – Undertaking modifications to flour mills A and B – The construction of a new industrial building adjoining the Starch Dryer No. 5 building containing: – The new product dryer – Plant and equipment associated with the processing of specialized speciality products. – Addition to Starch Dryer No 5 building to house a bag house for this dryer – Conversion of two existing gluten dryers (1 and 2) to starch dryers – Additional sifter for the interim packing plant – Construction of a coal-fired co-generation plant to the south of the existing boiler house complex. The co-generation plant will house a new boiler (No. 8) – Construction of lime silos: The lime injection system will consist of two storage silos and associated equipment for injecting powdered lime into each of the coal fired boilers – Relocation of the existing boiler No. 7 to the northern side of the overall boiler house complex – Construction of an indoor electrical substation on the northern side of Bolong Road – Construction of an additional rail intake pit for the unloading of rail wagons – Extension of the existing electrical substation located within the main factory area. Modification 17 comprised of the following: – Modification to the location of the baghouse for the No. 5 Starch Dryer. As part of this baghouse relocation, an additional stack was added to starch dryer 5. – Use of sawmilling residue (woodchips) for boiler fuel by blending woodchip with coal in Boilers 2 & 4 – Installation of a new product dryer (No. 9) within the footprint of the speciality products building as approved under Mod 16. – To install a 'services lift' to the outside of the existing staircase adjacent to the No. 5 Starches Dryer Building to allow on-going access for personnel and customers to the floors within the building – Modification of the service conduit extending from the Shoalhaven Starches factory site on the southern side of Bolong Road to the proposed Packing Plant on the northern side of Bolong Road by elevating a section of the conduit above ground level – Amendment to design specifications for silencers to exhaust fans for Flour Mill B

Modification	Summary of changes
	– Extension of the approved footprint for the product dryer building. The building will need to be wider than the one that has been approved – Installation of a wet end processing plant within the product dryer building – Extension of speciality products building to the north to provide bulk chemical storage to the south of the product dryer building – Demolition of existing stores and maintenance offices building – Repurposing the existing maintenance building – Changes to car parking arrangements.
Modification 18	Modification 18 comprised of the following: – Produce 120 ML/yr of hand sanitiser grade ethanol within the approved 300 ML/yr production limit – Repurposing of existing de-fatting building for the manufacturing of 1.5 ML/yr hand sanitiser – Relocation of approved, but not yet built gas fired boiler to be adjacent to ISO container storage area to the south east of the site to better service the existing distillery – New 24.5 m high boiler emissions stack – Extension of existing gantry and associated steam pipework between gas fired boiler and distillery for steam supply – Additional pipework to increase height of gantry from 9.75 m to 10.8 m – Erection of two 236,000 litre storage tanks for hand sanitiser storage – repurposing of de-fatting plant for hand sanitiser production storage
Modification 19	Modification 19 comprised of the following: – The installation of distillation columns and associated processing equipment immediately to the west of the existing Ethanol Distillery Plant. The proposed plant and equipment is of similar design, size and operation to the existing Beverage Grade Ethanol modification approved under Mod 12. – An additional three (3) ethanol storage tanks within the existing ethanol storage tank area. – The distillery modification in the proposed location will require a boundary adjustment adjacent to Bolong Road. Discussions have commenced with Shoalhaven City Council and an application has been submitted seeking a boundary adjustment with Council. – The construction of three (3) product silos above the existing interim packing plant. The construction of these three (3) silos will necessitate the relocation of an approved electrical substation that was approved (but not yet constructed) below and within the footprint of where it is now proposed to site the proposed product silos. This electrical sub-station is to be relocated to a position on the northern side (Bolong frontage) of the Gluten Dryer No. 5 building. North of Starch Dryer 5 Approved Baghouse. – The relocation of six (6) approved but not yet constructed, and the construction of an additional ten (10) product tanks. Under the existing approvals for the site ten (10) product storage tanks were to be sited to the rear of the Gluten Dryer and Specialty Product Buildings on the western side of Abernethy's Creek. Following detailed design, the diameter of the tanks has now increased and additional area is required for associated pumps and supporting equipment. As a result there is insufficient room to locate these tanks in the approved location. – The construction of an additional ethanol loadout immediately adjacent to and to the north of the existing loadout facility. – Installation of additional cooling towers within the eastern part of the site – The construction of a cable stay pipe bridge across Abernethy's Creek to supply power and product to these buildings. – The relocation of the extension of the existing electrical substation located on the eastern side of Abernethy's Creek – The extension of the existing car park located within the western part of the site in a south-westerly direction to provide an additional thirty-one (31) car parking staff for staff and contractors

1.3 Current proposal: Modification 21

Shoalhaven Starches have now identified that as a result of the increase in the range of products that will be able to be produced arising from the works associated with Mod 16, amendments will be required to the approved Packing Plant on the northern side of Bolong Road to accommodate these different products.

- The approved Packing Plant made provision for 7 silos to store product awaiting packaging. To accommodate the different types of gluten and starch products that will now be able to be produced from the Specialty Product Building following Mod 16, greater flexibility will be required for the storage of the increased range of gluten and starch products on the Packing Plant site. It is therefore proposed to construct sixteen (16) smaller silos instead of the original 7 approved silos. The proposed 16 silos will each have a square footprint with dimensions of 5 metres by 5 metres, height of 30 metres and volume of 300 tonnes each.
- Additional packer feed bins will also need to be installed within the Packing Plant building to accommodate the need for improved flexibility to enable a greater range of gluten and starch products to be packed.
- Additional product transfer lines and services will also need to extend from the Specialty Product Buildings approved under Mod 16 and extend across Bolong Road to the Packing Plant via the approved underground services crossing. It is also proposed to slightly relocate the transfer lines and gantry to accommodate the amended product silos.
- To accommodate the change in equipment used within the Packing Plant, such as the additional packer feed bins, the overall footprint of the Packing plant building will need to be slightly reconfigured from that which was originally approved.
- The change in the footprint of the Packing Plant building will also necessitate a change in the layout of the approved car parking spaces associated with the Packing Plant building.

In addition to the above modifications it is also proposed to carry out the following modifications to the approved Packing Plant site:

- To enable storage of additional rail wagons and enable wagons to be taken off line for maintenance purposes a third rail siding is proposed.
- It is also proposed to increase the height of the gantry containing the product transfer lines to the product silos to provide additional clearance above the container reach stacker. The current approved gantry has a height above ground level of 14.5 metres AHD. It is proposed to lift the gantry to a minimum height above ground level of 20.0 metres AHD, with the top of the gantry to 23.4 metres AHD.
- It is also proposed to provide a train tunnel where the noise mitigation walls surrounding the container storage area terminate at the rail line, to provide additional noise attenuation.
- It is also proposed to provide a loader maintenance and cleaning area within the container storage area.

In addition to the modifications associated with the approved Packing Plant, it is also proposed to undertake the following modifications to the Approved Project.

- It is proposed to install an additional raw waste water tank within proximity of the existing raw waste water tank adjacent to the oxidisation pond within the Environmental Farm and located to the north of Bolong Road (and opposite the former Paper Mill site). It is proposed that this tank will provide additional storage and act as a buffer in the case that the existing tank is required to be taken off line. This tank will have an effective volume of 3000 KL with dimensions of approximately 20 metres diameter and 12 metres height above ground level.
- It is also proposed to install a Nitrogen Generator and Storage Tanks that will supply Nitrogen to the existing and proposed ethanol storage tanks to eliminate in-tank fire risk. This facility will be located between the existing ethanol loading bay and the Bolong Road frontage of the site. This facility will comprise a Nitrogen Generator housed within a container type building. Four storage vessels comprising compressed air and mixing tanks will be sited between the Nitrogen Generator and Bolong Road. The Nitrogen that is produced will be stored in six vessels with a height above ground level of 10 metres adjacent and to the west of the Nitrogen Generator
- In order to produce ethanol, starch is essentially heated to convert it (with enzymes) into sugars which are then fermented to produce ethanol. This starch heating process is undertaken in an Indirect Cooking Facility. Shoalhaven Starches have identified that there is inadequate capacity in their current Indirect Cooking

process to accommodate both the existing ethanol production as well as that associated with the movement from lower to higher grade ethanol production under Mods 18 and 19. To provide increase indirect cooking capacity it is proposed to establish an additional Indirect Cooking Facility to be located adjacent to the existing Glucose Plant, to the north of the internal railway and to the south of the Ethanol Distillery.

– The additional Indirect Cooking Facility will comprise series of vessels housed within a structure that will have a footprint of 184.5 m^2 (20.5 m x 9 m) and height of 16.6 metres above ground level. The structure will include a range of processing vessels situated over three floors; and a single product feed tank.
– It is also proposed to install an additional two fermenters (No. 18 and 19) to the east of the existing evaporators and approved cooling towers to the east of the site, The additional fermenters are required to provided sufficient volume to accommodate current 'foaming' problems they are presently encountering in the existing fermenters.

1.4 Scope

The proposed changes (Mod 21) requires an application to the EPA assessing the associated off-site odour and air quality impacts.

In order to meet EPA NSW requirements, this report provides:

– A revised emissions inventory for odorous and combustion sources on site. A comparative analysis of the emissions inventory has been undertaken with the last major air quality assessments for the site.
– A level 2 air quality assessment of odour and air quality in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA 2016) (the Approved Methods). Dispersion modelling was undertaken using CALPUFF version 7.
– A comparison of predicted odour and air quality results against the EPA criteria and against the previous modification results.

1.5 Assumptions

The major assumptions used in this assessment are as follows:

– Stack emission testing reports from the past measurements are accurate and representative of normal operations, and do not vary significantly
– The odour dispersion modelling using the NSW EPA and US EPA approved regulatory Gaussian puff dispersion model CALPUFF version 7, which was considered appropriate for the location. Limitations with the predicted odour are inherent within the model and in its ability to handle multiple buildings and stacks in a complex setup, with wake effects included. As such, the layout of the plant was simplified in order for the model to handle the setup
– Odour emissions from the major sources of odour were modelled as both variable emission and fixed point, volume and area sources in CALPUFF with appropriate dispersion characteristics
– The site representative meteorological data was obtained from previous assessments of the plant, which have been approved by EPA NSW in the past. The meteorological data is discussed in Section 5
– Small silos in the Packing Plant are conservatively assumed to be filled 24 hours a day
– Odour sources with horizontal releases have conservatively been modelled with vertical velocities of 0.1 m/s
– The VOC concentration in the biofilter exhaust is not high enough to induce density flows of the exhaust plume in ambient air
– The emissions inventory, and therefore the dispersion modelling results, is largely based on estimates and on data measured on site by Stephenson Environmental Management Australia (SEMA). Actual measurements are dependent on site conditions at the time of measurement and these conditions may change. GHD does not accept any responsibility for updating the measurements or estimates made by SEMA.

1.6 Report structure

This report:

– Describes the operations of the plant
– Describes the site-representative meteorological and background air quality data
– Describes the proposed modifications
– Characterises odour sources at the plant, accounting for the required changes to the Mod 21 model setup
– Presents the results of odour dispersion modelling for the proposed Mod 21 scenario using CALPUFF
– Characterises non-odour sources at the plant
– Presents the results of air quality dispersion modelling for the proposed Mod 21 scenario using CALPUFF
– Presents a summary of the results and draws conclusions as to the off-site impacts (both odour and non-odour)
– Outlines the limitations of the analyses and conclusions presented.

1.7 Limitations

This report: has been prepared by GHD for Shoalhaven Starches Pty Ltd and may only be used and relied on by Shoalhaven Starches Pty Ltd for the purpose agreed between GHD and Shoalhaven Starches Pty Ltd as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than Shoalhaven Starches 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(s) 1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

2. Site location and context

2.1 Site description

Figure 2.1 shows the site context and location of the Shoalhaven Starches plant in Bomaderry, New South Wales. It is located between the Shoalhaven River and township of Bomaderry. The plant comprises a factory, a proposed (but not yet constructed) packing plant and environmental farm. The packing plant lies immediately to the north of the factory, while the environmental farm is situated approximately 400 m to the east. Figure 2.2 shows the site location and layout.

2.2 Nearby sensitive receptors

The Approved Methods define a sensitive receptor as “a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area”.

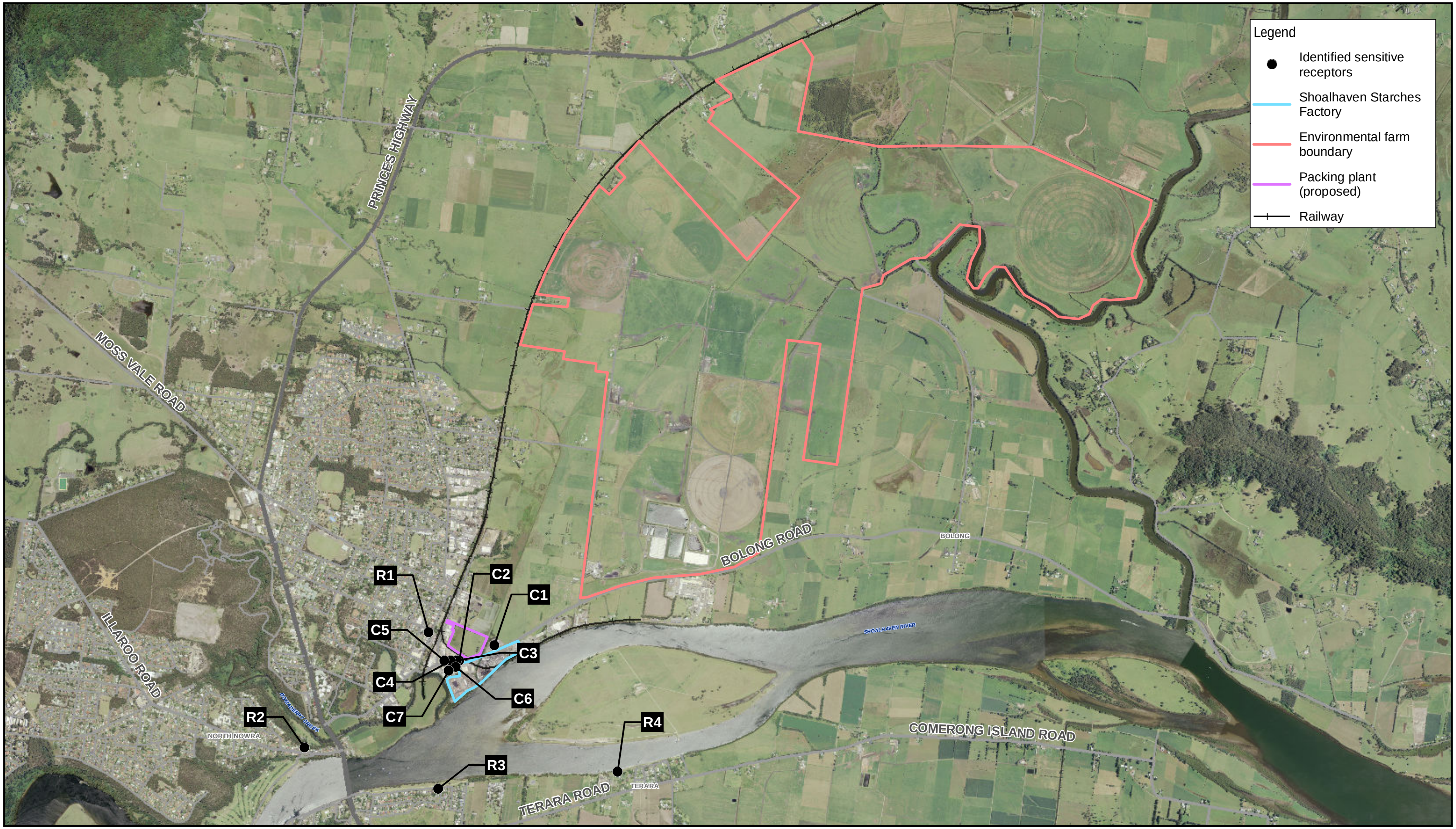
The site is proximate to a number of sensitive receptors. The township of Bomaderry lies to the northwest of the factory and west of the packing plant. Nowra is situated south of the plant. Commercial and industrial sensitive receptors are located directly adjacent to the site and across from it along Bolong Road.

The nearest residential sensitive receptors are located between 150 to 1300 metres from the site. The nearest commercial/industrial sensitive receptors (denoted by a receptor ID beginning with C) and residential sensitive receptors (denoted by a receptor ID beginning with R) to the site have been included in the modelling and are listed in Table 2.1, including the approximate distances and orientation of each receptor from the site. The commercial/industrial receptors also include the operating times in brackets.

The sensitive receptors are shown in Figure 2.1 and Figure 2.2.

Table 2.1 Location of identified sensitive receptors

Receptor ID	Range, m	To nearest odour source	Direction	MGA56. Easting (m)	MGA56. Northing (m)
R1	150	Packing Plant	W	281,430	6,140,610
R2	1300	Factory	SW	280,400	6,139,650
R3	700	Factory	S	281,510	6,139,310
R4	1300	Factory	SE	283,000	6,139,450
C1 (7am to 5pm, weekdays)	45	Factory	N	281,977	6,140,501
C2 (8am to 5pm, weekdays)	20	Factory	N	281,685	6,140,373
C3 (8am to 5pm, weekdays)	30	Factory	N	281,663	6,140,373
C4 (7am to 4pm, weekdays)	75	Factory	NW	281,615	6,140,371
C5 (24 hours)	125	Factory	NW	281,563	6,140,372
C6 (7am to 5pm, weekdays 7am to 12pm, Saturday)	30	Factory	NW	281,655	6,140,320
C7 (8am to 5pm, weekdays, 8am to 12pm, Saturday)	55	Factory	NW	281,597	6,140,289



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0 0.3 0.6 0.9 1.2

Kilometers

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

N

Manildra Group Pty Ltd
Shoalhaven Starches

Site Context

Project No. 12548374
Revision No. 0
Date 20 May 2021

FIGURE 2.1

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Print date: 20 May 2021 - 12:26

Data source:General Topo: NSW LPI DTDB 2012 © Department of Customer Service 2020. Created by: kpsroba

Manildra Group Pty Ltd
Shoalhaven Starches

Project No. 12548374
Revision No. 0
Date 20 May 2021

Site location and layout

FIGURE 2.2

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Print date: 20 May 2021 - 12:26

Data source: General Topo: NSW LPI DTDB 2012. © Department of Finance, Services & Innovation 2018. Created by: kpsroba

3. Operation description

3.1 General overview

Wheat flour and grains (wheat) are processed at the Shoalhaven Starches factory to produce ethanol, starch, gluten and glucose. Solid wastes are treated to produce distiller's dried grain (DDG), with liquid wastes being transferred to the environmental farm waste water treatment plant. Excess treated waste water is irrigated onto pasture. The main processing and materials treatment areas at Shoalhaven Starches comprise the:

– Flour mill
– Starch plant
– Glucose plant
– Ethanol and distillation plants
– DDG plant
– Packing plant
– Pellet Plant
– Environmental farm.

A brief description of the production process associated (including emission control) with each plant is given below. Figure 3.1 shows the layout of the plant in terms of its operational areas, along with the major odour sources of the plant, accounting for around 80% of total odour emissions (excluding the environmental farm).

3.2 Flour mill

Shoalhaven Starches commenced full operations at the flour mill in June 2011. The flour mill was originally approved by NSW Department of Planning and Environment in 2007 and was consolidated into the ethanol expansion project approval in 2008.

Proposed Modifications to the flour mill were approved in March 2016, which enabled an increase in the total flour production capacity on the site from the previously approved limit of 265,000 tonnes per annum to 400,000 tonnes per annum.

The flour is used in the plant to produce starch, gluten, glucose and ethanol. All remaining mill feed and pollard (flour sieving rejects) is processed through the DDG dryers for sale as stock feed. Flours from the various grinding operations are collected and blended together before passing through final treatment and weighing operations to bulk storage bins. Flour is taken from these bins for use in existing site production processes.

All air extracted from the mill is passed through Buhler Airjet bag houses prior to being discharged to the atmosphere vertically via ten individual stacks. Approval has previously been obtained for the installation of additional plant to increase production, along with two additional exhausts from the roof of the building.

3.3 Starch plant

Within the starch plant, flour is processed to separate the starch from gluten (the protein component of flour). The starch is graded, dried and packed for shipment. Different grades of starch are manufactured for food and paper making applications. Starch that is not used for these applications is used as a raw material for the ethanol plant. Gluten is dried and sold for use in the food industry.

Aqueous (water-based) wastes are reused within the plant or are transferred to the environmental farm waste water treatment plant.

Starch Dryer No.5 has been constructed and is currently operational (see Figure 3.1). No change to the production volume is predicted.

3.4 Glucose plant

The glucose plant (contained within the starch plant area) houses two lines; the ‘confectioners’ glucose line and the ‘brewers’ glucose line. Confectioner’s glucose is distinguished by having been demineralised to remove latent odours and flavours that might be carried through to the final product by the glucose.

Both processes use starch as the raw material. The starch is broken down to its constituent glucose molecules using enzymatic and hydrolytic processes. Water is removed from the resulting solutions using evaporation to produce glucose and brewer’s solutions of desired concentration. The glucose product is shipped to customers in bulk containers.

The glucose manufacturing process generates aqueous wastes, mostly condensate from the evaporators, which is reused during regeneration of the ion exchangers.

3.5 Ethanol and distillation plants

Waste starch from the starch plant is transferred to the ethanol plant and fermented to produce ethanol. Starch (described in section 3.3), which is in suspension, is heated in jet cookers before being fermented.

Fermentation is carried out in fermentation vessels using the treated substrate to which an ethanol-producing yeast inoculum has been added. The yeast inoculum is generated using yeast propagator vessels, these being seeded using commercial strains of yeast.

Wastes from the fermenters are transferred to the DDG plant (refer to section 3.6) for processing. Fermentation liquor from the ethanol plant is transferred to the distillation plant where water and other impurities are removed to produce various grades of ethanol.

3.6 DDG plant

Wastes from the ethanol and distillation plant are dewatered in decanter centrifuges and dried in steam dryers to produce granular DDG. Light phase from the DDG decanters is evaporated to recover soluble protein (syrup) and produce clear condensate (liquid line). The syrup is added to the dryer feed for recovery of the solids (solids line). DDG granular product is transferred to the DDG Pellet Plant for pelletising; the DDG pellets are stored in silos. Some of the granular DDG product is stored in a storage shed until it is loaded into trucks in the DDG load-out area.

Exhaust gases from the existing DDG dryers (three) are transferred to the boiler air intake in order to destroy odorous components of the gases by combustion.

3.7 Steam production

Steam is generated at Shoalhaven Starches by using a combination of three gas fired boilers (numbers 1, 3 and 7) and four coal fired boilers (numbers 2, 4, 5 and 6). The combustion gases from these boilers are discharged via stacks, with boilers 5 and 6 having a combined stack. Exhaust from boilers 2 and 4 is treated in a cyclone and baghouse prior to discharge to atmosphere. Exhaust from boilers 5 and 6 is treated in a baghouse prior to discharge to atmosphere.

The number of boilers operational at any given time depends on the operational and maintenance requirements of the plant. With boiler 8 installed and coal-fired boilers operating at full capacity, only one gas-fired boiler will be operational with the other two gas-fired boilers on standby. When coal-fired boilers are not at full capacity or offline for maintenance, steam requirements are met from the natural gas boilers.

3.8 Environmental farm

A number of wastewater streams are produced at the factory. These consist of five clear condensate streams (distillation plant condensate, evaporator condensate, DDG condensate, a small flow from the carbon dioxide plant and boiler blowdown) and a combined ‘dirty’ stream from the factory processes. The ‘dirty’ wastewater streams are combined in the farm tank (located at the factory) and pumped to the waste water treatment plant. Treated water is pumped back to the factory for re-use, while excess treated water is stored in dams for irrigation on the farm.

3.9 Packing plant (proposed)

It is proposed that dried gluten/starch will be pneumatically transferred from the existing site to the proposed new packing plant via underground pipes. This dried material is proposed to be stored in silos.

At present, the approved packing plant has not been constructed at the Shoalhaven Starches sites. The proposed packing plant was assessed by SEMA in 2015.

The packing plant will consist of seven silos that will store either gluten or starch product. The medium and large silos are to be filled 24 hours a day, seven days a week, while the small silos can be filled at any time of the day for eight hours.

3.10 Other activities

3.10.1 Product load-out areas

Starch, glucose and ethanol products are loaded into road tankers from bulk storage silos and tanks. Load out of starch and glucose does not have the potential to generate odours, as these products have a low inherent odour characteristic.

Given the flammable nature of ethanol, the load out process is strictly controlled for occupational health and safety purposes. These controls have the secondary effects of minimising the potential for vapour generation and spillage.

3.10.2 Cooling towers

Cooling towers operate as part of the cooling water circuit for the ethanol glucose and DDG plants. The recirculated cooling water has the potential to absorb odours and to disperse the odours to atmosphere during the evaporative cooling (aeration) process within the cooling towers. Odour sampling undertaken at the cooling towers observed a decline in odour emissions demonstrating relatively low odour emissions and it has since been removed as an EPL odour monitoring point. Manildra advised that the cooling towers are no longer a source of odour and therefore they were removed from the odour emissions inventory.

3.10.3 Biofilters

Exhaust air from odorous sources at the DDG plant is captured and ducted to two existing soil-bed biofilters, each having a surface area of 110 m^2, located at the southwest corner of the factory (on the southern margin of the container storage area – placed to the left lower margin in Figure 3.1). The biofilters comprise a bed of organic bark and compost material (the matrix), with distribution of the odorous airstream through the floor of the biofilter via a manifold. Biological oxidation of odorous compounds takes place as the foul air percolates upward through the matrix. The oxidation is achieved by a population of microorganisms in the bed.

While the efficiency of biofilters destroying odorous components of the waste air varies according to a range of factors including soil moisture, composition and temperature, it is very high. Any odour in the exhaust air from the biofilter is due to the inherent odour of the matrix materials and typically has an ‘earthy’ characteristic.

The two biofilters at the site operate in parallel and are sized so that one biofilter can be taken offline during periodic replacement of the matrix of the sister filter.

As such, a soil-bed biofilter operating as designed, with no malfunctions, will not vary significantly in its odour emissions; it will emit at the matrix background level independent of fluctuations in the input odour loading.

3.11 Proposed modifications

3.11.1 Mod 11, 12, 13, 16, 17 and 19

Modifications 11, 12 and 13 focused on changing the configuration of the DDG plant (to the southwest of the factory), changes to the ethanol distillery and modification to boilers 2 and 4. These modifications have been discussed in Section 1.2. The resulting air quality impacts have been addressed in GHD's previous quality assessments (GHD 2017).

Mod 16 focused on changing the configuration of the flour mill exhausts, conversion of gluten dryers 1 and 2 to starch, change to boiler 7's location, a new gluten dryer (no. 8) and a new coal-fired boiler (boiler 8). The resulting air quality impacts from Mod 16 have been addressed in GHD's previous air quality assessment (GHD, February 2019).

Mod 17 focused on changes to the baghouse (including the addition of a new stack) for starch dryer 5, addition of a new product dryer and use of sawmilling residue (woodchips) for boilers 2 and 4. The resulting air quality impacts from Mod 17 were assessed by GHD (2020).

Modification 19 is discussed in Section 1.3. The main changes affecting odour and air quality impacts consist of:

- Additions to the existing Ethanol Distillery Plant. The additional plant will be of a similar design, size and operation to the existing beverage grade ethanol modification approved under Mod 12.
- The construction of three (3) product silos above the existing interim packing plant.

Further discussion of these changes in the context of the dispersion modelling is presented in Section 7.

3.11.2 Mod 21

Modification 21 is discussed in Section 1.3. The main changes affecting odour and air quality impacts consist of:

- Modification of the packing plant layout. It is proposed to construct sixteen (16) smaller silos instead of the original 5 approved silos. However no change to total packing plant emissions is proposed.
- Installation of an additional raw waste water tank within the Environmental Farm. The proposed raw waste water tank would be equipped with a floating roof to prevent odour emissions. No additional odour emissions are anticipated.
- Increase to indirect cooking capacity by 50%. It is anticipated that this was result in a 50% increase in odour emissions from the glucose plant cooking.
- Installation of two additional fermenters (No. 18 and 19). It is understood the additional fermenters would be operated in batch mode to provide more fermenter redundancy for process upsets, fermenters cleans, etc. The overall throughput of the fermenters would not change and therefore no additional odour emissions are anticipated.

The proposal is expected to have a slight increase in odour impacts due to proposed increase in indirect cooking capacity and a neutral impact on combustion emissions compared against the previously modification (Mod 19).

Paper Size ISO A4

0 10 20 30 40 50 60

Metres

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

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Manildra Group Pty Ltd
Shoalhaven Starches

Project No. 12548374
Revision No. 0
Date 20 May 2021

Site layout and major odour sources

FIGURE 3.1

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Print date: 20 May 2021 - 12:26

Data source: General Topo: NSW LPI DTDB 2012. © Department of Customer Service 2020. Created by: kpsroba

3.12 Summary of odour controls

3.12.1 Odour control status

Manildra has a number of mandatory odour controls which were issued as part of Appendix 3 of Project Approval 06_0228. Table 3.1 provides a summary and the status of odour mitigation measures that have been implemented at the premise. These have been split into the following categories:

– Stage 1 Mandatory odour controls
– Stage 2 Additional odour controls
– Stage 3 Additional odour controls
– GHD odour audit 2007 key odour sources

The approximate odour reduction efficiency of key controls with sampling data are discussed in Section 3.12.2.

Table 3.1 Summary of odour controls

Reference number	Description	Control	Mandatory	Status
Stage 1 Mandatory odour controls				
1.1	Install and commission a bioscrubber or biofilter (full details of its design, location, size, capacity and output must be included in the Odour Management Plan).	Biofilter A	Yes	Installed 2009-2010
1.2	Duct high priority dry distillers grain plant (DDG) odour sources to the bioscrubber/biofilter. The odorous sources include the DDG liquids line, the DDG solid line, the DDG (liquids) plant concentrate tank, finisher feed tank and feed holding tank (syrup). These have been identified as sources with very unpleasant odour. It is proposed to increase the volume of foul process air from sources within the DDG dryer building to the boiler.	Biofilter / Boiler	Yes	Installed 2009-2010
1.3	The bioscrubber/biofilter must have sufficient capacity to eliminate the odour collected at the plant's ultimate production limit and/or be capable of being readily upgraded to meet the requirements of any other control works that require implementation in the future, for example any of the additional odour control measures listed below.	Biofilter B	Yes	Installed 2012
1.4	Install and commission a wastewater treatment plant at the Environmental Farm capable of processing the liquid waste streams from the factory at full approval capacity (full details of its design, location, capacity and output must be included in the Odour Management Plan).	WWTP	Yes	Installed 2009-2010
1.5	Install wet-legs on key odour sources that are not ducted to the bioscrubber at this stage. These sources include:			
	1.5.1 Farm tank (located near ethanol plant)	Wet-leg	Yes	Installed 2010-2011
	1.5.2 Ethanol plant Jet cooker retention tank "F7"	Wet-leg	Yes	Installed 2010-2011
	1.5.3 Glucose plant enzyme tank	Wet-leg	Yes	Installed 2010-2011
	1.5.4 DDG (solids) plant decanter feed tank	Wet-leg	Yes	Installed 2010-2011
1.6	Regularly clean all starch and gluten dryer ductwork to remove build up of solids that can become odorous	Maintenance	Yes	Complete

Reference number	Description	Control	Mandatory	Status
Stage 1 Mandatory odour controls				
1.7	Implement and maintain best practice standards for factory housekeeping in general and in particular the DDG plant grounds.	Housekeeping	Yes	Complete
1.8	Decommission designated odour sources as follows:			
	1.8.1 Ethanol plant cooling towers	NA	Yes	Completed 2010
	1.8.2 Kestner dryer exhaust at Starch plant	NA	Yes	Completed 2010
1.9	Install a ducting system in the DDG plant to collect odorous discharges from the sources listed in the GHD Report (October 2007) and direct them to at least 2 of the boilers. Existing connections from the non-condensables discharge fans and cyclone transfer fans must remain connected to the boilers.	Ducting and boilers	Yes	Installed 2010
1.10	Re-route the Palmer cooler discharge stack to at least 2 of the boilers.	Boilers	Yes	Complete 2010-2011
1.11	Install a ducting system to collect all odorous discharges nominated in the GHD Report (October 2007) for the evaporator plant area and direct them to a new bio-filter via a venturi scrubber and cyclone separator.	Scrubber and Biofilter	Yes	Installed 2009-2010
1.12	Modify the DDG load-out area in the following manner:			
	1.12.1 Extend the existing load-out awning to the south and fit each end of the shed with a motorised roller door configured such that at all times either the north or south door will be closed when a truck is loading DDG to prevent a wind tunnel effect and powder drifting out of the load-out area.	Enclosure	Yes	Completed 2010-2011
	1.12.3 Install the truck load-out chutes with Moduflex Bellow Feeders fitted with a dust extraction system to collect dust at the chute discharge and duct it to the bio-filter.	Extraction and biofilters	Yes	Installed 2010-2011
Stage 2 and 3 additional odour controls				
2.1	Duct medium priority odour sources to **bioscrubber**. These sources include:			
	2.1.1 Farm tank (located near ethanol plant)		Additional	Incomplete
	2.1.2 Ethanol plant Jet cooker retention tank “F7”		Additional	Incomplete
	2.1.3 Glucose plant enzyme tank		Additional	Incomplete
	2.1.4 Ethanol plant decanter feed tank (DDG1)	Ducted to Boilers	Additional	Complete
	2.1.5 Ethanol plant yeast propagators (tanks 1 to 5)		Additional	Incomplete
	2.1.6 DDG (liquid) plant vent condenser drain		Additional	Incomplete
	2.1.7 DDG (solids) plant decanters 1 and 4 and decanter feed	Ducted to Boilers	Additional	Complete
2.2	Duct low priority odour sources to bioscrubber. These sources include:			
	2.2.1 Residual emission from the DDG dryer building		Additional	Incomplete
	2.2.2 DDG (solids) plant load out shed		Additional	Incomplete
	2.2.3 Glucose plant drum vacuum receiver		Additional	Incomplete
	2.2.4 Distillery plant molecular sieve vacuum drum		Additional	Incomplete
	2.2.5 Ethanol plant jet cookers 1, 2 and 4		Additional	Incomplete

Reference number	Description	Control	Mandatory	Status
Stage 1 Mandatory odour controls				
	2.2.6 Glucose plant cooker A&B flash tanks		Additional	Incomplete
	2.2.7 DDG (liquids) plant light phase recovery tank		Additional	Incomplete
	2.2.8 Glucose plant ion exchange effluent tank		Additional	Incomplete
	2.2.9 Ethanol plant starch factory rejects collection tank		Additional	Incomplete
2.3	Duct individual starch and gluten dryer discharge points to common tall stack.		Additional	Incomplete
2.4	Pelletise DDG product.		Additional	Complete
GHD odour audit 2007 key odour sources				
DDG20	Evaporator Feed (dump) Tank	Capped and ducted to biofilter	Yes	Complete
DDG23	Condensate Tank		Yes	Complete
DDG24	Vent Condenser		Yes	Complete
DDG26	Finisher Feed Tank		Yes	Complete
DDG28	Finisher Pump Tank		Yes	Complete
DDG30	Dryer Feed Tank		Yes	Complete
DDG31	Syrup Holding tank		Yes	Complete
DDG32	CIP Tank		Yes	Complete
DDG34	Product Storage Shed Baghouse's		Yes	Complete
DDG35	Load Out Awning Discharge Chutes		Yes	Complete
DDG11, DDG12, DDG13	DDG Dryer No.1, No.2 & No.3 vents	Sources ducted to at least two boilers	Yes	Complete
DDG14	Cyclone Transfer Fans (x 3)		Yes	Complete
DDG16	Palmer Cooler Baghouse Stack		Yes	Complete
DDG18	Feeds Palmer Cooler Dryer Baghouse		Yes	Complete
-	Air Leakage Fans (x 3) off DDG Dryers (non-condensables discharge fans)		Yes	Complete
DDG1	Decanter Feed Tank		Additional	Complete
DDG2	Decanter No.1		Additional	Complete
DDG3	Decanter No.2		Additional	Complete
DDG4	Decanter No.3		Additional	Complete
DDG5	Decanter No.4		Additional	Complete
DDG7, DDG8, DDG9	Paddle Mixers on DDG Dryers No.1, No.2 & No.3		Additional	Complete
Starch (F18)	Farm Tank	Install wet-leg	Yes	Complete
Ethanol (E8)	Ethanol Jet Cooker retention tank F7		Yes	Complete
Glucose	Enzyme Tanks		Yes	Complete
DDG1	Decanter Feed Tank		Yes	Complete

3.12.2 Odour reduction efficiency

Data is provided below for the odour reduction efficiency for the key odour controls onsite:

– Biofilters – odour sources ducted to the biofilters for treatment include DDG truck loading chutes, DDG evaporator tanks/wet scrubber and DDG dryer 4.
– Two odour recovery scrubbers (one for the DDG dyers and one for the DDG evaporator plant) – odour sources treated by the wet scrubbers originate from the DDG drying plant and DDG evaporator plant.
– Boilers – odour sources ducted to the boilers for treatment include the palmer cooler and treated air from DDG wet scrubbers.

The biofilters and boilers are the ultimate odour controls that treat a majority of the captured odorous air onsite, and sampling has been conducted at various times to determine the odour reduction efficiency.

The latest biofilter odour sampling data is provided in Table 3.2. Based on biofilter inlet and outlet sampling data, the biofilters are currently removing about 71% of the total odours. A chart of biofilter sampling over time is provided in Figure 3.2.

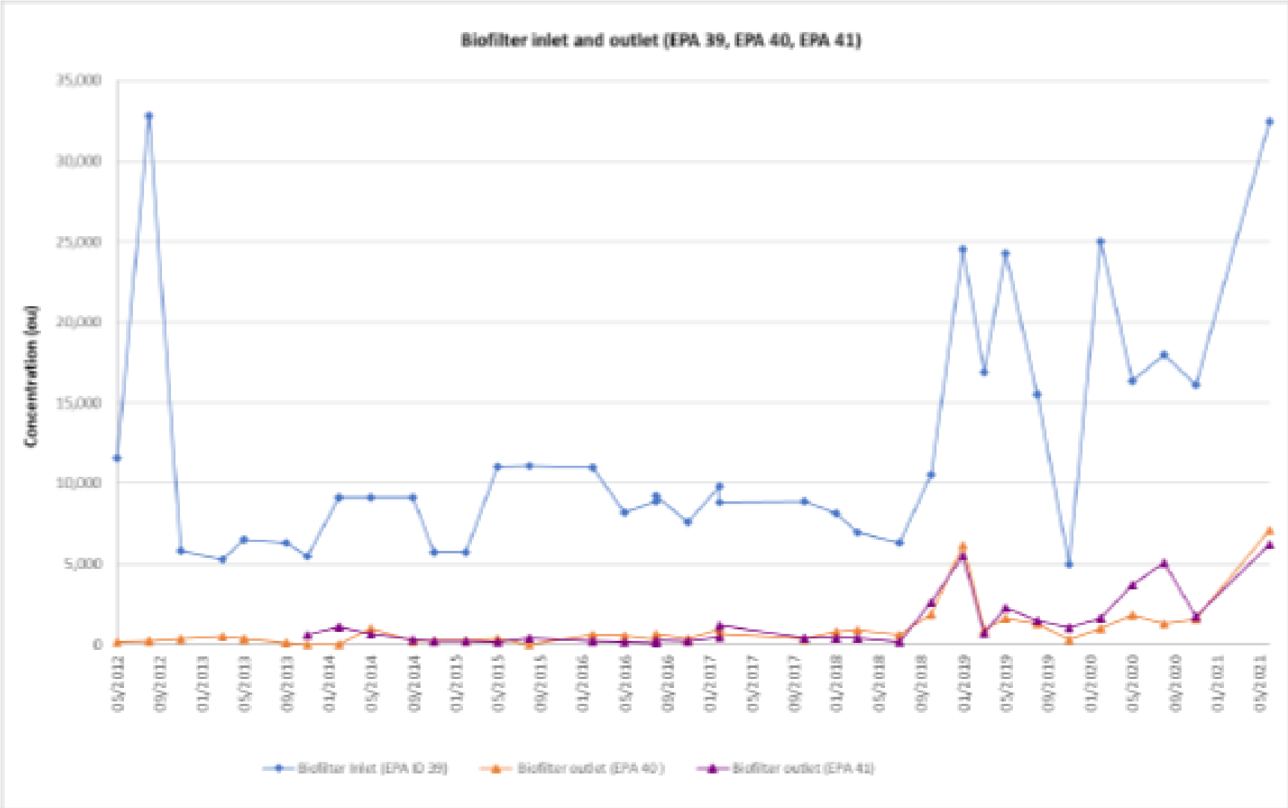
Prior to introduction of DDG dryer odour, the biofilters were operating at approximately 90% odour reduction. Investigations are underway to address this issue including installation of additional biofilter capacity.

Table 3.2 Biofilter odour inflow and outflows

Biofilter	Biofilter inlet[1]		Biofilter outlet[1]	
	Odour concentration and emission rate	**Odour character**	**Odour concentration and emission rate**	**Odour character**
Biofilter A	4,900 OU 16,167 OU/m^3/s	Bread, dough, yeast	East – 7,100 OU – 8,667 OU/m^3/s West – 8,100 OU – 8,500 OU/m^3/s Average – 7,600 OU – 8,584 OU/m^3/s	Yeast, vegemite
Biofilter B	60,000 OU 45,000 OU/m^3/s	Bread, dough, yeast	East – 6,200 OU – 7,667 OU/m^3/s West – 8,700 OU – 11,000 OU/m^3/s Average – 7,450 OU – 9,333 OU/m^3/s	Yeast, vegemite
Total	**61,167 OU/m^3/s**		**17,917 OU/m^3/s**	

[1] Biofilter inlet and outlet odour concentrations and characters were based on odour sampling data undertaken on 7/06/2021

Figure 9. Biofilters (EPA 39,40, 41)



Zero result represents Biofilter not available to be sampled for that event

Figure 3.2 ***Odour sampling results from biofilters (Source: Ektimo 2021)***

Available odour sampling data from sources ducted to boilers 5 and 6 for treatment are summarised in Table 3.3. A total odour emission rate of 229,349 OU/m^3/s is treated by boilers 5 and 6.

Table 3.3 ***Boiler 5/6 odour inflows***

Odours going to boiler	Odour concentration	Odour character
DDG Dryer 1 and 2 leakage	14000 OU (7/10/2021) 23,000 OU/m^3/s	Wet, grain, sweet
DDG Dryer 3 leakage	6200 OU (7/10/2021) 150,000 OU/m^3/s	Bread, wet, grain
DDG scrubber outlet	9120 OU (4/9/2014) 49,174 OU/m^3/s	Hessian, hay, fresh baked bread, coffee, chocolate, grease, menthol
Palmer cooler	1462 (28/5/2014) 7,175 OU/m^3/s	Hessian, grain, cereal, peanut butter, cooked vegetables, wheat tones, yeast
TOTAL	229,349 OU/m^3/s	

Review of last four available quarters of odour sampling data for boiler 5/6 is summarised in Table 3.4 and shown in Figure 3.3. Odour emissions from boiler 5 and 6 range from 15,500 to 71,745 OU/m^3/s depending on when the sampling occurred.

Table 3.4 *Boiler 5/6 odour outflows*[2]

Sampling quarter	Boiler 5/6 odour concentration	Odour character
Quarter 1 2021/2022	480 OU (8/06/2021) 15,500 $OU/m^3/s$	Sulfur, chlorine
Quarter 3 2020/2021	2200 OU (24/11/2020) 71,745 $OU/m^3/s$	Chlorine, acid, oil, burnt kerosene, swampy, natural gas
Quarter 2 2020/2021	2000 OU (12/8/2020) 66,000 $OU/m^3/s$	Damp, musty, car exhaust, sweet coal, steam train exhaust, septic, earth, wood, grain, plastic
Quarter 1 2020/2021	1000 OU (21/05/2020) 30,246 $OU/m^3/s$	Acetylene, disinfectant, plastic, paint, bleach, hydrochloric, chloride, ammonia, acid, swampy

Based on the available incoming and outgoing odour emission rate data, boiler 5/6 achieves an odour destruction performance that ranges from 69% to 93%, showing that treatment of odour via combustion in boilers is an effective odour control measure. The odour character of the odorous air being treated in the boiler changes significantly as well from the grain, yeasty odour character typical of the odour inflow sources to a more chlorine, acid or exhaust odour.

Based on the odour character of the boiler 5/6 odour samples, it is considered likely that odours from the boiler stacks comprise primarily of residual coal combustion odours and that very little of the odorous air ducted into the boilers for treatment is emitted via the boiler stack (i.e. a high portion of odour inflows are removed via combustion).

Figure 6. Combined Boiler 5 & 6 Stack (EPA 35)

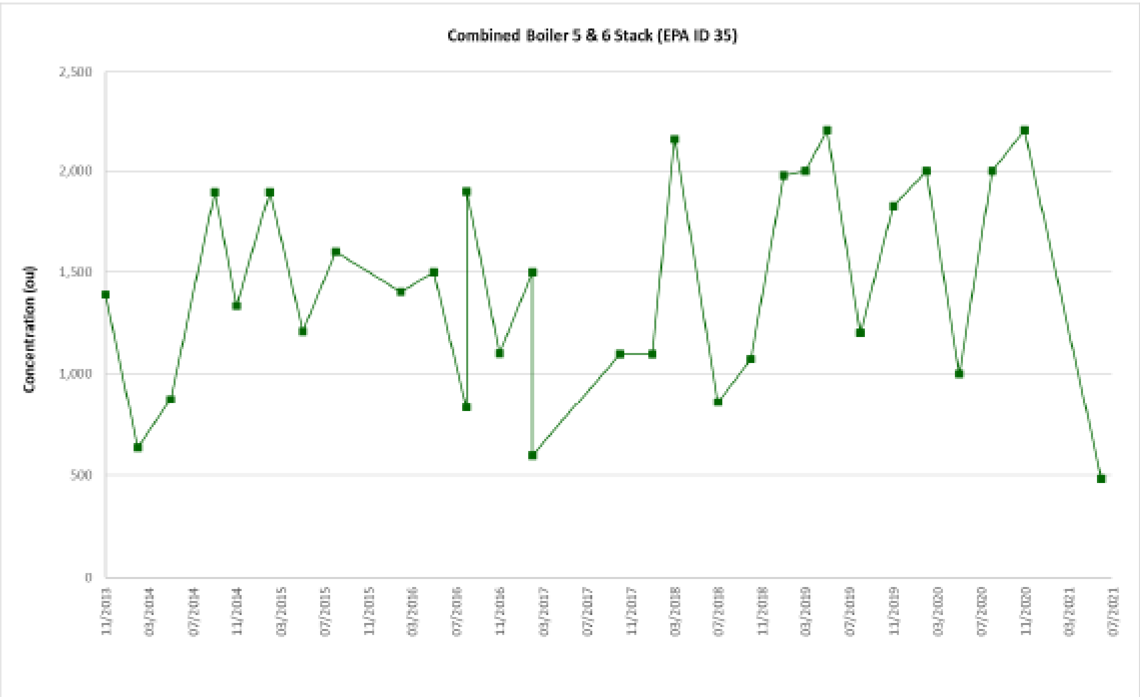


Figure 3.3 ***Odour sampling from boiler 5/6 (Source: Ektimo 2021)***

[2] It is noted that quarterly odour sampling was not undertaken for Quarter 4 2020/2021

4. Criteria for assessment

4.1 Odour

4.1.1 Odour Concentration

Odour 'strength' or concentration is measured in odour units (OU), where 1 OU represents the concentration of a sample that can just be detected by 50% of people in a controlled situation where there is no background ‘ambient‘ odour.

4.1.2 Measurement of Odour

The most common method of measuring odour concentration is Dynamic Olfactometry using the ‘forced choice’ method. Dynamic olfactometry simply dilutes the odour sample in known ratios with odour free air. At each dilution, the diluted odour and a zero odour is presented in turn to six panellists via two ‘sniffing’ ports. Further, the selection of the port with the diluted odour sample is randomly reassigned at each presentation. Each panellist is required (forced) to nominate the port (left or right) from which the diluted odour emanates. Each panellist’s response (i.e. 'guess', 'likely' or 'certain') is recorded. The sequence of presentations generally follows a decreasing dilution ratio, and when half of the panellists have correctly returned a ‘certain’ response, that dilution ratio is numerically equal to the concentration of the original, undiluted odour sample. Hence, for example, if the dilution needed to get the 50% response was 250:1, then by definition the original sample had an odour concentration of 250 OU.

4.1.3 EPA Criterion for Odour

EPA has defined an odour criterion and the Odour Guideline specifies how it 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:

The **F**requency of the exposure

The **I**ntensity of the odour

The **D**uration of the odour episodes

The **O**ffensiveness of the odour

The **L**ocation of the source

These factors are often referred to as the FIDOL factors.

DEC defined the odour criterion to take account of two of these factors (**F** is set at 99 percentile, **I** is set at from 2 to 7 OU). The choice of criterion odour level has also been made to be dependent on the population of the affected area, and to some extent it could be said that population is a surrogate for location – so that the **L** factor has also been considered. The relationship between the criterion odour level **C** to affected population **P** is given below.

$$C = [\log P - 4.5] \div -0.6 \qquad \text{Equation 1}$$

Table 4.1 lists the values of C for various values of affected populations as obtained using equation 1.

Table 4.1 Odour criterion for the assessment of odour

Population of affected community	Odour performance criteria (nose response odour certainty units at 99th percentile)
Single Residence (≤ ~2)	7
~ 10	6
~ 30	5

Population of affected community	Odour performance criteria (nose response odour certainty units at 99th percentile)
~ 125	4
~ 150	3
Urban (~2,000)	2

The NSW Approved Methods specifies a criterion of two odour units at the 99th percentile over a short term averaging nose-response time of one second for a complex mixture of odorous air pollutants in an urban area (population greater than 2000 or with schools and hospitals). The criterion is applied at the location of the nearest sensitive receptor or likely future location of sensitive receptor.

5 OU is commonly taken as a conservative measure of the odour level which can be distinguished against the ambient background level of odour, and which if offensive, could result in complaint.

1 OU generally cannot be detected in a non-laboratory situation (i.e. where the ambient background odour levels reduce the detectability of a given odorant).

As the CALPUFF dispersion model (utilised in this assessment), when operating in micrometeorological mode can only predict concentrations over an averaging period of one hour, a ratio between the one second peak concentration and 60 minute average concentration has been applied to the source odour emission rates. In this manner, the predicted one hour odour levels predicted in CALPUFF represent the corresponding one second short-term levels required to be compared to the DEC criterion. The ratio is known as the peak to mean ratio (PM60). PM60 is a function of source type, stability category and range (i.e. near or far-field), and values are tabulated in the modelling Guideline[3]. This is reproduced in Figure 4.1.

Table 6.1: Factors for estimating peak concentrations in flat terrain (Katestone Scientific 1995 and 1998)

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

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

Figure 4.1 Factors for estimating peak concentrations (Extract from NSW Approved Methods)

4.1.4 Other air quality impacts

Potential non-odorous air quality impacts from the site include dust and products of combustion. The following pollutants have been assessed against relevant criteria:

– Total suspended particles (TSP)
– Fine particulate matter less than 10 micron equivalent aerodynamic diameter (PM_{10})
– Fine particulate matter less than 2.5 micron equivalent aerodynamic diameter ($PM_{2.5}$)
– Products of combustion including carbon monoxide, oxides of nitrogen (NOx), sulfur dioxide (SO2), hydrogen chloride (HCL), heavy metals (Type I & II), total volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAHs) and hydrogen fluoride (HF).

[3] Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005).

The air quality impact assessment criteria for these pollutants has been sourced from the Approved Methods and is summarised in Table 4.2.

Table 4.2 Air quality impact assessment criteria – other pollutants

Pollutant	Averaging period	Percentile	Criterion
Particulate Matter PM_{10}	24 hours	100^{th}	50 µg/m^3
	Annual	100^{th}	25 µg/m^3
Particulate Matter $PM_{2.5}$	24 hours	100^{th}	25 µg/m^3
	Annual	100^{th}	8 µg/m^3
TSP	Annual	100^{th}	90 µg/m^3
Carbon monoxide (CO)	15 minutes	100^{th}	100 mg/m^3
	1 hour	100^{th}	30 mg/m^3
	8 hours	100^{th}	10 mg/m^3
Sulfur dioxide (SO_2)	10 minutes	100^{th}	712 µg/m^3
	1 hour	100^{th}	570 µg/m^3
	24 hours	100^{th}	228 µg/m^3
Nitrogen dioxide (NO_2)	1 hour	100^{th}	246 µg/m^3
	Annual	100^{th}	62 µg/m^3
Hydrogen fluoride (HF)	90 days	100^{th}	0.25 µg/m^3
	30 days	100^{th}	0.4 µg/m^3
	7 days	100^{th}	0.8 µg/m^3
	24 hours	100^{th}	1.5 µg/m^3
Hydrogen Chloride (HCL)	1 hour	99.9^{th}	0.14 mg/m^3
Polycyclic aromatic hydrocarbon (PAH)	1 hour	99.9^{th}	0.0004 mg/m^3
Type 1 metals			
Antimony	1 hour	99.9^{th}	0.009 mg/m^3
Arsenic	1 hour	99.9^{th}	0.00009 mg/m^3
Cadmium	1 hour	99.9^{th}	0.000018 mg/m^3
Lead	Annual	100^{th}	0.5 µg/m^3
Mercury	1 hour	99.9^{th}	0.0018 mg/m^3
Type 2 metals			
Beryllium	1 hour	99.9^{th}	0.000004 mg/m^3
Chromium	1 hour	99.9^{th}	0.00009 mg/m^3
Manganese	1 hour	99.9^{th}	0.018 mg/ m^3
Nickel	1 hour	99.9^{th}	0.00018 mg/ m^3

5. Meteorological data

5.1 Overview

A 12-month dataset was constructed using the 3D prognostic modelling package, TAPM and the diagnostic 3D meteorological model, CALMET for the period from January to December 2004. This 12 month period was chosen to be consistent with previous modelling undertaken for the 2008 Air Quality Assessment, approved at the time by EPA and to allow to a direct comparison to previous modelling. Further detail is provided in Appendix A in regards to the selection and construction of the meteorological dataset used in the modelling.

5.2 Meteorological modelling

The CALMET modelling can be summarised as follows:

– Prognostic models TAPM and CALMET were used for initial wind field 'guesses'
– Observations from both the environmental farm Automatic Weather Station (AWS) and Nowra AWS were used to optimise and check the prognostic model simulations
– Wind speeds and direction observations from the environmental farm AWS were assimilated into the prognostic model to make the data site-specific

The result of assimilating this data into the CALMET simulations makes the data site-specific (required for a Level 2 assessment), and inter-annual variability is not required to be accounted for, with the conditions of the Approved Methods met for using "*at least one-year of site-specific meteorological data*".

An annual wind rose generated using CALMET is provided in Figure 5.1 to show the wind field at the factory. The following trends are evident from Figure 5.1:

– Annual average wind speed of 3.2 m/s
– Winds are most prevalent from the west and west northwest, accounting for around one third of all winds
– Winds are least prevalent along the north-south axis
– Light winds (shown in grey) are more prevalent from the northwest
– Drainage flows occurring during stable conditions at night time are dominated by the following distinct features (in order of scale):
  - Shoalhaven River running west to east through the site
  - Browns Mountains to the northwest of the site
  - Yalwal State Forest mountain range to the west.

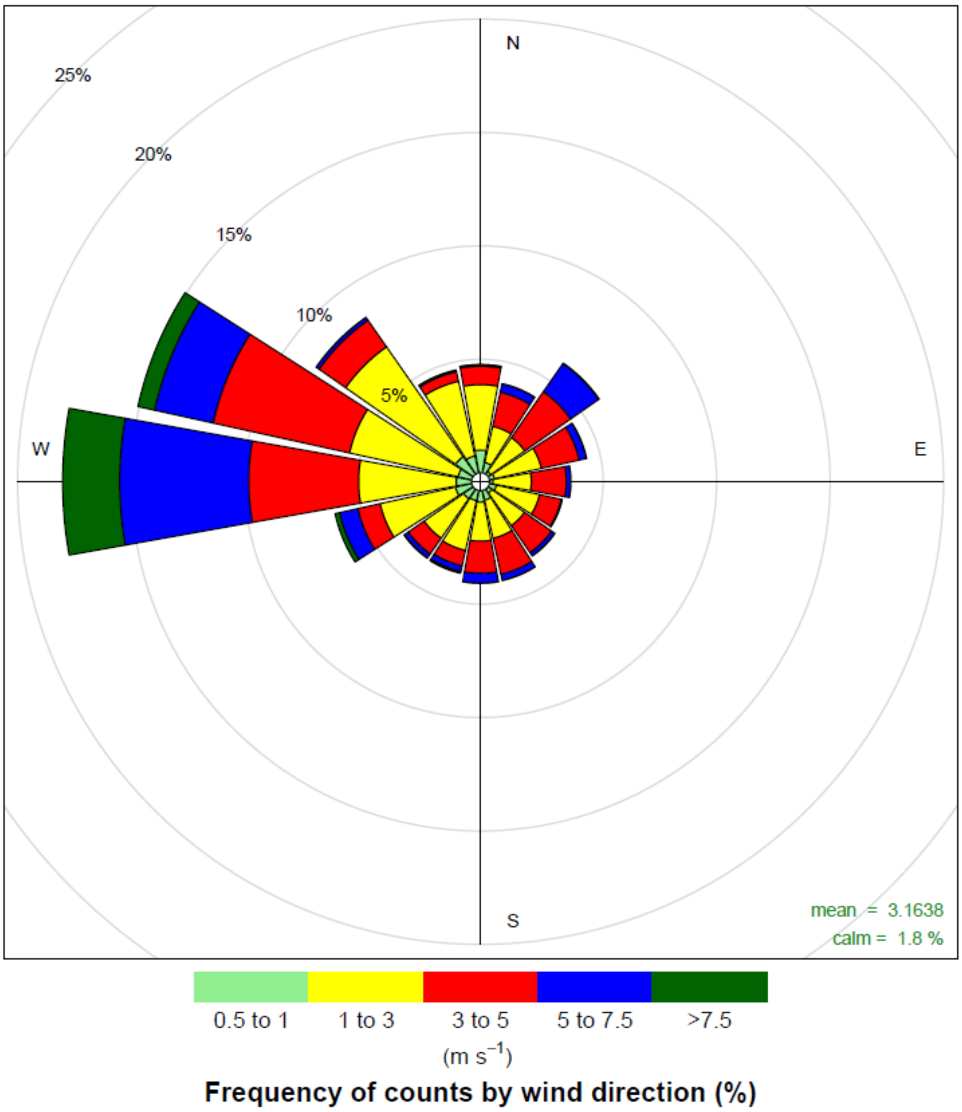


Figure 5.1 CALMET wind rose for the factory

5.2.1 Representative year discussion

GHD has undertaken an analysis of more recent measured meteorological data from the Shoalhaven Starches site, in order to determine if the existing EPA approved model would still be considered representative, given the age of the meteorological data. Figure 5.2 below shows annual wind roses for the site for both 2004 CALMET data (the data used in this assessment) and available site observations (dated from 29/04/2019 to 26/05/2020). The following comments are provided regarding the representativeness and suitability of 2004 CALMET data for use in this assessment:

– General wind pattern alignment between observations and modelled meteorological conditions is considered acceptable. Both wind roses show winds are predominantly from the west and have an even spread of winds from the south and east. The more recent observations have a lower percentage of winds occurring from the north compared to the modelling data. Consequently, the modelling data may be over predicting impacts to the south, (i.e. potential to result in less impact at R3 located to the south of the site which is the worst case receptor in terms of odour)

– Changing the meteorological file used in modelling will not enable a direct comparison of changes at the site between modifications. Recalibration of the baseline model (running original 2008 Air Quality assessment model with new meteorological file) would be required to meaningfully compare the relative change in impacts of each modification.

– Currently, only a limited site-specific meteorological dataset exists. While the comparison of this observed dataset shows good general alignment with the modelled meteorological conditions, it is recommended that site based meteorology be reviewed at the end of 2021 or when there is a sufficient number of years available for representative analysis. Currently, insufficient quantity of data is available to conduct a representative year analysis and therefore the alignment of observations against meteorological trends over longer timeframes cannot be assessed.

Based on this review GHD finds the 2004 meteorological dataset used in the assessment appropriate for use in this assessment.

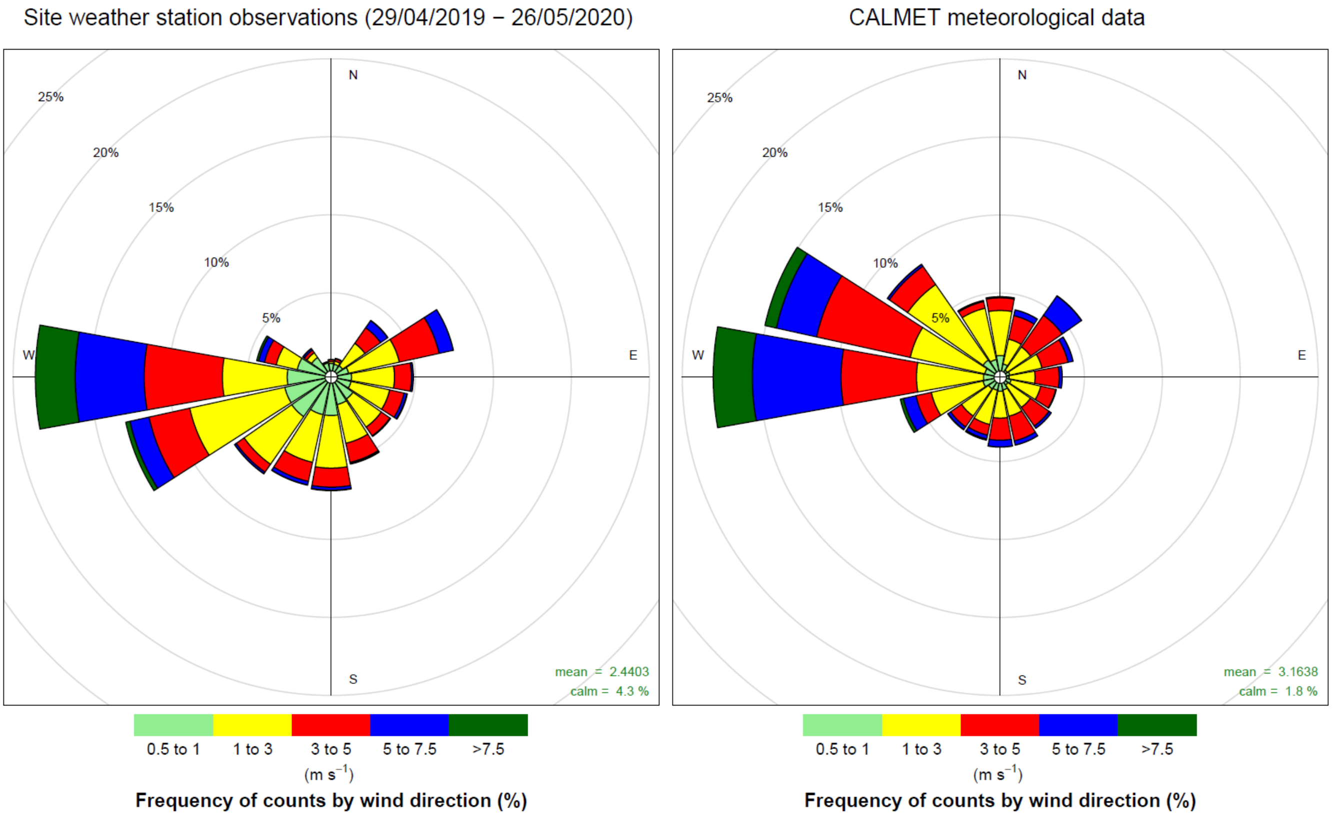


Figure 5.2 ***Comparison of site weather station observations and CALMET meteorological***

6. Background air quality

6.1 Background data

The Department of Planning, Industry and Environment (DPIE) operate a state wide air quality monitoring network, with the nearest monitoring site to Shoalhaven Starches being the Albion Park South station located approximately 34 km northeast of the site, followed by the Kembla Grange station located approximately 46 km northeast of the site, followed by the Wollongong station located approximately 54 km northeast of the site.

Use of background data from the closest DPIE monitoring station(s) was prioritised where sufficient data was available (stations prioritised in order from Albion Park South to Kembla Grange to Wollongong).

A contemporaneous assessment approach was adopted to assess PM_{10}, $PM_{2.5}$ and NO_2 (NO_2 was assessed using Method 2 from the Approved Methods). Albion Park South commenced operation in 2005 meaning that contemporaneous data was not available for comparison to the GHD CALPUFF model of the site which uses meteorology from 2004. Therefore, contemporaneous 24 hour average variable PM_{10} and $PM_{2.5}$ data was sourced from Wollongong station (insufficient data from Kembla Grange) and contemporaneous one hour average NO_2 and O_3 data was sourced from Kembla Grange station.

Previous modification assessments from Mod 13 (GHD, 2018) onwards utilised the following background data:

– Data from the Albion Park South station for the 2016 calendar year:
  - 1 hour, 24 hour and annual averaged SO_2 data for use in the cumulative assessment
  - 70th percentile PM_{10} and $PM_{2.5}$ data for graphically plotting only (refer Figure 8.2 and Figure 8.3, 70th percentile concentrations were considered a reasonable representation of ambient PM_{10} and $PM_{2.5}$ concentrations)

– Data from the Wollongong station for the 2016 calendar year:
  - 1 hour and 8 hour averaged CO data for use in the cumulative assessment (it is noted that CO predictions are orders of magnitude below the assessment criteria therefore no further investigation regards background CO concentrations was undertaken).

For consistency purposes to allow meaningful comparison between modifications, the same 2016 Albion Park South data was adopted for this assessment. As part of this assessment, GHD reviewed the most recent calendar year of SO_2 data (01/01/2020-01/01/2021) and noted that background 1 hour average SO_2 concentrations were that same as those recorded in 2016 while background 24 hour and annual SO_2 concentrations had both decreased. Therefore use of background 2016 data was considered conservative. Additionally, it is noted that particulate levels in recent years (particularly in 2019 to 2020) were not considered representative of typical concentrations due to elevated levels cause by bushfires and therefore GHD did not update the 70th percentile data used for plotting purposes.

Background levels of SO_2, CO and 70th percentile PM_{10} and $PM_{2.5}$ used in the assessment are provided in Table 6.1.

Table 6.1 Background Air Quality Data – Albion Park South (2016)

Pollutant	Averaging Period	Concentration [4]	Units
Sulfur dioxide (SO_2)	1 hour	57.6	µg/m^3
	24 hour	15.7	
	Annual	1.6	
Carbon monoxide (CO)[5]	1 hour	1.0	mg/m^3
	8 hour	0.6	
PM_{10}	24 hours	43.2	

[4] Values are 100th percentile, except where stated as 70th percentile for PM_{10} and $PM_{2.5}$
[5] CO was sourced from the Wollongong monitoring station as this was not available at Albion Park South

Pollutant	Averaging Period	Concentration [4]	Units
	70^{th} percentile 24 hour average	18.3	$\mu g/m^3$
	Annual	14.9	
$PM_{2.5}$	24 hours	30.7	$\mu g/m^3$
	70^{th} percentile 24 hour average	8.0	
	Annual	7.2	

The contemporaneous particulate assessment was undertaken using data from Wollongong in 2004. A review of particulate levels at Wollongong and Albion Park is provided in Table 6.2. Average particulate levels at Wollongong have reduced from 2004 to 2016. Levels at Albion Park South in 2016 are lower than the levels at Wollongong over the same period. Therefore use of contemporaneous 2004 PM_{10} and $PM_{2.5}$ data from Wollongong is likely conservative as background concentrations have decreased over time (shown via comparison of 2004 Wollongong data to 2016 Wollongong data) and concentrations in Wollongong are higher than those closer to the site (shown via comparison of 2016 Wollongong to 2016 Albion Park data).

Table 6.2 Review of particulate monitoring at Albion Park South and Wollongong, $\mu g/m^3$

Site and Year	Albion Park 2016	Wollongong 2016	Wollongong 2004
Average PM_{10}	14.9	17.3	25.5
70^{th} percentile PM_{10}	18.3	20.7	28.8
90^{th} percentile PM_{10}	25.6	29.7	37.8
Average $PM_{2.5}$	7.2	7.4	9.7
70^{th} percentile $PM_{2.5}$	8.0	8.3	12.2
90^{th} percentile $PM_{2.5}$	11.2	11.6	16.4

Shoalhaven Starches engaged Stephenson Environmental Management Australia to conduct targeted background ambient air quality monitoring at 26 Coomea Street, Bomaderry over four seasons. (AMBIENT AIR QUALITY MONITORING –SUMMARY REPORT 2015-2016, Stephenson Environmental Management Australia, April 2016). The maximum measured levels of pollutants measured over the monitoring periods with a 24 hour averaging period were:

– SO_2 – 10.2 $\mu g/m^3$

– NO_2 – 54.5 $\mu g/m^3$

– PM_{10} – 28.1 $\mu g/m^3$

The results show all pollutants are significantly lower than the levels recorded at Albion Park South, and would include any emissions from the Shoalhaven Starches site. The maximum levels all readily comply with the relevant criteria. Using the background SO_2 and CO data from the Albion Park South monitoring station in this assessment allows for additional conservatism.

The results show all pollutants are significantly lower than the levels recorded at Albion Park South, and would include any emissions from the Shoalhaven Starches site. The maximum levels all readily comply with the relevant criteria. Using the background SO_2 and CO data from the Albion Park South monitoring station in this assessment allows for additional conservatism.

6.2 Odour complaint history

GHD has undertaken a review of the site's odour complaint history over the last five years. The number of odour complaints per calendar year in the last 5 years is shown on Figure 6.1.

A summary of the odour complaint review is included below in Table 6.3 and it includes:

– Nature of the complaints including odour character and if it was reported as offensive
– The reported cause of the odour complaint (if identified)
– Any follow up actions taken by Shoalhaven Starches to address the odour complaint
– The ethanol production rate on the day of the odour complaint compared against the average ethanol production rate is shown on Figure 6.2. This was included to gain an understanding if site throughputs were significantly higher than the average on the day of the complaint.
– The complaint address has not been provided in this public report.

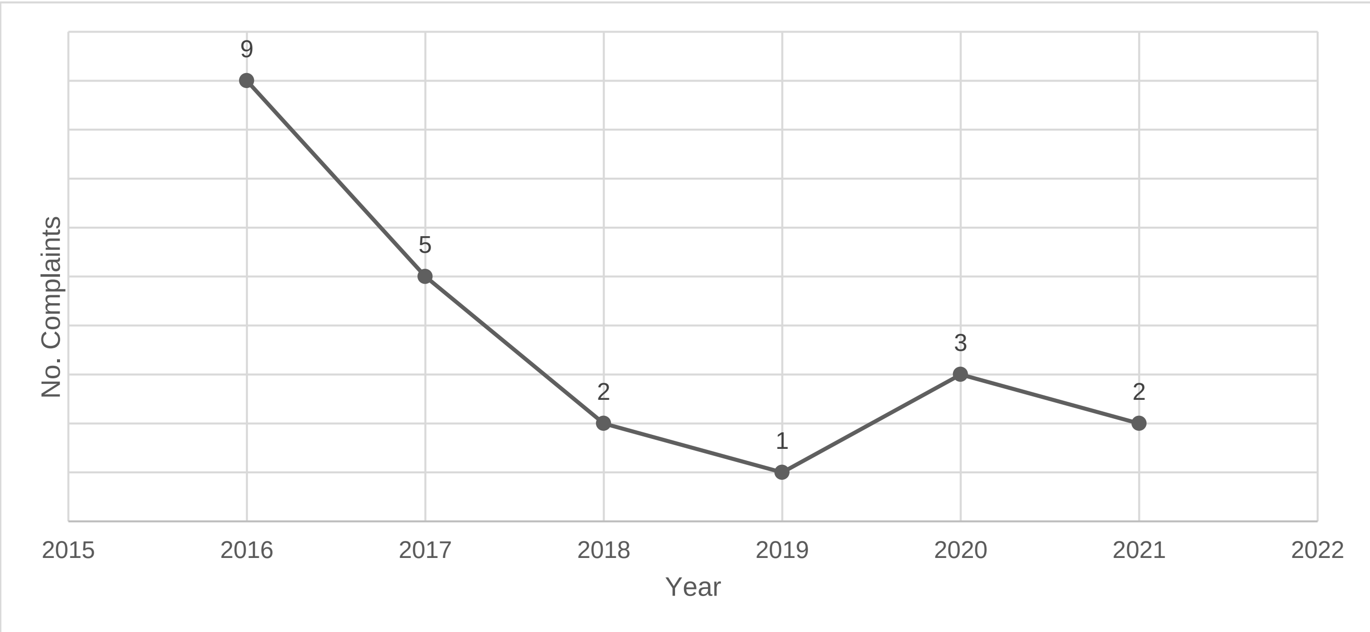


Figure 6.1 Number of odour complaints per calendar year in the last 5 years

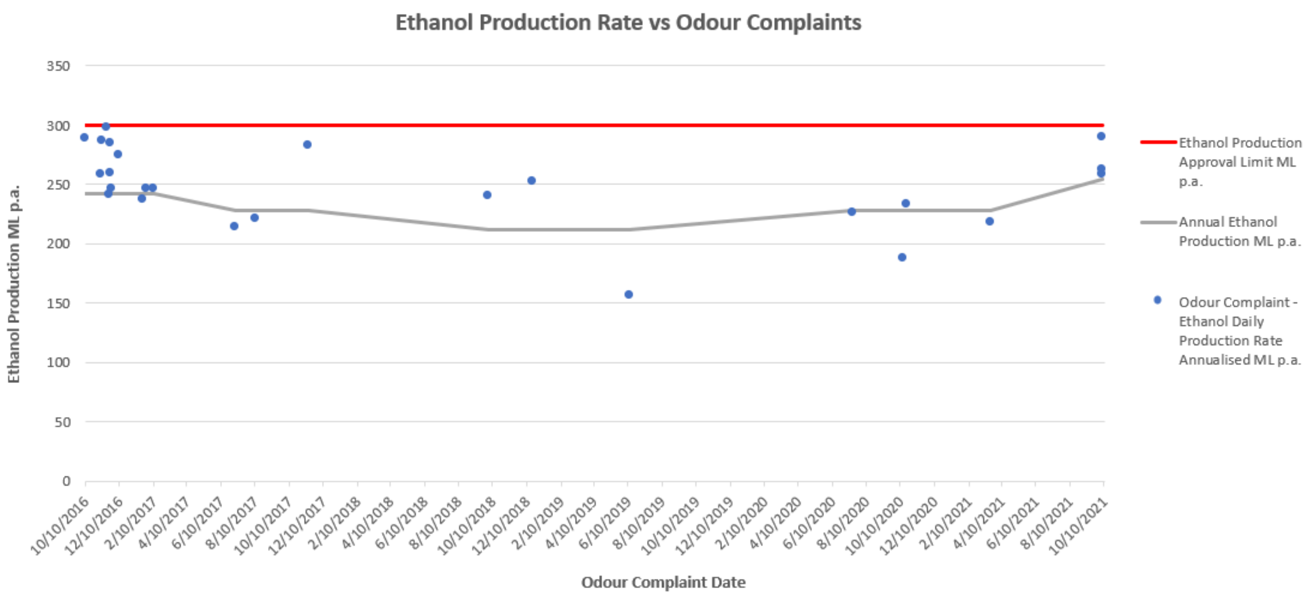


Figure 6.2 Ethanol production rate compared against odour complaints

6.2.1 Community engagement

Further to actively following up and addressing odour complaints, Shoalhaven Starches has a history of undertaking community consultation and engagement activities. This includes guest speaker roles to local community organisations which inform the community of the company's operations including any new developments. An overview of these organisations is presented in Appendix B.

Shoalhaven Starches also provides a Shoalhaven Starches Community Newsletter which is distributed to approximately 30,000 homes in the Bomaderry/Nowra region. The newsletter outlines the activities and projects ongoing at the Shoalhaven Starches site and can be access online[6].

In addition, a number of notification letters have been distributed to nearby affected residents on upcoming development on site. e.g. North Packing Plant, Gas Pipeline project.

Shoalhaven Starches ran a community consultation committee however this no longer operates due to the dramatic decrease in odour complaints received and lack of interest from its previous members.

[6] Newsletter available online at https://www.manildra.com.au/shoalhaven-starches-newsletter

Table 6.3 Summary of odour complaints in last 5 years

Date and time	Complaint location and wind direction	Complaint and odour character	Cause	Follow up action	Ethanol Production (ML)	Attributed to Shoalhaven Starches?
7:00 10-10-2016	4.2 km North and still weather conditions (NNE at 0-5km/hr).	Strong ‘yeasty’ odour. Permeated the residence and was extremely intrusive.	Still weather conditions may have contributed to the odour (DDG) travelling further than normal due to poor dispersion.	Complaint location was visited at 10:00 and revealed no detectable odour. NE winds had strengthened. A check of factory odour controls appeared to be operating correctly.	Annual average: 242 Annualised production on day of complaint: 289	Inconclusive
18:30 7-11-2016	1-3 km NW and wind direction from SE.	Very bad sour odour coming from the waste water treatment at Shoalhaven Starches.	Unknown. Unlikely to be attributed to the Shoalhaven Starches Environmental Farm based on SE wind direction; any odours would be directed North of Bomaderry towards Meroo Meadow.	Environmental Farm operations and odour checks around WWTP revealed no sour odours. Noted that Bomaderry Sewage Treatment Plant has recently spread biosolids out to dry which had strong ‘sewage’ odour which could be detected in Meroo St Bomaderry. The factory operations and odour recovery systems were operating as normal.	Annual average: 242 Annualised production on day of complaint: 258	No
12:30 8-11-2016	1.8 km NW and wind direction from SE.	Yeasty odour.	Described as yeasty odour which is consistent with the DDG plant odours. The wind direction would direct any factory odours toward the complaint location.	A ‘DDG’ odour was detected near the Bomaderry Bowling Club area which disappeared when travelling west along Cambewarra Rd downwind from the Factory. No odour could be detected at around 14:00 near the complaint location. All factory odour recovery systems were operating correctly at the time of complaint.	Annual average: 242 Annualised production on day of complaint: 256	Yes
5:45-8:15 18-11-2016	1-3 km NW and still weather conditions (wind variable at 0-4 km/hr)	Offensive odour described as a sickly sweet, hot starchy cooking odour coming from Shoalhaven Starches.	Unknown. Unlikely to be from the factory starch dryers as the discharge air is passed through a wet scrubber and the odour concentrations are low. Poor odour dispersion with still weather conditions at the time of the complaint may have been a contributing factor.	A check of all odour controls and plant operating conditions were operating as normal. At the time of receiving the complaint (14:12), no factory odours could be detected in the Bomaderry area, noting the wind had strengthened. There was a strong ‘sewage’ odour on Meroo St, then a slight DDG odour in the lower part of	Annual average: 242 Annualised production on day of complaint: 298	Inconclusive

Date and time	Complaint location and wind direction	Complaint and odour character	Cause	Follow up action	Ethanol Production (ML)	Attributed to Shoalhaven Starches?
				Meroo St on the day of the complaint.		
21-11-2016 (no time nominated)	2.4 km NW and slight breeze from the east in the morning.	Offensive chemical odour from the Manildra Group.	Unknown.	No plant odours detected around Bomaderry, Nowra and Terara area at approximately 15:30. Wind at this time was moderate from NE direction. All odour recovery points were operating satisfactorily apart from those identified as requiring action. General 'DDG' odour emanating from the plant was considered normal. Inspection and maintenance of various equipment was raised as job requested in the maintenance system.	Annual average: 242 Annualised production on day of complaint: 241	Inconclusive
24-11-2016	1 km NW and no breeze.	Sweet sickening odour complaint. Believes odour has become worse since previous years. Same as below, complaint received via the EPA.	Unknown. Possibly fugitive DDG odours from the DDG plant, however this could not be confirmed as no odours could be detected at the complainants locations by the time the complaint was received.	Inspection of Bomaderry area downwind (SE) of the factory at midday revealed a faint 'DDG' odour at Karowa St which disappeared travelling further away from the plant. No odours detected at complaint location. All odour recovery controls were operating as normal at the time of the complaint.	Annual average: 242 Annualised production on days of complaint: 284	Inconclusive
25-11-2016	1 km NW and no breeze.	Sweet sickening odour complaint. Believes odour has become worse since previous years. Same as above, complaint received directly.	Unknown. Possibly fugitive DDG odours from the DDG plant, however this could not be confirmed as no odours could be detected at the complainants locations by the time the complaint was received.	Inspection of Bomaderry area downwind (SE) of the factory at midday revealed a faint 'DDG' odour at Karowa St which disappeared travelling further away from the plant. No odours detected at complaint location. All odour recovery controls were operating as normal at the time of the complaint.	Annual average: 242 Annualised production on days of complaint: 259	Inconclusive
14:49 27-11-2016	1 km WSW	Strong odour from the plant over the last couple of months.	Unknown.	A drive around the complainants location on 29-11-2016 at 15:00 during light to moderate ESE wind (downwind), could not detect any factory odours.	Annual average: 242 Annualised production on	Inconclusive

Date and time	Complaint location and wind direction	Complaint and odour character	Cause	Follow up action	Ethanol Production (ML)	Attributed to Shoalhaven Starches?
					day of complaint: 247	
11:58 10-12-2016	1-3 km NW and light and variable wind in the early morning, which strengthened from the ESE to ENE from 10:00 onwards.	Strong odour and white flakey ash possibly coming from Manildra. Consistent with increased odour from Manildra and is worse on weekends.	Unknown.	Check of plant systems, processes and maintenance records revealed no baghouse issues over the weekend. No factory odours detected on 12-12-2016 in the afternoon near the Bomaderry Bowling Club downwind from the plant. On 13-12-2016 in the morning the wind direction was SE and no factory odours present through Bomaderry.	Annual average: 242 Annualised production on day of complaint: 274	Inconclusive
21-1-2017 00:50 and 27-1-2017 12:22	No location specified. Light SE winds in the morning, ENE in the afternoon.	First complaint described bad foot odour or dog poo smell. Second complaint described a vomit smell.	Complaint received from EPA on 3-2-2017. Due to delay in receiving complaint it is difficult to determine if the odour source is likely to be from the factory or from the Bomaderry Sewage Treatment Plant (STP) which was undergoing upgrade works including removal of sludge from the ponds.	Investigation confirmed that the plant was operating as normal with all factory odour controls operating correctly at the time of the complaints. Pond 4 cover was intact and odour checks do not identify Pond 4 as the source of the odour complaints.	Annual average: 242 Annualised production on days of complaints: 237 and 246	Inconclusive / No
14:00 10-2-2017	1 km NW and no wind.	Sweet, sickly, cooking odour.	Likely DDG odour based on description. Extremely hot and humid weather conditions with no wind creating poor odour dispersion may be a contributing factor.	No factory odours detected around complainant location in the afternoon, noting that at this time wind had strengthened from an ESE direction (downwind from the factory). All factory odour controls and plant operating conditions at the time of the complaint were operating as normal.	Annual average: 242 Annualised production on day of complaint: 246	Yes
5-7-2017	11 km East. No wind direction specified.	Strong odour like an off yeast smell. Occurred very early morning and evenings for 4-5 months. Odour was much stronger at night and was worse since the upgrade.	Unknown. Potential DDG odour.	No process upsets or unusual operations over the last few months. The odour recovery systems were operating as designed. On occasion a thermal gradient flows off the Cambewarra	Annual average: 228 Annualised production on day of complaint: 213	Inconclusive / Yes

Date and time	Complaint location and wind direction	Complaint and odour character	Cause	Follow up action	Ethanol Production (ML)	Attributed to Shoalhaven Starches?
				Range which flows into the Shoalhaven River creating a light thermal drift that flows along the river and out to sea during the night-time period. During these weather conditions the odour from the factory may travel further than usual along the river due to poor dispersion. Detailed engineering review of the DDG odour recovery systems on-site to review their effectiveness and identify opportunities for improvement commenced.		
8:00 12-8-2017	8.8 km East and moderate West winds in the early morning. Light SE winds from 8-10am, before strengthening and returning to a west direction.	Offensive and putrid smell.	Based on the wind direction at the time of the complaint and the nature of the odour described it is unlikely the Shoalhaven Starches Farm operations was the cause of this odour complaint.	The Farm WWTP was operating as normal, there were no silage activities at the time and the Pond and BVF covers were intact.	Annual average: 228 Annualised production on day of complaint: 221	No
19:00 13-11-2017	<1 km NW. No wind direction specified.	Very strong ammonia odour noted as an ongoing problem.	Most likely source was the Bomaderry STP and associated construction works.	Follow-up observations have detected odour emanating from the STP which is of a different character compared to the usual sewage type smell. May be attributed to current STP upgrade works or excavations of biosolids.	Annual average: 228 Annualised production on day of complaint: 283	No
2-10-2018	No location or wind direction specified.	Odour similar to Manildra wastewater pond smell.	Odour most likely caused by biosolids spread out from the Bomaderry STP.	A drive around the factory and Environmental Farm could not detect any offensive odours. Travelling along Railway St and Meroo St a strong sewage/ammonia type smell could be detected. The odour was traced back to an area adjacent to the Bomaderry STP which had recently spread out pond biosolids.	Annual average: 212 Annualised production on day of complaint: 240	No

Date and time	Complaint location and wind direction	Complaint and odour character	Cause	Follow up action	Ethanol Production (ML)	Attributed to Shoalhaven Starches?
16:00 20-12-2018	No location specified. Light ENE winds at 12:30-14:30 which then turned to a SE direction at around 15:30.	Odour complaint described as 'gassy'.	Unknown. Unlikely to be attributed to Shoalhaven Starches as odour detected is unusual/different to typical odours from the Shoalhaven Starches factory.	Inspection around the Bomaderry area revealed a faint DDG odour downwind of the plant (light to moderate SE wind). A 'gassy' or unusual odour described by the complainant could not be detected. Another inspection on 21-12-2018 further west downwind from the plant revealed no odours detected typical of Shoalhaven Starches operations, however another unusual odour was detected which could be described as a 'rotting/garbage' type smell.	Annual average: 212 Annualised production on day of complaint: 252	No
13:00 14-6-2019	5 km NE and light to moderate westerly winds.	Pungent odour which comes and foes and appears the be coming from the Manildra Farm.	Unknown.	Survey of complainant's location at 14:00 on 14-6-2019 could not identify any odour as described. Inspection of the Environmental Farm did not reveal any unusual or abnormal odours.	Annual average: 212 Annualised production on day of complaint: 156	Inconclusive
15:00 16-7-2020	3.5 km SW. No wind direction specified.	Electrical, acrid smell that also smelled similar to a combination of yeast and smoke. Did smell like the same type of smoke as a house wood fire. Odour was noticeable at night when there were strong winds blowing towards the complainant from the direction of premises. Friends of the complainant in Bomaderry also experienced this same odour.	Unknown.	No likely cause identified. No odours on site typically described as electrical, acrid or smoke-like. Odours associated with the premises are typically described as vegemite/yeasty odours. Odour recovery controls were reviewed and were operating as normal around the time of the complaint.	Annual average: 228 Annualised production on day of complaint: 226	Inconclusive
16-10-2020	1-3 km West. No wind direction specified.	Varying odour that can smell like vegemite, methylated spirits, baking cakes, and rotten eggs. Predominantly affected during SE winds and in the mornings and nights. Ongoing issue for past 8 years. Also affected by a 'black carbon	Unknown. Still weather conditions being more frequent in the morning and night creating poor odour dispersion is a potential cause of stronger odours. Potential sources of black powder emissions from the	Email response to EPA which specified no changes in processes during the morning and nights that would produce stronger odours compared to the daytime, and included ambient air quality monitoring conducted in	Annual average: 228 Annualised production on day of complaint: 187	Inconclusive / Yes

Date and time	Complaint location and wind direction	Complaint and odour character	Cause	Follow up action	Ethanol Production (ML)	Attributed to Shoalhaven Starches?
		powder' which is sticky and difficult to remove.	premises include the coal stockpiles and the coal-fired boilers.	Bomaderry over four quarters during 2015-2016.		
14:15 22-10-2020	1.5 km West.	Odour comes and goes, and is more pronounced during the mornings.	Unknown. Odour may be more pronounce during the early mornings during calm/still weather conditions resulting in poor odour dispersion.	A drive around the Bomaderry area at 14:30 22-10-2020 detected a very faint 'DDG' odour downwind of the plant, which could not be detected when travelling toward the complainant's location. A review of the factory's odour/treatment systems at the time of the complaint were noted to be operating as normal.	Annual average: 228 Annualised production on day of complaint: 233	Inconclusive
16:00 22-3-2021	<1 km NW. Light wind from ESE direction, downwind from the plant.	Fermenter/yeasty odour.	Unknown. Based on the description, possibly the DDG or ethanol fermentation plant odour.	A drive around the complainant location identified a slight DDG type odour. The site's odour/treatment systems at the time of the complaint were noted to be operating as normal.	Annual average: 228 Annualised production on day of complaint: 218	Inconclusive / Yes
6-10-2021 to 8-10-2021	1-3 km NW.	'Cheesy whey smell' detected on the evening of 6-10-2021 which persisted for the next 2 days.	The likely cause of the odour was not coming from the Shoalhaven Starches premises but from local farmers applying fertiliser on their land.	A drive around the complainant's location on the afternoon of 11-10-2021 did not reveal any detected odours as described, noting however the complaint was not received by Shoalhaven Starches until 5 days after the odour was detected. Description of odour was not consistent which the odours typically associated with the Shoalhaven Starches operations.	Annual average: 254 Annualised production on days of complaint: 290, 258 and 262	No

7. Odour assessment

7.1 Approach

Odour sampling is conducted quarterly at Shoalhaven Starches, with varying results due to site conditions at the time of sampling, and the inherent variability and errors involved in odour sampling and olfactometry. The quarter with the overall highest site odour emission rate is chosen for modelling in order to predict a general worst-case of potential odour impacts from the site.

Conservatively, sources with different odour characteristics are all included in the cumulative odour model including sources with offensive odour (such as the DDG Plant, Ethanol Plant, Distillery, Biofilters and Farm) and sources with odour not observed to be offensive (such as Starch & Glucose dryers, Boilers and Packing Plant).

Odour sampling quarter 2 was found to have the highest overall odour profile in the last year, however the highest contributors in this quarter were:

- Biofilters A and B (odour emissions increased by 358% and 426% respectively compared to Mod 19 – refer Section 7.1.1)
- Ethanol Recovery Scrubber Discharge (odour emissions increased by 25% compared to Mod 19)
- Gluten dryers 3 and 4 and Starch dryer 3 (odour emissions increased by 152%, 120% and 79% respectively compared to Mod 19)

These sources increased substantially compared to the previous values used in Mod 19, although site operations have not significantly changed and there is no general trend of increases over time, other than this one high quarter. Therefore, these increases are attributed to natural variances in the sampling methodology.

While it is important to see how these high odour sources influence off-site odour impacts, the increase in predicted odour impacts is not a result of Mod 21 and highlights potential areas for improvements in odour control.

In order to demonstrate that the site is not increasing odour impacts the following modelling methodology has been undertaken:

- Quarter with maximum odour emissions modelled (in accordance with the methodology adopted for past modification air quality assessments) (Quarter 2) (Q2)
- Most recent quarter (Quarter 3) (Q3) modelled to demonstrate that latest site odour footprint has not increased compared to Mod 19

Proposed changes in Mod 21 will have a negligible impact on the total site odour emission rate. Based upon the above review, the following changes in Section 7.1.1 are identified outside of Mod 21 that Shoalhaven Starches should investigate to reduce odour emissions as part of the modification.

7.1.1 Additional recommended odour mitigation

A review of the biofilter sampling over the last seven years has shown a large increase in odour beginning in quarter 2 of 2018-19 (refer to Figure 7.1 for a review of biofilter outlet odour concentrations). This corresponds with Shoalhaven Starches directing odorous air from DDG Dryer 4 (DDG4) (flow rate of 1300 m^3/h) to the biofilters. There have also been some spikes in measurements during periods when biofilter media was changed and they were being stabilised. It is anticipated that odorous air from DDG4 is contributing to overloading the biofilters and consequently resulting in higher than expected odour emissions from the biofilters.

In order to reduce odours from the existing biofilters to concentrations expected of a well performing biofilter, Shoalhaven Starches propose to install additional approved biofilter capacity. The biofilter would be located in the previously approved location next to biofilters A and B which will result in improved odour performance and would be capable of treating a higher volume of odorous air.

This upgrade is to be done concurrently with Mod 21. Implementation of the upgrade is anticipated to reduce biofilter odour concentrations to levels observed prior to the diversion of odorous air from DDG4. Therefore, odour concentrations from biofilter sampling undertaken prior to the diversion of odorous air from DDG4 have been used in this assessment. Biofilter odour concentrations from quarter 4 of 2017-2018 was selected for use in this assessment (669.3 OU) as this was the highest measured biofilter outlet value (highest quarterly value for the average of biofilters A and B outlets) in the year before odorous air from DDG4 was diverted to the biofilter.

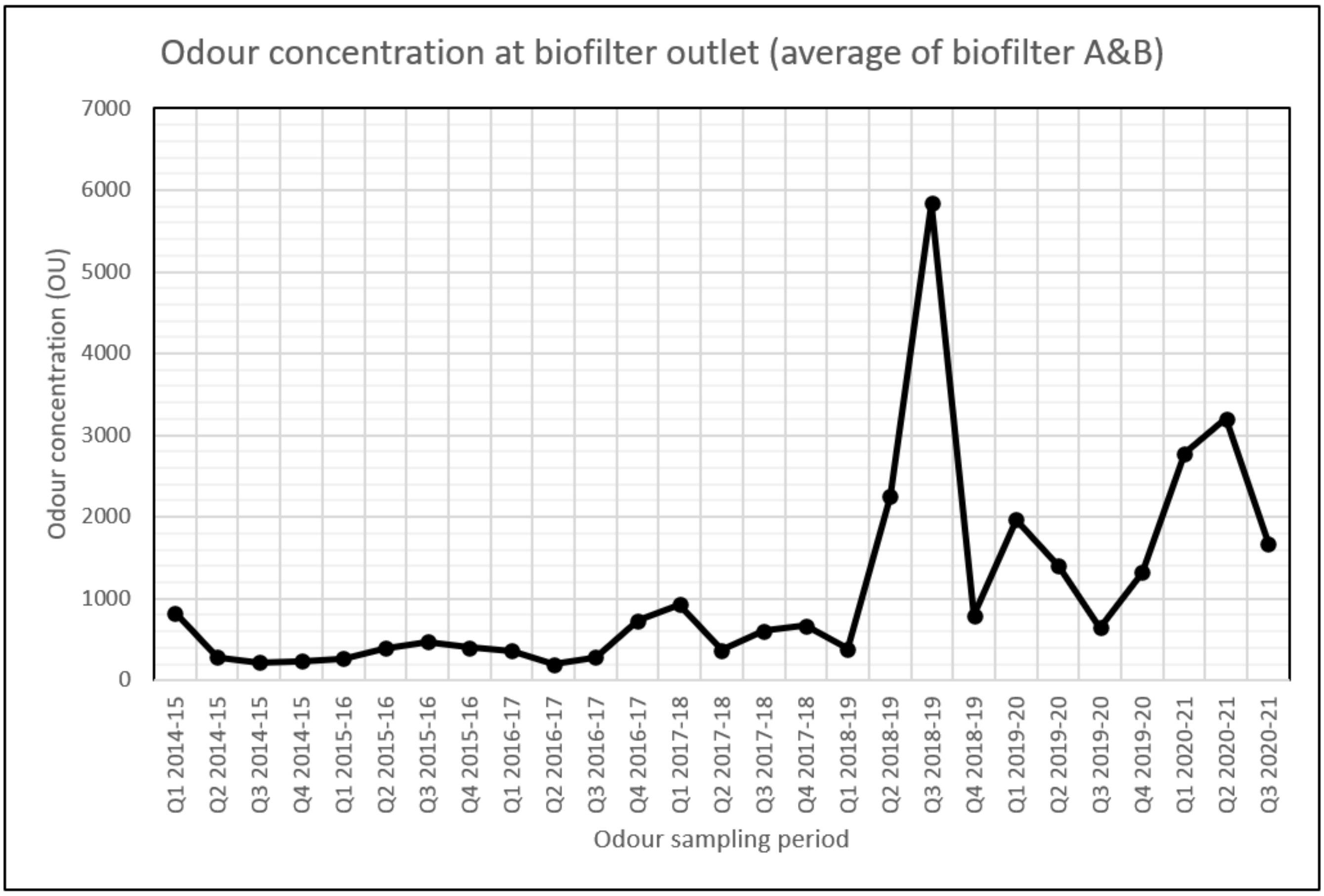


Figure 7.1 Review of biofilter outlet odour concentrations (average of biofilter A and B)

7.2 Emissions inventory

7.2.1 Source identification

Odour emanating from Shoalhaven Starches is comprised of a complex mixture of primarily odorous volatile organic compounds (VOCs). VOC speciation data from a range of principal odour sources indicates that the individual VOCs within the mixture tend to be classified under odour-based air quality criteria rather than toxicity-based[7] criteria. Therefore, the identified sources of odour are modelled collectively as odour.

Consistent with the previous air quality assessments, the following sources contribute to the majority of the odour impacts from the Shoalhaven Starches sites:

– DDG Plant (including Pellet Plant exhaust stack and biofilters)
– Starch Plant (Gluten and Starch Dryers)
– Ethanol Plant (yeast propagators and retention tank).

A number of other minor odour sources contribute to the remainder of the plant's odour impact. These are detailed in Appendix C.

[7] Based on VOC speciation data for selected sources in the DDG plant: DDG dryers, palmer cooler and condensate tanks.

7.2.2 Changes to baseline odour model

The baseline odour model includes all existing and proposed odour sources at the Shoalhaven Starches plant, including EPA monitored sources and all minor sources, up to Mod 19. The odour sources associated with these modifications have been discussed in depth in previous air quality assessments.

The following assumptions and additional changes were made to the baseline odour model:

– Peak odour emission rates were sourced from the odour monitoring conducted by SEMA in the previous four quarters for EPA ID sources. The sources were scaled to an ethanol production rate of 300 ML per year production. The quarter with the maximum measured total OER was selected for use in the assessment and is consistent with guidance in the Approved Methods and the recommendation from EPA (16 February 2017) that peak emissions should be assessed. The peak period was found to be quarter 2, 2020 (August 2020).
– The exit velocities and temperatures for EPA ID sources were adjusted to the modelled quarter. These measurements include the mitigation modifications made to No. 3 and No. 4 gluten dryer exhausts as part of the Mod 11 and 12 air quality assessment recommendations.
– No. 1 and No. 2 gluten dryers were proposed to be modified to starch dryers as part of 16 assessment. Therefore, the emission rates assigned to these dryers remains unchanged from the Mod 16 assessment as the dryers have not been modified yet.
– Mod 16 assessed the addition of a new gluten dryer (GD8). The emission rates assumed in Mod 16 remain unchanged as the dryer has not been constructed yet.
– Mod 17 assessed the addition of a new product dryer (No. 9) (PD9), which is planned to be installed within the speciality products building. The product dryer will comprise about 20% of the size and production capacity of the approved (but not yet constructed) Gluten Dryer 8. It is envisaged that Product Dryer 9 will be used on an interim basis to process gluten allowing for an incremental increase in processing of gluten until the approved product dryer building is constructed and gluten dryer 8 is operational.
– Once gluten dryer 8 is operational, it is envisaged that product dryer 9 will revert to processing starch. PD9 will not result in any increase in production above the current approval limit for flour processing under Mod 16 of 25,400 tonnes per week.
– For the purposes of odour modelling, as part of Mod 17, PD9 was modelled as processing gluten with odour emission rates conservatively modelled as per gluten dryer 1 (which is of a similar size). The stack from the dryer will rise above and through the roof of the speciality product building at a height of 35.6 m. The diameter of the stack is proposed to be 0.85 m. The flow rates were calculated based on 20% of the proposed gluten dryer 8.
– As part of the Mod 19 proposal, a new distillation plant (with columns and associated processing equipment) is proposed to be installed immediately to the west of the existing Ethanol Distillery Plant. One additional emission source associated with this change is the new Distillation plant Column Washing Vent (CWV2), which is a duplication of the existing source (CWV). The stack height of the new source as provided by Manildra, is 55 metres tall. Stack diameter, exit velocity and temperature were sourced from the sampling report for the similar existing source (*Odour Research Laboratories Australia (2020) Olfactometry Test Report for Beverage Ethanol D500 Vent Report No. 7091/ORLA/01)*.
– Cooling tower odours are not included in the Mod 19 emissions inventory based on improvements at the site and subsequently being removed as a EPL odour sampling point
– As part of the current proposal (Mod 21), the following changes were made:
  - Increased indirect cooking facility odour emissions by 50%.
  - Odour concentrations from the upgraded biofilters A and B were estimated based on sampling from quarter 4 of 2017-2018. A biofilter outlet odour concentration of 669.3 OU was adopted. This was the highest measured biofilter outlet value (highest quarterly value for the average of biofilters A and B outlets) in the year before odorous air from DDG4 was diverted to the biofilter.
– Odour emission rates were assumed to be unchanged for the other emission sources.

7.2.3 Source summary and comparison

Modelling for the proposed Mod 21 scenario comprised the following sources:

– 67 point sources in total throughout the site;
  - 63 point sources with constant emissions
  - Four point sources with variable emissions
– 11 area sources (consisting of two biofilters and the effluent treatment ponds)
– Five volume sources within the factory area.
– These sources are detailed in Table 7.1 and Appendix C.

A comparison of the sources between Mod 13, Mod 16, Mod 17, Mod 19 and the current modification is provided in Table 7.1. This shows that the total odour levels:

– Increased by approximately 9% between the previous (Mod 19) and current modification (Mod 21) based on quarter 2 odour sampling
– Decreased by approximately 15% between the previous (Mod 19) and current modification (Mod 21) based on quarter 3 odour sampling

Table 7.1 Comparison of odour emissions from previous mods to current mod

Source	Model Reference	MOER OU.m^3/s (Mod 13)	MOER OU.m^3/s (Mod 16)	Modelled Mod 17 MOER OU.m^3/s	Modelled Mod 19 MOER OU.m^3/s	Modelled Mod 21 MOER OU.m^3/s	
						Q2	Q3
Boilerhouse							
Boiler no 2	BOILR2	-	-	-	12,677	8,309	7,025
Boiler no 4	BOILR4	3,171	5,666	22,077	27,988	37,247	29,207
Boiler no 5 & 6	BOILR5	38,463	43,711	68,610	88,902	94,550	102,780
Sub total MOER		**41,634**	**49,377**	**90,687**	**129,567**	**140,106**	**139,013**
% of total MOER		**15.0%**	**18.3%**	**23.8%**	**29.9%**	**29.7%**	**37.9%**
DDG Plant							
Condenser drain	VCD	31	31	31	4,419	4,419	4,419
DDG tent storage area	DDG36	1,929	1,929	1,929	1,929	1,929	1,929
Product storage sheds	DDG34	1,023	1,023	1,023	1,023	1,023	1,023
Light phase tank	DDG19	20	20	20	74	74	74
Cooling towers	DDG46	172	172	172	-	0	0
DDG Loadout Shed Awning	DDG35	923	923	923	923	923	923
Pellet exhaust stack	PPES	38,240	31,544	88,073	67,000	84,100	40,442
Pellet silo	S12	350	350	350	350	350	350
Stillage surge tank	SST	149	149	149	173	173	173
Pellet plant fugitives (non-DDG sources)	PPF	5,771	5,771	5,771	5,771	5,771	5,771
Additional Cooling towers	CTP	172	172	172	-	0	0
Sub total MOER		**48,780**	**42,084**	**98,613**	**81,661**	**98,761**	**55,103**
% of total MOER		**17.5%**	**15.6%**	**25.9%**	**18.9%**	**20.9%**	**15.0%**
Ethanol Plant							
Yeast Propagators -tanks 4 and 5	YP45	820	820	820	820	820	820
Grain retention tank	GRT	3,250	3,250	3,250	4,535	4,535	4,535
Ethanol recovery scrubber	ERESC	3,132	10,660	15,405	33,091	41,258	15,198

Source	Model Reference	MOER OU.m^3/s (Mod 13)	MOER OU.m^3/s (Mod 16)	Modelled Mod 17 MOER OU.m^3/s	Modelled Mod 19 MOER OU.m^3/s	Modelled Mod 21 MOER OU.m^3/s	
						Q2	Q3
Fermenters 10-16	FERM	2,668	3,298	795	2,500	2,000	2,804
Jet cooker 1 retention tank	E13	1,067	1,067	1,067	1,067	1,067	1,067
Jet cooker 2/4 grain retention	E7	567	567	567	567	851	851
Feed to distillery	E22	83	83	83	83	83	83
Sub total MOER		**11,587**	**19,745**	**21,987**	**42,663**	**50,613**	**25,358**
% of total MOER		**4.2%**	**7.3%**	**5.8%**	**9.9%**	**10.7%**	**6.9%**
Distillery							
Incondensable gases vent	D6	558	558	558	558	558	558
Molec. sieve vacuum drum	D2	1,350	1,350	1,350	1,350	1,350	1,350
Column Washing Vent	CWV	23	25	27	1,399	1,218	1,218
Distillation plant Column Washing Vent	CWV2				1,399	1,218	1,218
Sub total MOER		**1,931**	**1,933**	**1,935**	**4,707**	**4,344**	**4,344**
% of total MOER		**0.7%**	**0.7%**	**0.5%**	**1.1%**	**1.0%**	**1.0%**
Starch and Glucose							
Flour mill A Exhaust	A4	679	679	679	679	679	679
Flour mill A Exhaust	A5	96	96	96	96	96	96
Flour mill A Exhaust	A6	449	449	449	449	449	449
Flour mill A Exhaust	A7	932	932	932	932	932	932
Drum vac receiver	C4	1,400	1,400	1,400	1,400	1,400	1,400
Dry gluten roof bin	S07	4,500	4,500	4,500	4,500	4,500	4,500
Enzyme tanks	B7	2,042	2,042	2,042	2,042	2,042	2,042
Flash vessel jet cooker	C1	970	970	970	970	970	970
Flour bin aspirator	S13A	500	500	500	500	500	500
Flourbin aspirator	S13B	500	500	500	500	500	500
Flourbin motor drive	S06	283	283	283	283	283	283
Flour mill aspiration (Mod 8)	FMP1	266	205	205	205	205	205

Source	Model Reference	MOER OU.m³/s (Mod 13)	MOER OU.m³/s (Mod 16)	Modelled Mod 17 MOER OU.m³/s	Modelled Mod 19 MOER OU.m³/s	Modelled Mod 21 MOER OU.m³/s	
						Q2	Q3
Flour mill aspiration (Mod 8)	FMP2	205	266	266	266	266	266
High protein dust collector	S08	600	600	600	600	600	600
Ion exchange effluent tank	C18	250	250	250	250	250	250
No 1 gluten dryer baghouse	S02	5,925	5,166	5,166	9,800	9,800	7,136
No 1 starch dryer	S01	5,193	5,193	11,316	2,800	3,200	6,358
No 2 gluten/starch dryer	S04	2,354	5,166	5,166	7,200	6,000	3,362
No 3 gluten dryer baghouse	S03	58,917	29,036	21,696	12,700	32,000	11,540
No 3 starch dryer	S18	1,663	5,166	5,166	3,800	6,800	1,942
No 4 gluten dryer baghouse	S05	31,222	22,433	13,693	9,100	20,000	9,768
No 4 starch dryer	S19	1,824	4,008	5,020	3,600	2,500	1,848
No 5 ring dryer gluten/starch	SDR5	4,817	4,817	4,817	4,350	4,625	3,378
No 5 starch dryer (existing)	SD5C	6,800	6,800	3,393	4,931	2,123	3,172
No 5 starch dryer (new stack)	SD5N	-	-	17,387	25,269	10,877	16,256
No 6 gluten dryer	GD6	12,568	12,568	12,568	12,568	12,568	12,568
No 7 gluten dryer	GD7	9,553	9,553	9,553	9,553	9,553	9,553
Spray dryer	S20	738	738	738	738	738	738
Starch factory rejects	E10	183	183	183	183	183	183
Farm tank	F18	3,834	3,834	3,834	3,833	3,833	3,833
Pellet mill silo	PMFS	173	173	173	173	173	173
Flour Mill B Exhaust	FMBA to FMBM	5,637	4,621	4,621	3,621	3,621	3,621
Flour Mill C Exhaust	FMC1 to FMC3	n/a	1,658	1,658	1,560	1,560	1,560
Gluten dryer No.8	GD8	n/a	12,568	12,568	12,568	12,568	12,568
Product dryer 9	PD9	n/a	n/a	5,166	9,800	9,800	7,136
Sub total MOER		**165,073**	**147,353**	**157,553**	**151,819**	**166,194**	**130,365**
% of total MOER		**59.3%**	**54.7%**	**41.3%**	**35.1%**	**35.2%**	**35.6%**

Source	Model Reference	MOER OU.m³/s (Mod 13)	MOER OU.m³/s (Mod 16)	Modelled Mod 17 MOER OU.m³/s	Modelled Mod 19 MOER OU.m³/s	Modelled Mod 21 MOER OU.m³/s	
						Q2	Q3
Packing Plant (Not constructed)							
Starch silo 1	PPL1	86	86	86	86	86	86
Starch silo 2	PPL2	86	86	86	86	86	86
Gluten silo 1	PPM1	173	173	173	173	173	173
Gluten silo 2	PPM2	173	173	173	173	173	173
Gluten silo 3	PPM3	173	173	173	173	173	173
Small gluten silo	PPS1	92	92	92	92	92	92
Small starch silo	PPS2	35	35	35	35	35	35
Sub total MOER		**818**	**818**	**818**	**818**	**818**	**818**
% of total MOER		**0.3%**	**0.3%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**
Area sources: Environmental farm after WWTP							
Biofilter A (additional capacity to be installed as part of Mod 21)	BIO1	440	1,408	1,386	502	1,307	1,239
Biofilter B (additional capacity to be installed as part of Mod 21)	BIO2	330	803	1,111	1,648	1,208	1,187
Biofilter C	BIO3	1,089	1,089	1,089	1,089	1,089	1,307
Biofilter D	BIO4	1,280	1,280	1,280	1,280	1,281	1,208
Storage dam 1	PO1	148	71	119	1,475	948	948
Storage dam 2	PO2	1,656	248	143	973	687	687
Storage dam 3	PO3	192	569	1,231	2,962	1,626	1,626
Storage dam 5	PO5	515	971	1,922	6,538	1,248	1,248
Storage dam 6	PO6	1,775	1,435	793	3,097	1,435	1,435
Sulfur oxidisation basin	SOBAS	830	349	535	1,939	489	489
Membrane bio-reactor	MBR	62	62	62	54	54	54
Sub total MOER		**8,317**	**8,286**	**9,671**	**21,557**	**11,372**	**11,429**
% of total MOER		**3.0%**	**3.1%**	**2.5%**	**5.0%**	**2.4%**	**3.1%**
Total (Mod 11 and Mod 12)		**278,140**					

Source	Model Reference	MOER OU.m^3/s (Mod 13)	MOER OU.m^3/s (Mod 16)	Modelled Mod 17 MOER OU.m^3/s	Modelled Mod 19 MOER OU.m^3/s	Modelled Mod 21 MOER OU.m^3/s	
						Q2	Q3
Total (Mod 16)			**269,595**				
Total (Mod 17)				**381,265**			
Total (Mod 19)					**432,792**		
Total (Mod 21)						**472,208**	**366,428**

7.3 Dispersion modelling

The odour dispersion modelling was conducted using the Gaussian puff model CALPUFF Version 7. This model is also a recognised regulatory model in NSW. Where the modelling of odour dispersion is in complex terrain (as is the case at the Shoalhaven site), CALPUFF is recommended for use under NSW Guidelines. CALPUFF is especially suited for modelling light to calm wind conditions.

The following settings were used in the simulations:

- Model: CALPUFF Version 7
- The receptor grid was 10 km x 10 km, with a 200 m grid resolution
- The nearest receptors from the townships of Bomaderry (to the west) and Nowra (to the south) were used as sensitive receptors, along with a few isolated residences around the factory and environmental farm
- Ground level receptor heights have been modelled using the same terrain data as the original 2008 GHD assessment. This terrain data was used in the CALMET 2004 model which is used for CALPUFF modelling
- Emissions were scaled based on a nose-response time for odour of one second, applying a peak-to-mean ratio to the one hour average concentration of 2.3 for wake affected point sources and volume sources, and variable scaling for non-wake affected sources and area sources
- Meteorology was taken from the CALMET 2004 synthesised dataset, approved for use in previous studies
- Building wake effects (including changes to the building layouts) were modelled to the extent practicable.

7.4 Predicted odour impacts

Table 7.2 and Figure 7.2 shows the predicted 99th percentile odour impacts (one second nose-response time) for the proposed Mod 21 operations based on quarter 2 and quarter 3 odour sampling concentrations and the previous modifications.

The predicted odour levels for Mod 21 Q2 show a slight increase in odour at receptors R1 – R4, C1, C4, C5 and C7 compared to Mod 19 while predicted odour levels for Mod 21 Q3 show a slight decrease at receptors C2, C3 and C6 compared to Mod 19.

The fluctuation in odour predictions for this modification compared with the previous modification is attributed to variability in odour sampling. The results for Mod 21 Q3 show that the impact assessment odour criteria are achieved at all residential sensitive receptors.

Seven commercial/industrial receptors are included in the assessment. These are all located within approximately 125 m of the site. For previous modifications up to Mod 19, one second, 99th percentile odour impacts have been predicted based on the hours of operation of the receptors as per Section 2.2 (i.e. predicted odour impacts when the sites are not operational have been excluded from the assessment). For Mod 21, a revised approach was adopted where one second 99th percentile odour impacts were predicted based continuous exposure 24 hours per day, 7 weeks per week to align with the hours of operation of the site. It is noted that the commercial receptors may not be occupied for all hours of the day, consequently the predictions in Table 7.2 show the potential worst case odour impacts.

Mod 21 predicted marginal exceedances of the 6 OU criteria (assumed the same criteria as R1) at commercial/industrial receptors C2, C3, C4, C5, and C7 due to the higher quarterly odour sampling results.

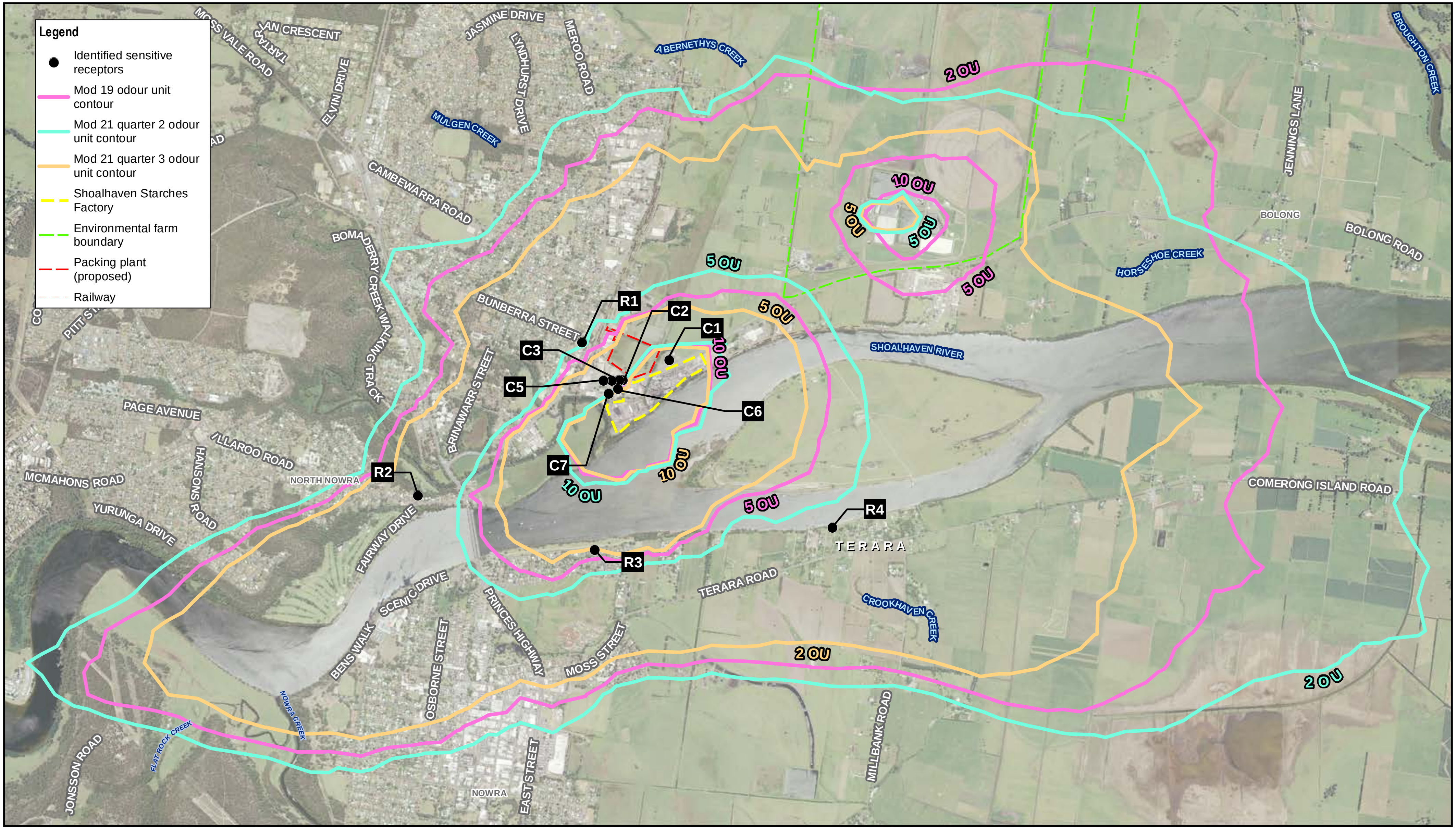
Commercial receptors C1 and C6 are located approximately 45 and 80 metres from the site. Given the industrial nature of these receptor, and its existing proximity to the site no significant odour impacts are anticipated from the proposal.

Two odour complaints (one in October 2020 and one in March 2021) attributed to the Shoalhaven Starches plant was received in the last year.

Table 7.2 ***Predicted peak (99th percentile, short term averaged) odour impact at nearby receptors***

Receptor	Range, m	To nearest odour source	Direction	2009 EA approved 'base case' Odour criterion	Odour impact, OU, 99th percentile, nose-response time					
					Mod 13	Mod 16	Mod 17[8]	Mod 19	Mod 21 (Q2)	Mod 21 (Q3)
R1 Bomaderry	150	Packing Plant	W	6	3.3	3.5	4	4	5	4
R2 North Nowra	1300	Factory	SW	3	2.5	2.6	3	3	4	3
R3 Nowra	700	Factory	S	5	4	4.6	5	5	6	5
R4 Terara	1300	Factory	SE	5	3.7	3.7	4	4	5	4
C1	45	Factory	N	n/a	n/a	10.3	12	12	16	14
C2	20	Factory	N	n/a	n/a	5.8	8	10	10	9
C3	30	Factory	N	n/a	n/a	5.3	7	9	9	8
C4	75	Factory	NW	n/a	n/a	4.4	6	7	8	7
C5	125	Factory	NW	n/a	n/a	6.1	7	7	8	7
C6	30	Factory	NW	n/a	n/a	5.4	7	10	10	9
C7	55	Factory	NW	n/a	n/a	4.8	7	8	10	9

[8] Predicted odour concentrations rounded to nearest whole number from MOD17 onwards as per EPA advice



Paper Size ISO A4

0 170 340 510 680 850 1,020

Metres

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

N

GHD

Manildra Group Pty Ltd
Shoalhaven Starches

Project No. 12548374
Revision No. 0
Date 30 Jun 2021

Odour impacts, 99th percentile, short term averaged – Modification 21

FIGURE 7.2

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Print date: 30 Jun 2021 - 09:44

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Finance, Services & Innovation 2018. Created by: kpsroba

7.5 Summary of source contributions to odour impacts

7.5.1 Source contribution overview

A source contribution analysis was undertaken for quarter 2 (maximum quarter) odour emissions to identify the key sources with potential to cause odour nuisance in the community. This allows implementation of targeted and efficient source mitigation measures.

The results of the source contribution analysis should be interpreted with an understanding of the inherent limitation that odour dispersion modelling does not give consideration to the hedonic tone[9] or character of odour emissions. Instead, odour modelling calculates cumulative odour impacts assuming all odour emissions are equally as offensive as one another and are of the same character.

Consequently, odour dispersion modelling is likely to overpredict odour concentrations in situations where odour emissions originate from different sources with different hedonic tones and characters, such as this site.

A review of the character of odour emissions from major source groups (refer to Table 7.1 for identification of sources within each source group), was undertaken to identify which source groups are likely to cause odour nuisance in the community. The odour characters with potential to cause community nuisance were determined based on inspection of the odour complaint history (refer Section 6.2). A summary of the odour character review is provided in Table 7.3.

Table 7.3 Source group odour character review

Source group	Typical odour character	Potential to cause community nuisance
Boilerhouse	Exhaust fumes, musty, sweet vinegar, plastic	Low – no known odour complaints based on this source
DDG Plant (including pellet plant stack)	Yeasty, grain, bread,	Yes – based odour character and contribution data below
Ethanol Plant (including Ethanol Recovery Scrubber Discharge)	Sweet, fermentation, alcohol, ink, caramel liquer, perfume, yeast	Yes – based odour character and contribution data below
Distillery	Beer, fermentation, coffee, caramel liqueur, nutty, garbage	Low – minimal potential impact at residential receptors
Starch and Glucose	Wheat, grain, earthy, yeast, hessian, dirty feet, plastic	Yes – based odour character and contribution data below
Packing Plant	Fruit salad, rotten vegetables, hessian, garbage, mouldy, fish, musty	Low – minimal potential impact at residential receptors
Environmental farm after WWTP	Manure, vegemite, slight sewer, earthy, musty, swamp, wood,	Low – minimal potential impact at residential receptors

7.5.2 Source contribution to 99th percentile

The contribution of each source group to odour concentrations at receptor locations is provided in Figure 7.3. Key contributors to residential receptor odour concentrations were identified as the:

– Ethanol plant
– Starch and glucose

[9] Hedonic tone is the degree to which an odour is perceived as pleasant or unpleasant

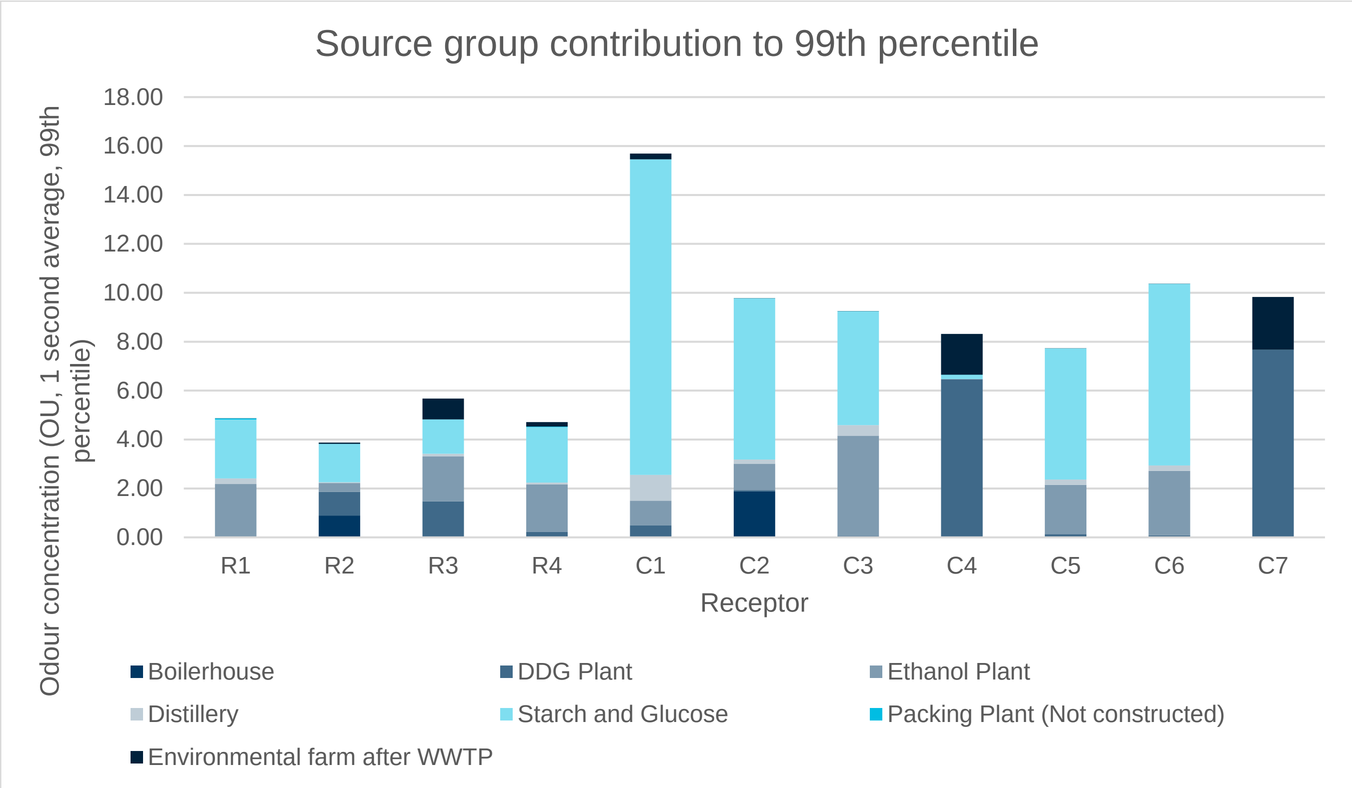


Figure 7.3 ***Source group contribution to 99th percentile (Mod 21 (Q2))***

A ranking of individual source that contribute to predicted 99th percentile odour concentrations at residential and commercial receptors is provided in Table 7.4 and Table 7.5 respectively.

It is noted that majority of the odour impacts at any receptor are attributed to a few sources. Key contributors to residential receptor odour concentrations were identified as follows:

- ERESC – Ethanol Recovery Scrubber Discharge
- PPES – Pellet Plant exhaust stack
- S02 – No. 1 Gluten Dryer baghouse
- BOILR4 – Boiler No. 4
- S03 – No. 3 Gluten Dryer

Table 7.4 Ranked source contribution to 99th percentile for residential receptors (Mod 21 (Q2), 99th percentile, 1 second average, OU)

Ranked contribution	Source contribution at residential receptor (OU)			
	R1	R2	R3	R4
1	1.5 (ERESC)	0.77 (PPES)	1.53 (ERESC)	1.55 (ERESC)
2	0.48 (S02)	0.43 (BOILR4)	0.58 (PPES)	0.4 (S03)
3	0.43 (F18)	0.35 (BOILR5)	0.39 (F18)	0.33 (S02)
4	0.36 (GRT)	0.29 (S03)	0.37 (PPF)	0.22 (S18)
5	0.28 (S04)	0.28 (ERESC)	0.3 (S02)	0.21 (S04)
6	0.18 (S18)	0.13 (S05)	0.26 (BIO1)	0.19 (GRT)
7	0.17 (S07)	0.12 (GD8)	0.24 (DDG36)	0.16 (F18)
8	0.15 (SDR5)	0.12 (PD9)	0.2 (BIO4)	0.15 (SDR5)
9	0.14 (B7)	0.11 (SD5N)	0.19 (S04)	0.14 (S07)
10	0.14 (S01)	0.11 (BOILR2)	0.18 (BIO3)	0.11 (S01)

Table 7.5 Ranked source contribution to 99th percentile for commercial receptors (Mod 21 (Q2), 99th percentile, 1 second average, OU)

Ranked contribution	Source contribution at commercial receptor (OU)						
	C1	C2	C3	C4	C5	C6	C7
1	4.62 (F18)	1.23 (BOILR4)	2.92 (ERESC)	1.76 (DDG36)	1.29 (ERESC)	1.65 (ERESC)	3.36 (DDG36)
2	2.43 (S02)	0.75 (S03)	1.58 (F18)	1.72 (PPF)	0.98 (S02)	1.52 (F18)	1.71 (DDG35)
3	1.31 (S04)	0.71 (S02)	0.81 (S02)	1.03 (DDG34)	0.77 (F18)	1.34 (S02)	1.6 (DDG34)
4	0.76 (B7)	0.69 (ERESC)	0.57 (GRT)	0.99 (VCD)	0.59 (S04)	0.8 (SDR5)	1 (PPF)
5	0.76 (D2)	0.69 (S18)	0.42 (S04)	0.95 (DDG35)	0.52 (SDR5)	0.79 (S07)	0.74 (BIO1)
6	0.74 (SDR5)	0.63 (BOILR2)	0.36 (S07)	0.67 (BIO1)	0.5 (S07)	0.77 (S04)	0.53 (BIO4)
7	0.63 (S07)	0.46 (SD5N)	0.27 (S18)	0.41 (BIO2)	0.43 (S18)	0.49 (GRT)	0.5 (BIO2)
8	0.61 (S01)	0.45 (S07)	0.24 (D2)	0.29 (BIO4)	0.37 (GRT)	0.37 (S01)	0.39 (BIO3)
9	0.43 (E13)	0.45 (SDR5)	0.23 (FERM)	0.29 (BIO3)	0.29 (S01)	0.36 (S18)	0 (F18)
10	0.34 (C4)	0.42 (GD6)	0.22 (SDR5)	0.1 (F18)	0.23 (B7)	0.28 (B7)	0 (B7)

7.5.3 Maximum source contribution

A ranking of maximum source contribution at residential and commercial receptors is provided in Table 7.6 and Table 7.7 respectively. It is noted that the odour concentration presented in these tables are the maximum from each source over the modelled year and would not necessarily occur at the same time.

Key sources that result in significantly odour concentrations at residential receptors include:

- ERESC – Ethanol Recovery Scrubber Discharge
- PPES – Pellet Plant exhaust stack
- BOILR4 – Boiler No. 4
- S03 – No. 3 Gluten Dryer
- F18 – Farm tank

Table 7.6 Ranked maximum source contribution for residential receptors (Mod 21 (Q2), 1 second average, OU)

Ranked contribution	Source contribution at residential receptor (OU)			
	R1	R2	R3	R4
1	2.82 (PPES)	1.75 (PPES)	3.36 (ERESC)	3.04 (ERESC)
2	2.81 (ERESC)	1.25 (BOILR4)	1.6 (S03)	1.38 (PPES)
3	1.42 (F18)	1.2 (ERESC)	1.36 (BOILR4)	1.18 (S03)
4	1.24 (PPF)	0.87 (PPF)	1.3 (PPES)	0.8 (F18)
5	1.2 (S03)	0.67 (BOILR5)	1 (PPF)	0.65 (PPF)
6	1.16 (BOILR4)	0.54 (BIO1)	0.77 (BIO4)	0.62 (BOILR4)
7	0.92 (BOILR5)	0.54 (BIO4)	0.76 (BIO1)	0.54 (BOILR2)
8	0.86 (DDG36)	0.53 (F18)	0.75 (BOILR5)	0.52 (S02)
9	0.77 (S02)	0.48 (S03)	0.71 (F18)	0.51 (BIO1)
10	0.65 (BIO1)	0.44 (BIO2)	0.69 (S02)	0.46 (BIO4)

Table 7.7 Ranked maximum source contribution for commercial receptors (Mod 21 (Q2), 1 second average, OU)

Ranked contribution	Source contribution at commercial receptor (OU)						
	C1	C2	C3	C4	C5	C6	C7
1	13.28 (F18)	4.85 (PPES)	4.91 (PPES)	4.75 (PPES)	4.73 (PPES)	5.71 (PPES)	5.07 (PPES)
2	6.7 (ERESC)	4.73 (F18)	4.21 (F18)	3.39 (ERESC)	3.23 (ERESC)	4.23 (F18)	4.96 (DDG36)
3	4.28 (S02)	3.72 (ERESC)	3.57 (ERESC)	3.23 (F18)	2.93 (DDG36)	3.57 (DDG36)	3.08 (ERESC)
4	3.96 (S03)	2.97 (BOILR4)	2.86 (DDG36)	3.19 (DDG36)	2.47 (F18)	3.31 (ERESC)	3.05 (F18)
5	3.68 (BOILR4)	2.82 (DDG36)	2.83 (BOILR4)	2.45 (BOILR4)	2.26 (PPF)	2.88 (BOILR4)	2.65 (DDG35)
6	3.61 (BOILR5)	2.21 (S03)	2.02 (PPF)	2.28 (PPF)	2.18 (BOILR4)	2.5 (S03)	2.61 (BIO1)
7	3.39 (GRT)	2.21 (BOILR5)	2.02 (BOILR5)	2.02 (S03)	1.93 (S03)	2.28 (PPF)	2.45 (PPF)
8	3.03 (B7)	2.13 (PD9)	1.9 (S03)	1.7 (DDG35)	1.55 (DDG35)	2.14 (BIO1)	2.32 (DDG34)
9	2.89 (PPES)	1.99 (PPF)	1.86 (PD9)	1.69 (DDG34)	1.53 (DDG34)	2.05 (DDG35)	2.26 (BOILR4)
10	2.85 (S04)	1.71 (S02)	1.57 (DDG35)	1.67 (BOILR5)	1.52 (BIO1)	1.9 (BOILR5)	2.09 (BIO4)

8. Air quality assessment

8.1 Emissions inventory

In addition to odour emissions, the operation of the Shoalhaven Starches plant also has the potential to generate emissions of particulate matter and products of combustion.

The emissions inventory for Modification 21 includes all existing air emissions sources and those proposed in previous Modifications (up to and including Modification 19). Emission rates were estimated for a factory throughput of 300 ML per annum (maximum approved throughput).

No new emission sources are proposed as part of Modification 21, however the assessment was updated to include the most recent sampling data.

Two air quality scenarios were considered as part of Modification 21. The scenarios consider different arrangement of active boiler to fulfil the steam generation requirements of the site. It is noted that surplus steam generation capacity is installed on site (additional boilers and proposed gas turbines) so that boilers can be offline for periods in accordance with boiler statutory requirements and for maintenance and cleaning. The air quality scenarios considered as part of Mod 21 included:

– Base scenario: No change from Mod 19 boiler fuel usage.
– Mitigation scenario: revised boiler operation to replace the use of coal fired boiler 8 with gas fired boilers 7 and 8. In additional, all remaining coal fired-boilers were operated at maximum throughput to conservatively assess worst case operations which is expected to occur while boilers operate using coal.

The proposed boiler and fuel usage for each scenario is summarised in Table 8.1.

The emissions estimation methodology adopted for Modification 21 was consistent with that of previous modifications. Modification 21 emission rates were updated based on most recent sampling data to reflect the site's current operations. Assumptions and changes made to the baseline air quality model as part of this assessment are discussed in detail below for each of the individual source types.

8.1.1 Boiler emissions

Emission estimation based on site specific sampling data was prioritised where available, however sampling data for gas fired boilers was not available. Therefore, emissions factors from the *National Pollutant Inventory Emission estimation technique manual for Combustion in boilers Version 3.6 (December 2011)* (NPI factors) were used (emissions factors for natural gas (≤30MW wall fired)). Boiler emission rates were updated based on recent site sampling reports which are provided in Appendix D. Emission was scaled based on proposed boiler fuel usage rates for Modification 19 provided by Manildra.

Boiler emissions were estimated based on the properties outlined in Table 8.1.

Table 8.1 Boiler emissions estimation

Boiler	Fuel type	Modification 21 fuel usage		Emission estimation methodology[10]
		Base scenario	Mitigation scenario	
Boiler 1	Gas	71.5 GJ/hour	84 GJ/hour	NPI factors

[10] PAH and FL emissions for all boilers have been calculated based on the emission factors listed in *National Pollutant Inventory Emission estimation technique manual For Combustion in boilers Version 3.6* (December 2011) Table 10

Boiler	Fuel type	Modification 21 fuel usage		Emission estimation methodology[10]
		Base scenario	Mitigation scenario	
Boiler 2	Coal and woodchips	Coal: 1.17 t/hr Woodchips: 0.62 t/hr	Coal: 1.2 t/hr Woodchips: 0.31 t/hr	Coal: SEMA (2020) Compliance Stack Emission Survey – Q2 2020-2021 - Boiler 2 - Report No. 7102 Woodchips: Average of past sampling data as presented in GHD (2020)
Boiler 3	Standby boiler, operation not proposed and therefore not included in this assessment			
Boiler 4	Coal and woodchips	Coal: 2.43 t/hr Woodchips: 0.74 t/hr	Coal: 3.0 t/hr Woodchips: 0.37 t/hr	Coal: SEMA (2020) Compliance Stack Emission Survey – Q2 2020-2021 - Boiler 4 - Report No. 7103 Woodchips: Average of past sampling data as presented in GHD (2020)
Boiler 5/6	Coal	12.2 t/hr	12.1 t/hr	SEMA (2020) Compliance Stack Emission Survey – Q2 2020-2021 - Boiler 5&6 - Report No. 7104A
Boiler 7	Gas	Standby boiler, operation not proposed for base scenario	66 GJ/hour	NPI factors
Boiler 8C	Coal	8.3 t/hr	Standby boiler, operation not proposed for mitigation scenario	Scaled off boiler 5/6 emission rates based on proposed fuel usage rates
Boiler 8G	Gas	Standby boiler, operation not proposed for base scenario	131 GJ/hour	NPI factors

Boiler details and modelled emission rates used as part of the Modification 19 air quality assessment are summarised in Table 8.2 and Table 8.3.

8.1.2 Product dryer emissions

The following updates have been made to the site emissions inventory for the product dryers:

– NO_x emissions from dryers without NO_x sampling results (gluten dryer 8 (GD8), spray dryer 5 (S20) and product dryer 9 (PD9)) were estimated based on the flowrate of the dryers and the average sampled exhaust NOx concentration from starch dryers 4 and 5 and gluten dryers 1, 2, 3, 4, 6, 7 and ring dryer 5.

– CO and SO_2 emissions from all dryers fitted with an auxiliary gas burner (gluten dryers 1, 2, 3, 4, 5, 6 and 7, ring dryer 5, starch dryers 3, 4 and 5, spray dryer 5 and product dryer 9) were estimated based on NPI factors (emissions factors for natural gas (tangential fired)) and projected gas consumption (gas usage split evenly across all dryers).

– Particulate emissions from starch dryer 5, which is fitted with a cyclone, were estimated based on an in-stack concentration of 5 mg/m^3 and provided flowrate[11].
– All other dryer emissions sources are as per Mod 19.

8.1.3 Gas turbines

Mod 21 proposes to fulfil the steam generation requirements of the site by using boilers only. The approved but not yet constructed gas turbines assessed as part of the 2008 air quality assessment (GHD, 2008) would be allocated to standby mode, therefore they would not be operated and consequently they were not included in this assessment.

8.1.4 Other emission sources

Other emissions sources would remain unchanged from previous air quality assessments. The modelled TSP and PM_{10} emission rates from all sources are summarised in Table 8.2 and the modelled products of combustion, PAH, VOCs and metals emission rates from Mod 21 base and mitigation scenarios are summarized in Table 8.3 and Table 8.4 respectively. It is noted that only boiler emission rates vary between the base and mitigation scenarios, all other sources remain unchanged between scenarios.

Table 8.2 Emission inventory – Particulate matter

Discharge Point	Model ID	EPA ID	Emission control	Base scenario		Mitigation scenario	
				TSP	PM_{10}	TSP	PM_{10}
Boiler No. 1	BOILR1		Gas-fired	0.072	0.072	0.084	0.084
Boiler No. 2	BOILR2	45	Cyclone and fabric filter	0.072	0.052	0.086	0.061
Boiler No. 4	BOILR4	42	Cyclone and fabric filter	0.15	0.13	0.21	0.18
Boiler No. 5/6	BOILR5	35	Fabric filter	0.24	0.1	0.24	0.1
Boiler No. 7	BOILR7		Gas-fired			0.066	0.066
Boiler No. 8C	BOILR8		Cyclone and fabric filter	0.17	0.069		
Boiler No. 8G	BOILR8G		Gas-fired			0.13	0.13
Gluten dryer No. 1	S02	8	Fabric filter	0.015	0.0003	0.015	0.0003
Gluten dryer No. 2	S04	9	Fabric filter	0.015	0.001	0.015	0.001
Gluten dryer No. 3	S03	10	Fabric filter	0.02	0.02	0.02	0.02
Gluten dryer No. 4	S05	11	Fabric filter	0.02	0.02	0.02	0.02
Ring Dryer No. 5	SDR5		Fabric filter	0.012	0.012	0.012	0.012
Gluten dryer No. 6	GD6		Fabric filter	0.02	0.02	0.02	0.02
Gluten Dryer No. 7	GD7		Fabric filter	0.035	0.035	0.035	0.035
Gluten Dryer No. 8	GD8		Fabric filter	0.02	0.02	0.02	0.02
Starch dryer No. 1	S01	12	Cylone and wet-scrubber	0.044	0.033	0.044	0.033
Starch dryer No. 3	S18		Cylone and wet-scrubber	0.04	0.013	0.04	0.013
Starch dryer No. 4	S19	14	Cylone and wet-scrubber	0.057	0.029	0.057	0.029
Starch dryer No. 5	SD5C	47	Cyclone	0.062	0.062	0.062	0.062

[11]An in-stack TSP conc of 5 mg/m^3 was taken from SEMA (2015) Air Quality Impact Assessment (Cumulative Impact) Starch Dryer 5 Relocation V3 29/10/2015

Discharge Point	Model ID	EPA ID	Emission control	Base scenario		Mitigation scenario	
				TSP	PM_{10}	TSP	PM_{10}
No. 5 Starch Dryer	SD5N		Cyclone	0.32	0.32	0.32	0.32
Spray dryer 5	S20		Fabric filter	0.0028	0.0019	0.0028	0.0019
Flour Mill	FMP1, FMP2		Fabric filter	0.0005	0.0005	0.0005	0.0005
New Flour Mill B (MOD 10)	FMBA-FMBF		Fabric filter	0.0037	0.0037	0.0037	0.0037
Flour Mill C (new)	FMC1-FMC3		Fabric filter	0.0013	0.0013	0.0013	0.0013
DDG Pellet Plant (MOD 4 & MOD 5)	PPF		Fabric filter	0.25	0.25	0.25	0.25
Packing Plant (MOD 9 approved)	PPL1-2, PPM1-3, PPS1-2		Fabric filter	0.016	0.016	0.016	0.016
Silo source 1 (combined stack for 3 silos)	SILO1		Fabric filter	0.0042	0.0042	0.0042	0.0042
Silo source 2 (combined stack for 6 silos)	SILO2		Fabric filter	0.0042	0.0042	0.0042	0.0042
Silo source 3 (combined stack for 2 silos)	SILO3		Fabric filter	0.017	0.017	0.017	0.017
Silo source 4 (combined stack for 6 silos)	SILO4		Fabric filter	0.0042	0.0042	0.0042	0.0042
Silo source 5 (combined stack for 3 silos)	SILO5		Fabric filter	0.013	0.013	0.013	0.013
Product dryer 9	PD9		Fabric filter	0.015	0.0003	0.015	0.0003

Table 8.3 Emission inventory – Products of combustion (Base scenario)

Discharge Point	Boiler No. 1	Boiler No. 2	Boiler No. 4	Boiler No. 5/6	Boiler No. 8C	Gluten dryer No. 1	Gluten dryer No. 2	Gluten dryer No. 3	Gluten dryer No. 4	Ring Dryer No. 5	Gluten dryer No .6	Gluten Dryer No. 7	Gluten Dryer No. 8	Starch dryer No. 3	Starch dryer No. 4	Starch dryer No. 5	No. 5 Starch Dryer	Spray dryer 5
Model ID	BOILR1	BOILR2	BOILR4	BOILR5	BOILR8	S02	S04	S03	S05	SDR5	GD6	GD7	GD8	S18	S19	SD5C	SD5N	S20
Fuel type	Natural gas	Coal and woodchip	Coal and woodchip	Coal	Coal	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Status / details	Existing boilers					Natural gas is fed through to the dryers for combustion												
Stack height (m)	25	40	41	54	54	25.5	27	21	30	25	35	29	29	20	20	33.5	30	19
Exhaust temp. (K)	453	475	436	403	403	344	337	347	345	320	346	341	346	309	312	341	341	344
Stack diameter (m)	0.9	0.7	0.9	2.1	2.0	3.2	3.2	2.5	2.7	1.2	1.7	1.8	1.9	1.2	1.2	2.4	2.4	1.4
Exhaust velocity (m/s)	25.0	27.7	28.4	14.5	11.8	14.0	17.0	11.0	21.0	10.0	20.0	19.0	20.0	23.0	22.0	2.9	14.7	8.0
Oxygen (%)	ND	10.9	15	8.5	ND	20.9	20.9	20.9	20.6	ND	20.9	20.9	ND	20.9	20.9	ND	ND	20.5
Moisture (%)	ND	5	4	5.7	ND	7.3	5.9	6.3	6.4	ND	7.0	6.5	ND	5.8	3.2	ND	ND	3.5
Exhaust Flow rate, actual (m3/s)	ND	9.2	20	48.0	ND	19.3	20.5	15.1	28.6	ND	27.2	25.3	ND	28.0	26.2	ND	ND	12.1
Ratio (Actual to normalised flow)	ND	1.8	1.7	1.5	ND	1.4	1.2	1.4	1.4	ND	1.4	1.3	ND	1.2	1.2	ND	ND	1.3
Emission rate (g/s)																		
CO	0.82	0.57	2.6	3.3	2.24	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.0023	0.012	0.014
SO_2	0.011	1.9	3.9	20	13.3	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00011	0.00055	0.00066
NO_2	0.49	2.1	6.1	17	11.9	0.12	0.02	0.43	0.060	0.075	0.10	0.062	0.23	0.038	0.036	0.016	0.082	0.048
VOC	0.054	0.013	0.14	0.19	0.127	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic (As) Type I	1.9E-06	4.6E-05	2.4E-04	1.7E-04	1.1E-04	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Cd) Type I	1.1E-05	3.0E-06	4.7E-06	4.1E-06	2.8E-06	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead (Pb) Type I	4.9E-06	1.7E-04	3.1E-04	6.0E-04	4.1E-04	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury (Hg) Type I	2.5E-06	9.8E-06	1.0E-05	2.5E-05	1.7E-05	-	-	-	-	-	-	-	-	-	-	-	-	-
Beryllium (Be) Type II	1.2E-08	2.5E-06	1.0E-05	2.5E-05	1.7E-05	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium (Cr) Type II	1.4E-05	2.3E-05	7.9E-05	6.0E-05	4.1E-05	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt (Co) Type II	7.9E-07	9.9E-06	3.3E-05	8.2E-05	5.6E-05	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese (Mn) Type II	3.7E-06	9.9E-05	1.2E-04	2.3E-04	1.6E-04	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel (Ni) Type II	2.0E-05	5.4E-05	2.3E-04	2.9E-04	2.0E-04	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium (Se) Type II	2.3E-07	5.4E-05	2.7E-04	1.7E-04	1.1E-04	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAH)	6.2E-06	1.1E-04	9.0E-05	3.2E-05	2.2E-05	-	-	-	-	-	-	-	-	-	-	-	-	-
Emission rates, normalised (mg/m^3)																		
CO	51.6	61.7	146.7	68.7	60.3	0.1	0.1	0.3	0.1	1.3	0.3	0.3	0.3	0.5	0.6	0.2	0.2	1.2
SO_2	0.7	210.5	214.6	408.0	358.4	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
NO_2	30.6	223.5	338.4	363.5	319.3	1.1	0.2	8.0	0.5	6.6	2.2	1.3	4.0	1.5	1.4	1.3	1.3	4.2
TSP	4.5	7.8	8.3	5.1	4.5	0.1	0.1	0.4	0.2	1.0	0.4	0.7	0.4	1.5	2.3	5.0	5.0	0.2

Discharge Point	Boiler No. 1	Boiler No. 2	Boiler No. 4	Boiler No. 5/6	Boiler No. 8C	Gluten dryer No. 1	Gluten dryer No. 2	Gluten dryer No. 3	Gluten dryer No. 4	Ring Dryer No. 5	Gluten dryer No .6	Gluten Dryer No. 7	Gluten Dryer No. 8	Starch dryer No. 3	Starch dryer No. 4	Starch dryer No. 5	No. 5 Starch Dryer	Spray dryer 5
Type 1 and 2 metals (combined)	0.004	0.051	0.072	0.034	0.030	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	0.0007	0.0003	0.0003	0.0001	0.0001	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	0.0002	0.0011	0.0006	0.0005	0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-
VOC	3.4	1.4	7.8	3.9	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-

The emission rate limits are as follows:

Protection of the Environment Operations (Clean Air) Regulation (2010): CO: 125 mg/m^3, SO_2: 1000 mg/m^3, NO_2: 500 mg/m^3, TSP: 50 mg/m^3, Type 1 and 2 metals (combined): 1 mg/m^3, Cadmium: 0.2 mg/m^3, Mercury: 0.2 mg/m^3, VOC: 40 mg/m^3, HCL: 100 mg/m^3, FL: 50 mg/m^3

EPA: SO_2: 600 mg/m^3, NO_2: 500 mg/m^3, TSP: 30 mg/m^3, Type 1 and 2 metals (combined): 1 mg/m^3, Cadmium: 0.2 mg/m^3, Mercury: 0.2 mg/m^3, VOC: 40 mg/m^3.

Table 8.4 Emission inventory – Products of combustion (Mitigation scenario)

Discharge Point	Boiler No. 1	Boiler No. 2	Boiler No. 4	Boiler No. 5/6	Boiler No. 7	Boiler No. 8G	Gluten dryer No. 1	Gluten dryer No. 2	Gluten dryer No. 3	Gluten dryer No. 4	Ring Dryer No. 5	Gluten dryer No .6	Gluten Dryer No. 7	Gluten Dryer No. 8	Starch dryer No. 3	Starch dryer No. 4	Starch dryer No. 5	No. 5 Starch Dryer	Spray dryer 5
Model ID	BOILR1	BOILR2	BOILR4	BOILR5	BOILR7	BOILR8G	S02	S04	S03	S05	SDR5	GD6	GD7	GD8	S18	S19	SD5C	SD5N	S20
Fuel type	Natural gas	Coal and woodchip	Coal and woodchip	Coal	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Status / details	Existing boilers					New boiler approved in Mod 18	Natural gas is fed through to the dryers for combustion												
Stack height (m)	25	40	41	54	25	24	25.5	27	21	30	25	35	29	29	20	20	33.5	30	19
Exhaust temp. (K)	453	475	436	403	453	527	344	337	347	345	320	346	341	346	309	312	341	341	344
Stack diameter (m)	0.9	0.7	0.9	2.1	1.0	1.7	3.2	3.2	2.5	2.7	1.2	1.7	1.8	1.9	1.2	1.2	2.4	2.4	1.4
Exhaust velocity (m/s)	25.0	27.7	28.4	14.5	25.0	10.3	14.0	17.0	11.0	21.0	10.0	20.0	19.0	20.0	23.0	22.0	2.9	14.7	8.0
Oxygen (%)	ND	10.9	15	8.5	ND	ND	20.9	20.9	20.9	20.6	ND	20.9	20.9	ND	20.9	20.9	ND	ND	20.5
Moisture (%)	ND	5	4	5.7	ND	ND	7.3	5.9	6.3	6.4	ND	7.0	6.5	ND	5.8	3.2	ND	ND	3.5
Exhaust Flow rate, actual (m3/s)	ND	9.2	20	48.0	ND	ND	19.3	20.5	15.1	28.6	ND	27.2	25.3	ND	28.0	26.2	ND	ND	12.1
Ratio (Actual to normalised flow)	ND	1.8	1.7	1.5	ND	ND	1.4	1.2	1.4	1.4	ND	1.4	1.3	ND	1.2	1.2	ND	ND	1.3
Emission rate (g/s)																			
CO	0.96	0.48	3.6	3.3	0.75	1.5	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.0023	0.012	0.014
SO_2	0.013	2.4	5.5	19	0.010	0.020	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00066	0.00011	0.00055	0.00066
NO_2	0.57	2.4	8.7	17	0.45	0.88	0.12	0.024	0.43	0.060	0.075	0.10	0.062	0.23	0.038	0.036	0.016	0.082	0.048
VOC	0.063	0.010	0.19	0.19	0.049	0.098	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic (As) Type I	-	4.2E-05	1.8E-04	1.7E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Cd) Type I	2.3E-06	4.9E-05	3.3E-04	1.7E-04	1.8E-06	3.5E-06	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead (Pb) Type I	1.3E-05	2.4E-06	5.1E-06	4.1E-06	9.8E-06	2.0E-05	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury (Hg) Type I	5.7E-06	1.6E-04	4.3E-04	5.9E-04	4.5E-06	8.8E-06	-	-	-	-	-	-	-	-	-	-	-	-	-
Beryllium (Be) Type II	2.9E-06	1.0E-05	1.4E-05	2.5E-05	2.3E-06	4.6E-06	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium (Cr) Type II	1.4E-08	3.1E-06	1.4E-05	2.5E-05	1.1E-08	2.1E-08	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt (Co) Type II	1.6E-05	2.7E-05	1.0E-04	5.9E-05	1.3E-05	2.5E-05	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese (Mn) Type II	9.2E-07	1.1E-05	4.8E-05	8.2E-05	7.3E-07	1.4E-06	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel (Ni) Type II	4.3E-06	7.2E-05	1.7E-04	2.3E-04	3.4E-06	6.7E-06	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium (Se) Type II	2.4E-05	6.7E-05	3.2E-04	2.9E-04	1.9E-05	3.7E-05	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAH)	2.7E-07	6.0E-05	3.9E-04	1.7E-04	2.1E-07	4.2E-07	-	-	-	-	-	-	-	-	-	-	-	-	-
Emission rates, normalised (mg/m³)																			
CO	60.2	51.8	197.4	68.1	38.3	64.1	0.1	0.1	0.3	0.1	1.3	0.3	0.3	0.3	0.5	0.6	0.2	0.2	1.2

Discharge Point	Boiler No. 1	Boiler No. 2	Boiler No. 4	Boiler No. 5/6	Boiler No. 7	Boiler No. 8G	Gluten dryer No. 1	Gluten dryer No. 2	Gluten dryer No. 3	Gluten dryer No. 4	Ring Dryer No. 5	Gluten dryer No .6	Gluten Dryer No. 7	Gluten Dryer No. 8	Starch dryer No. 3	Starch dryer No. 4	Starch dryer No. 5	No. 5 Starch Dryer	Spray dryer 5
SO_2	0.8	262.1	307.1	404.7	0.5	0.8	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
NO_2	35.7	259.1	480.3	360.6	22.7	38.0	1.1	0.2	8.0	0.5	6.6	2.2	1.3	4.0	1.5	1.4	1.3	1.3	4.2
TSP	5.3	9.4	11.5	5.0	3.4	5.6	0.1	0.1	0.4	0.2	1.0	0.4	0.7	0.4	1.5	2.3	5.0	5.0	0.2
Type 1 and 2 metals (combined)	0.004	0.051	0.101	0.034	0.003	0.005	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	0.0008	0.0003	0.0003	0.0001	0.0005	0.0008	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	0.0002	0.0011	0.0008	0.0005	0.0001	0.0002	-	-	-	-	-	-	-	-	-	-	-	-	-
VOC	3.9	1.1	10.8	3.9	2.5	4.2	-	-	-	-	-	-	-	-	-	-	-	-	-

The emission rate limits are as follows:

Protection of the Environment Operations (Clean Air) Regulation (2010): CO: 125 mg/m^3, SO_2: 1000 mg/m^3, NO_2: 500 mg/m^3, TSP: 50 mg/m^3, Type 1 and 2 metals (combined): 1 mg/m^3, Cadmium: 0.2 mg/m^3, Mercury: 0.2 mg/m^3, VOC: 40 mg/m^3, HCL: 100 mg/m^3, FL: 50 mg/m^3

EPA: SO_2: 600 mg/m^3, NO_2: 500 mg/m^3, TSP: 30 mg/m^3, Type 1 and 2 metals (combined): 1 mg/m^3, Cadmium: 0.2 mg/m^3, Mercury: 0.2 mg/m^3, VOC: 40 mg/m^3.

8.2 Dispersion modelling

The air quality dispersion modelling was conducted using the Gaussian puff model CALPUFF Version 7. The model settings were as described in Section 8.2.

8.3 Predicted air quality impacts

8.3.1 Particulates

8.3.1.1 Incremental particulate matter

The impact of dust emissions principally relates to the potential effect on human health of inhalation of particles in the air column, and it is the finer fraction that have the greater potential to cause respiratory health effects. EPA have advised to assess $PM_{2.5}$, if PM_{10} impacts are significant. As the boilers are proposed to be converted to gas fired, it is anticipated that particulate emissions would be primarily composed of finer fraction particulates.

The $PM_{2.5}$ emissions from some sources on site are not known, however guidance is available for estimates of $PM_{2.5}$ from gas fired boilers in the NPI. NPI emission factors for gas fired boilers state that $PM_{2.5}$ emissions are equal to that of PM_{10} emissions. Therefore a ratio of PM_{10} to $PM_{2.5}$ emissions of 1:1 was adopted.

A summary of the maximum incremental predicted levels at each receptor site for Mod 21 base and mitigation scenarios is presented in Table 8.5. The worst case predicted incremental 24 hour PM_{10} level at a residential sensitive receptors is at R1 with a level of 7.7 µg/m^3 for the base scenario and 7.6 µg/m^3 for the mitigation scenario.

Table 8.5 Maximum predicted incremental ground level TSP, PM_{10} and $PM_{2.5}$ concentrations (base and mitigation scenario)

Receptor	Base scenario					Mitigation scenario				
Pollutant	TSP	PM_{10}		$PM_{2.5}$		TSP	PM_{10}		$PM_{2.5}$	
Averaging period	Annual	24 hour	Annual	24 hour	Annual	Annual	24 hour	Annual	24 hour	Annual
Criteria µg/m^3	90	50	25	25	8	90	50	25	25	8
R1	0.7	7.5	0.6	7.5	0.6	0.7	7.6	0.7	7.6	0.7
R2	0.4	3.8	0.3	3.8	0.3	0.4	3.9	0.4	3.9	0.4
R3	0.6	5.0	0.6	5.0	0.6	0.6	5.2	0.6	5.2	0.6
R4	0.9	4.4	0.9	4.4	0.9	0.9	4.4	0.9	4.4	0.9
C1	2.0	12.0	1.6	12.0	1.6	2.1	12.8	1.7	12.8	1.7
C2	2.8	15.5	2.5	15.5	2.5	2.9	16.0	2.6	16.0	2.6
C3	2.6	15.8	2.4	15.8	2.4	2.7	16.2	2.5	16.2	2.5
C4	2.3	15.2	2.1	15.2	2.1	2.3	15.4	2.1	15.4	2.1
C5	1.9	12.6	1.7	12.6	1.7	1.9	12.7	1.8	12.7	1.8
C6	3.2	16.5	2.9	16.5	2.9	3.3	16.7	3.1	16.7	3.1
C7	2.7	15.7	2.5	15.7	2.5	2.8	16.4	2.6	16.4	2.6

8.3.1.2 Cumulative particulate matter (base scenario)

A contemporaneous assessment has been undertaken for the year 2004 in accordance with the Approved Methods. Predicted 24 hour $PM_{2.5}$ and PM_{10} values from the site in 2004 have been added to the 24 hour measured values at Wollongong for every day in the year. Predicted cumulative particulate matter concentrations for the base scenario are presented in this section while those for the mitigation scenario are presented in Section 8.3.1.3.

The top predicted, measured and total concentrations at the most impacted residential receptor (R1) and commercial receptor (C6) for Mod 21 base scenario are presented in Table 8.6 to Table 8.9 below. The background and incremental contributions for the highest cumulative concentrations are also included.

Results of the assessment show full compliance with the $PM_{2.5}$ and PM_{10} 24 hour criteria at the worst impacted residential sensitive receptor R1.

Results of the assessment predict exceedances of the PM_{10} 24 hour criteria for three days and the $PM_{2.5}$ 24 hour criteria for four days of the year at the worst impacted commercial receptor C6. The exceedances are bold in Table 8.8 and Table 8.9. The exceedances are primarily attributed to high background concentrations as background PM_{10} accounts for 94%, 92% and 97% of the criteria and background $PM_{2.5}$ accounts for 89%, 80%, 58% and 65% of the criteria on the days of the predicted exceedances.

Plots of the predicted 24 hour maximum PM_{10} levels are provided in Figure 8.1 (incremental impact) and in Figure 8.2 (cumulative impact with 70th percentile PM_{10} levels at Albion Park South 2016 for comparative purposes).

Plots of the predicted 24 hour maximum $PM_{2.5}$ levels are provided in Figure 8.3 (cumulative impact with 70th percentile $PM_{2.5}$ levels at Albion Park South 2016 for comparative purposes).

Table 8.6 Summary of highest measured and predicted PM_{10} levels, µg/m^3 (at receptor R1)

Top 10 PM_{10} background		Top 10 PM_{10} incremental		Top 10 PM_{10} cumulative			
Date	PM_{10} background	Date	PM_{10} increment	Date	PM_{10} cumulative	Background contribution	Site contribution
08/03/2004	49.0	10/03/2004	7.5	08/03/2004	49.0	49.0	0.0
27/11/2004	48.4	22/03/2004	6.6	26/03/2004	48.7	46.1	2.6
21/02/2004	47.0	17/08/2004	4.3	27/11/2004	48.7	48.4	0.3
26/03/2004	46.1	23/09/2004	3.6	21/02/2004	47.8	47.0	0.8
08/12/2004	43.7	01/03/2004	3.4	09/02/2004	44.3	43.1	1.2
10/01/2004	43.4	28/03/2004	3.3	08/12/2004	43.8	43.7	0.1
09/02/2004	43.1	04/04/2004	3.3	10/01/2004	43.4	43.4	0.0
06/02/2004	41.2	22/01/2004	3.2	06/02/2004	42.7	41.2	1.5
07/12/2004	40.8	09/11/2004	3.1	07/12/2004	41.3	40.8	0.5
20/02/2004	40.4	16/10/2004	3.0	22/01/2004	41.2	38.0	3.2

Table 8.7 Summary of highest measured and predicted $PM_{2.5}$ levels, µg/m^3 (at receptor R1)

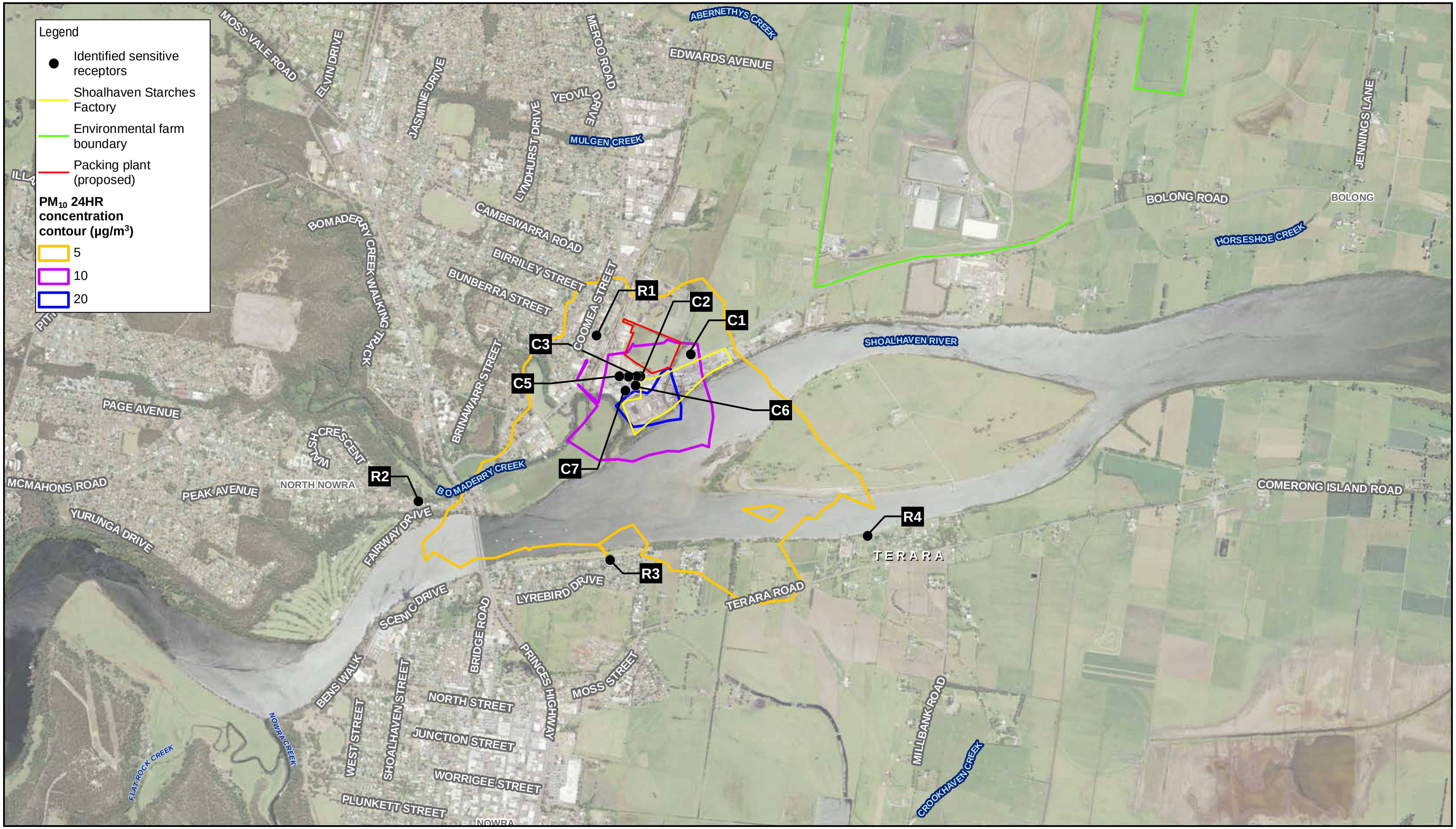
Top 10 $PM_{2.5}$ background		Top 10 $PM_{2.5}$ incremental		Top 10 $PM_{2.5}$ cumulative			
Date	$PM_{2.5}$ background	Date	$PM_{2.5}$ increment	Date	$PM_{2.5}$ cumulative	Background contribution	Site contribution
10/01/2004	22.6	10/03/2004	7.5	21/02/2004	23.1	22.3	0.8
21/02/2004	22.3	22/03/2004	6.6	10/01/2004	22.6	22.6	0.0
26/03/2004	19.9	17/08/2004	4.3	26/03/2004	22.5	19.9	2.6
06/02/2004	19.0	23/09/2004	3.6	06/02/2004	20.5	19.0	1.5
09/02/2004	18.3	01/03/2004	3.4	09/02/2004	19.5	18.3	1.2
11/02/2004	17.9	28/03/2004	3.3	11/02/2004	18.9	17.9	1.0
09/03/2004	17.6	04/04/2004	3.3	13/03/2004	17.9	17.0	0.9
08/03/2004	17.5	22/01/2004	3.2	07/05/2004	17.8	16.1	1.7
08/03/2004	17.5	09/11/2004	3.1	27/11/2004	17.8	17.5	0.3
13/03/2004	17.0	16/10/2004	3.0	07/02/2004	17.7	16.2	1.5

Table 8.8 Summary of highest measured and predicted PM_{10} levels, µg/m^3 (at receptor C6)

Top 10 PM_{10} background		**Top 10 PM_{10} incremental**		**Top 10 PM_{10} cumulative**			
Date	**PM_{10} background**	**Date**	**PM_{10} increment**	**Date**	**PM_{10} cumulative**	**Background contribution**	**Site contribution**
08/03/2004	49.0	22/03/2004	16.5	21/02/2004	**55.5**	47.0	8.5
27/11/2004	48.4	10/03/2004	14.0	26/03/2004	**53.1**	46.1	7.0
21/02/2004	47.0	25/02/2004	12.7	27/11/2004	**51.7**	48.4	3.3
26/03/2004	46.1	20/10/2004	12.2	08/03/2004	49.0	49.0	0.0
08/12/2004	43.7	20/03/2004	11.6	09/02/2004	46.0	43.1	2.9
10/01/2004	43.4	17/08/2004	11.1	08/12/2004	45.9	43.7	2.2
09/02/2004	43.1	02/03/2004	10.9	22/01/2004	45.8	38.0	7.8
06/02/2004	41.2	19/10/2004	10.7	07/12/2004	44.5	40.8	3.7
07/12/2004	40.8	09/11/2004	10.6	06/02/2004	44.1	41.2	2.9
20/02/2004	40.4	18/10/2004	10.1	10/01/2004	43.4	43.4	0.0

Table 8.9 Summary of highest measured and predicted $PM_{2.5}$ levels, µg/m^3 (at receptor C6)

Top 10 $PM_{2.5}$ background		**Top 10 $PM_{2.5}$ incremental**		**Top 10 $PM_{2.5}$ cumulative**			
Date	**$PM_{2.5}$ background**	**Date**	**$PM_{2.5}$ increment**	**Date**	**$PM_{2.5}$ cumulative**	**Background contribution**	**Site contribution**
10/01/2004	22.6	22/03/2004	16.5	21/02/2004	**30.8**	22.3	8.5
21/02/2004	22.3	10/03/2004	14.0	26/03/2004	**26.9**	19.9	7.0
26/03/2004	19.9	25/02/2004	12.7	20/03/2004	**26.1**	14.5	11.6
06/02/2004	19.0	20/10/2004	12.2	07/02/2004	**25.1**	16.2	8.9
09/02/2004	18.3	20/03/2004	11.6	13/03/2004	23.7	17.0	6.7
11/02/2004	17.9	17/08/2004	11.1	10/03/2004	22.9	8.9	14.0
09/03/2004	17.6	02/03/2004	10.9	11/02/2004	22.8	17.9	4.9
08/03/2004	17.5	19/10/2004	10.7	10/01/2004	22.6	22.6	0.0
08/03/2004	17.5	09/11/2004	10.6	03/04/2004	22.4	12.5	9.9
13/03/2004	17.0	18/10/2004	10.1	06/02/2004	21.9	19.0	2.9



Paper Size ISO A4

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Metres

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

N

Manildra Group Pty Ltd
Shoalhaven Starches

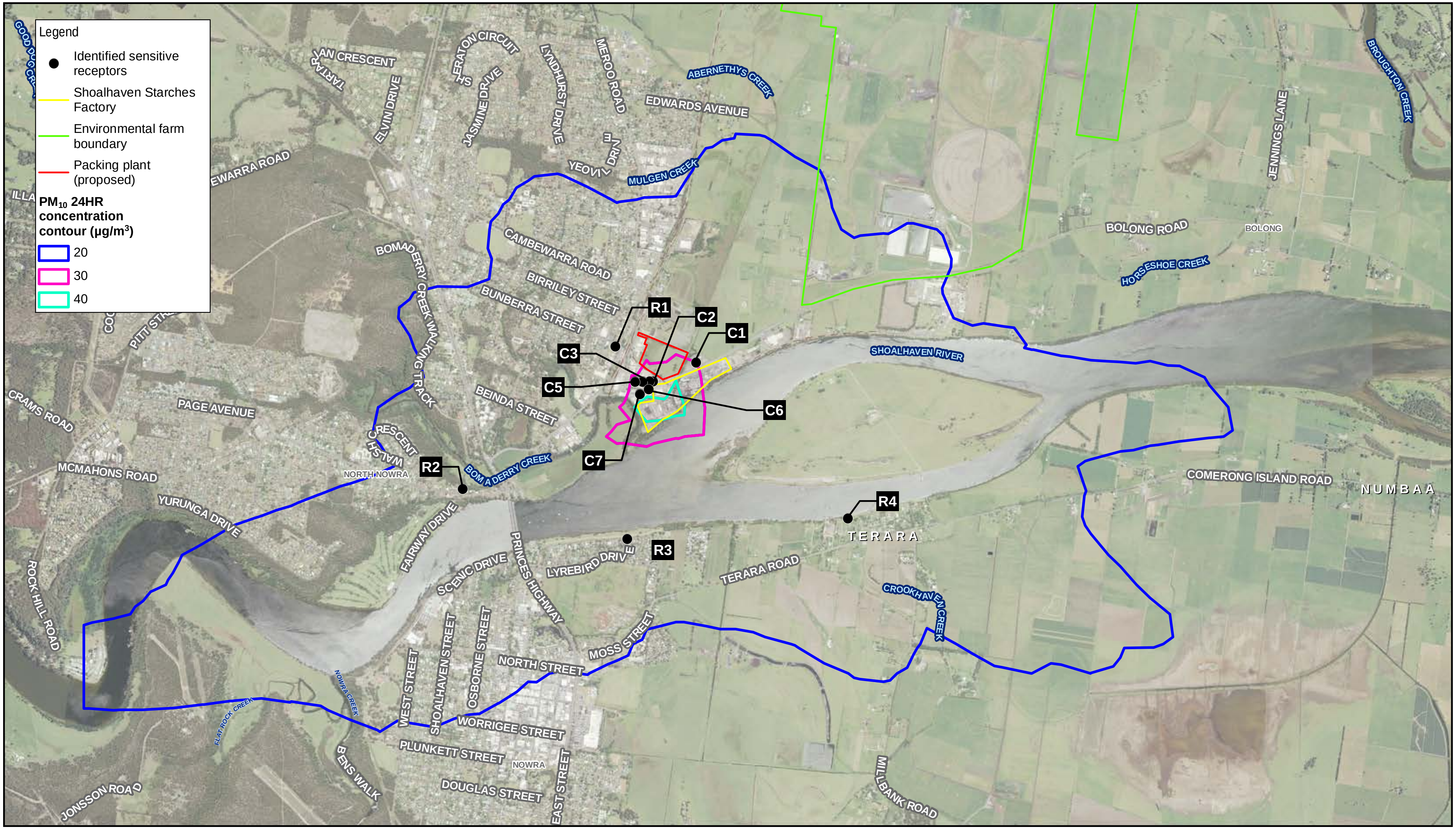
Maximum Predicted Incremental Ground Level PM_{10} Concentrations (24-hour Average) (base scenario)

Project No. 12548374
Revision No. 0
Date 30 Jun 2021

FIGURE 8.1

\\ghdnet\ghd\AU\Sydney\Projects\21\12534209\GIS\Maps\Deliverables\12548374\12548374_004_PM10Incremental.mxd
Print date: 30 Jun 2021 - 09:51

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Finance, Services & Innovation 2018. Created by: kpsroba



Paper Size ISO A4

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Metres

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

N

GHD

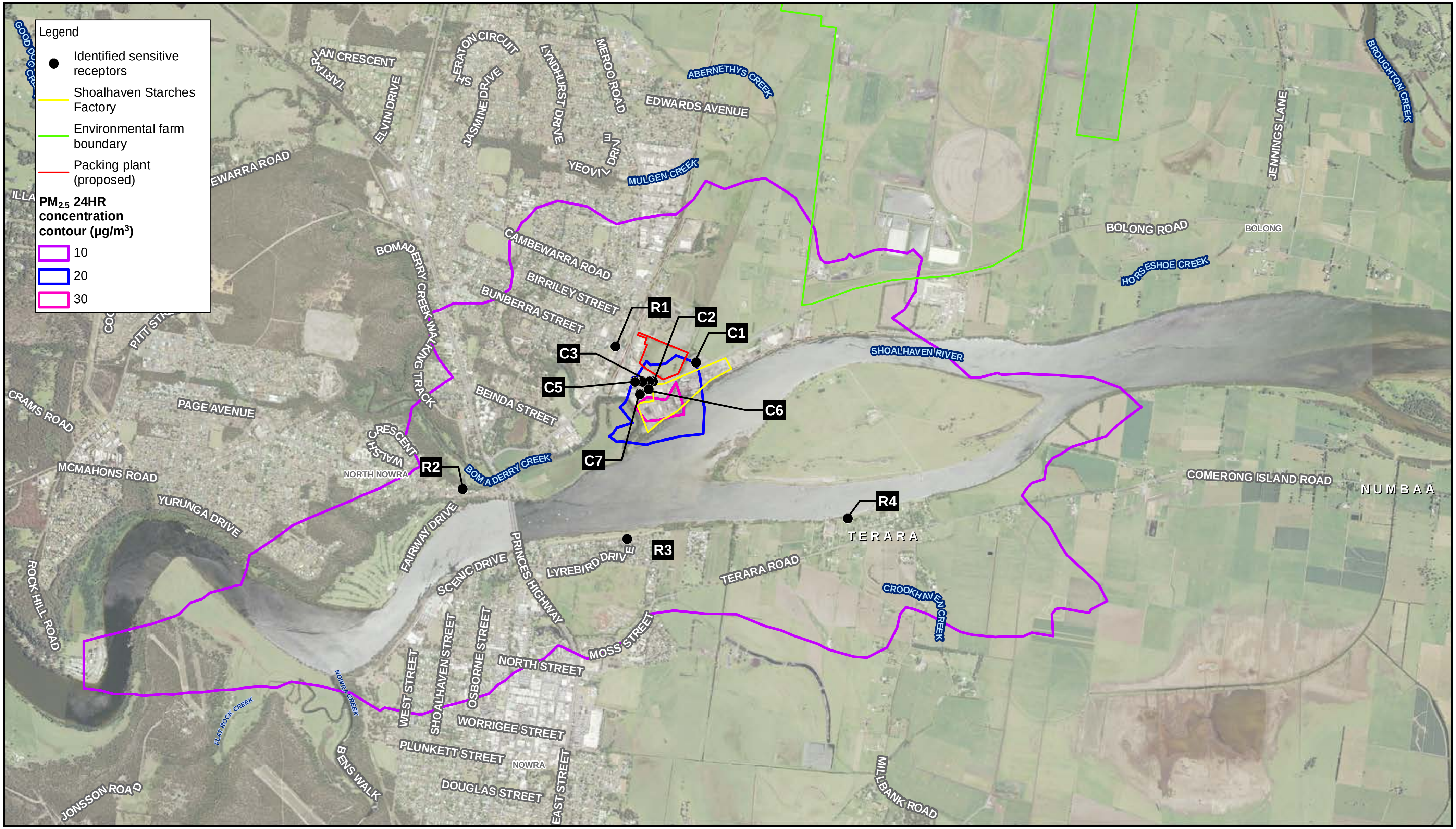
Manildra Group Pty Ltd
Shoalhaven Starches

Maximum Predicted Cumulative Ground Level PM_{10} Concentrations (24-hour Average) (base scenario)

Project No. 12548374
Revision No. 0
Date 30 Jun 2021

FIGURE 8.2

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Finance, Services & Innovation 2018. Created by: kpsroba



Paper Size ISO A4

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Metres

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

N

Manildra Group Pty Ltd
Shoalhaven Starches

Maximum Predicted Cumulative Ground Level $PM_{2.5}$ Concentrations (24-hour Average) (base scenario)

Project No. 12548374
Revision No. 0
Date 30 Jun 2021

FIGURE 8.3

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Print date: 30 Jun 2021 - 10:07

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Finance, Services & Innovation 2018. Created by: kpsroba

8.3.1.3 Cumulative particulate matter (mitigation scenario)

The top predicted, measured and total concentrations at the most impacted residential receptor (R1) and commercial receptor (C6) for Mod 21 mitigation scenario are presented in Table 8.6 to Table 8.9 below. The background and incremental contributions for the highest cumulative concentrations are also included.

Results of the assessment show full compliance with the $PM_{2.5}$ and PM_{10} 24 hour criteria at the worst impacted residential sensitive receptor R1.

Results of the assessment predict exceedances of the PM_{10} 24 hour criteria for three days and the $PM_{2.5}$ 24 hour criteria for four days of the year at the worst impacted commercial receptor C6. The exceedances are bold in Table 8.8 and Table 8.9. Similarly to the results presented in Section 8.3.1.2, the exceedances are primarily attributed to high background concentrations as background PM_{10} accounts for 94%, 92% and 97% of the criteria and background $PM_{2.5}$ accounts for 89%, 80%, 58% and 65% of the criteria on the days of the predicted exceedances.

Plots of the predicted 24 hour maximum PM_{10} levels are provided in Figure 8.4 (incremental impact) and in Figure 8.5 (cumulative impact with 70^{th} percentile PM_{10} levels at Albion Park South 2016 for comparative purposes).

Plots of the predicted 24 hour maximum $PM_{2.5}$ levels are provided in Figure 8.6 (cumulative impact with 70^{th} percentile $PM_{2.5}$ levels at Albion Park South 2016 for comparative purposes).

Table 8.10 Summary of highest measured and predicted PM_{10} levels, µg/m^3 (at receptor R1)

Top 10 PM_{10} background		Top 10 PM_{10} incremental		Top 10 PM_{10} cumulative			
Date	**PM_{10} background**	**Date**	**PM_{10} increment**	**Date**	**PM_{10} cumulative**	**Background contribution**	**Site contribution**
08/03/2004	49.0	10/03/2004	7.6	08/03/2004	49.0	49.0	0.0
27/11/2004	48.4	22/03/2004	6.8	26/03/2004	48.8	46.1	2.7
21/02/2004	47.0	17/08/2004	4.4	27/11/2004	48.7	48.4	0.3
26/03/2004	46.1	23/09/2004	3.7	21/02/2004	47.8	47.0	0.8
08/12/2004	43.7	01/03/2004	3.5	09/02/2004	44.4	43.1	1.3
10/01/2004	43.4	04/04/2004	3.4	08/12/2004	43.8	43.7	0.1
09/02/2004	43.1	22/01/2004	3.3	10/01/2004	43.4	43.4	0.0
06/02/2004	41.2	28/03/2004	3.3	06/02/2004	42.7	41.2	1.5
07/12/2004	40.8	09/11/2004	3.3	22/01/2004	41.3	38.0	3.3
20/02/2004	40.4	16/10/2004	3.1	07/12/2004	41.3	40.8	0.5

Table 8.11 Summary of highest measured and predicted $PM_{2.5}$ levels, µg/m^3 (at receptor R1)

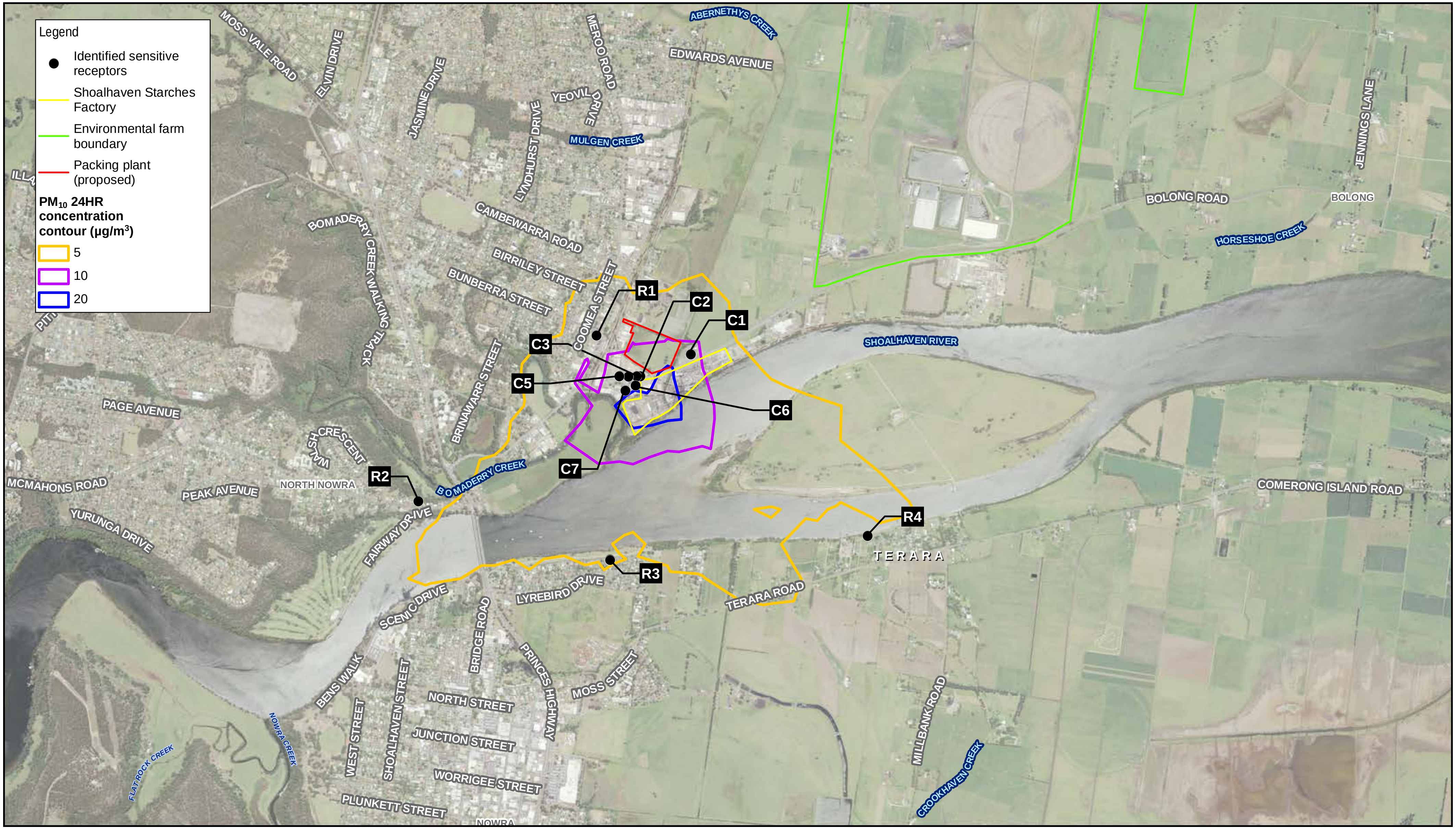
Top 10 $PM_{2.5}$ background		Top 10 $PM_{2.5}$ incremental		Top 10 $PM_{2.5}$ cumulative			
Date	**$PM_{2.5}$ background**	**Date**	**$PM_{2.5}$ increment**	**Date**	**$PM_{2.5}$ cumulative**	**Background contribution**	**Site contribution**
10/01/2004	22.6	10/03/2004	7.6	21/02/2004	23.1	22.3	0.8
21/02/2004	22.3	22/03/2004	6.8	10/01/2004	22.6	22.6	0.0
26/03/2004	19.9	17/08/2004	4.4	26/03/2004	22.6	19.9	2.7
06/02/2004	19.0	23/09/2004	3.7	06/02/2004	20.5	19.0	1.5
09/02/2004	18.3	01/03/2004	3.5	09/02/2004	19.6	18.3	1.3
11/02/2004	17.9	04/04/2004	3.4	11/02/2004	18.9	17.9	1.0
09/03/2004	17.6	22/01/2004	3.3	13/03/2004	18.0	17.0	1.0
08/03/2004	17.5	28/03/2004	3.3	07/05/2004	17.9	16.1	1.8
08/03/2004	17.5	09/11/2004	3.3	27/11/2004	17.8	17.5	0.3
13/03/2004	17.0	16/10/2004	3.1	07/02/2004	17.8	16.2	1.6

Table 8.12 Summary of highest measured and predicted PM_{10} levels, µg/m^3 (at receptor C6)

Top 10 PM_{10} background		Top 10 PM_{10} incremental		Top 10 PM_{10} cumulative			
Date	**PM_{10} background**	**Date**	**PM_{10} increment**	**Date**	**PM_{10} cumulative**	**Background contribution**	**Site contribution**
08/03/2004	49.0	22/03/2004	16.7	21/02/2004	**56.1**	47.0	9.1
27/11/2004	48.4	10/03/2004	14.0	26/03/2004	**53.5**	46.1	7.4
21/02/2004	47.0	25/02/2004	13.7	27/11/2004	**51.9**	48.4	3.5
26/03/2004	46.1	20/10/2004	12.7	08/03/2004	49.0	49.0	0.0
08/12/2004	43.7	20/03/2004	11.7	08/12/2004	46.1	43.7	2.4
10/01/2004	43.4	17/08/2004	11.6	09/02/2004	46.0	43.1	2.9
09/02/2004	43.1	19/10/2004	11.6	22/01/2004	46.0	38.0	8.0
06/02/2004	41.2	02/03/2004	11.5	07/12/2004	44.7	40.8	3.9
07/12/2004	40.8	09/11/2004	11.0	06/02/2004	44.1	41.2	2.9
20/02/2004	40.4	18/10/2004	10.7	10/01/2004	43.4	43.4	0.0

Table 8.13 Summary of highest measured and predicted $PM_{2.5}$ levels, µg/m^3 (at receptor C6)

Top 10 $PM_{2.5}$ background		Top 10 $PM_{2.5}$ incremental		Top 10 $PM_{2.5}$ cumulative			
Date	**$PM_{2.5}$ background**	**Date**	**$PM_{2.5}$ increment**	**Date**	**$PM_{2.5}$ cumulative**	**Background contribution**	**Site contribution**
10/01/2004	22.6	22/03/2004	16.7	21/02/2004	**31.4**	22.3	9.1
21/02/2004	22.3	10/03/2004	14.0	26/03/2004	**27.3**	19.9	7.4
26/03/2004	19.9	25/02/2004	13.7	20/03/2004	**26.2**	14.5	11.7
06/02/2004	19.0	20/10/2004	12.7	07/02/2004	**25.5**	16.2	9.3
09/02/2004	18.3	20/03/2004	11.7	13/03/2004	24.2	17.0	7.2
11/02/2004	17.9	17/08/2004	11.6	10/03/2004	22.9	8.9	14.0
09/03/2004	17.6	19/10/2004	11.6	03/04/2004	22.8	12.5	10.3
08/03/2004	17.5	02/03/2004	11.5	11/02/2004	22.8	17.9	4.9
08/03/2004	17.5	09/11/2004	11.0	10/01/2004	22.6	22.6	0.0
13/03/2004	17.0	18/10/2004	10.7	18/02/2004	22.2	16.0	6.2



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Project No. 12548374
Revision No. 0
Date 30 Jun 2021

Maximum Predicted Incremental Ground Level PM_{10} Concentrations (24-hour Average) (mitigation scenario)

FIGURE 8.4

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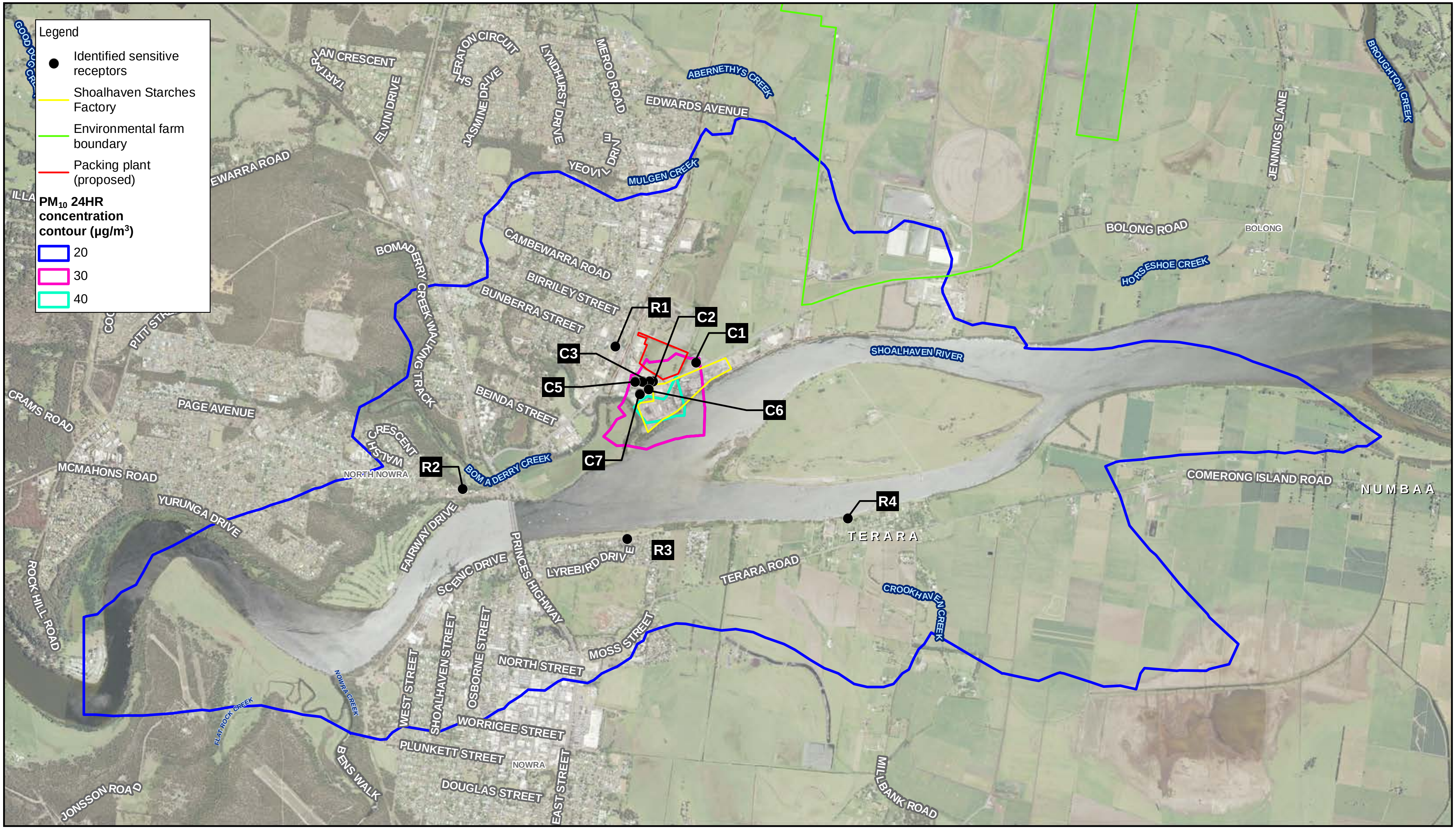
Print date: 30 Jun 2021 - 10:09

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Finance, Services & Innovation 2018. Created by: kpsroba



Paper Size ISO A4

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Metres

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

N

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Manildra Group Pty Ltd
Shoalhaven Starches

Maximum Predicted Cumulative Ground Level PM_{10} Concentrations (24-hour Average) (mitigation scenario)

Project No. 12548374
Revision No. 0
Date 30 Jun 2021

FIGURE 8.5

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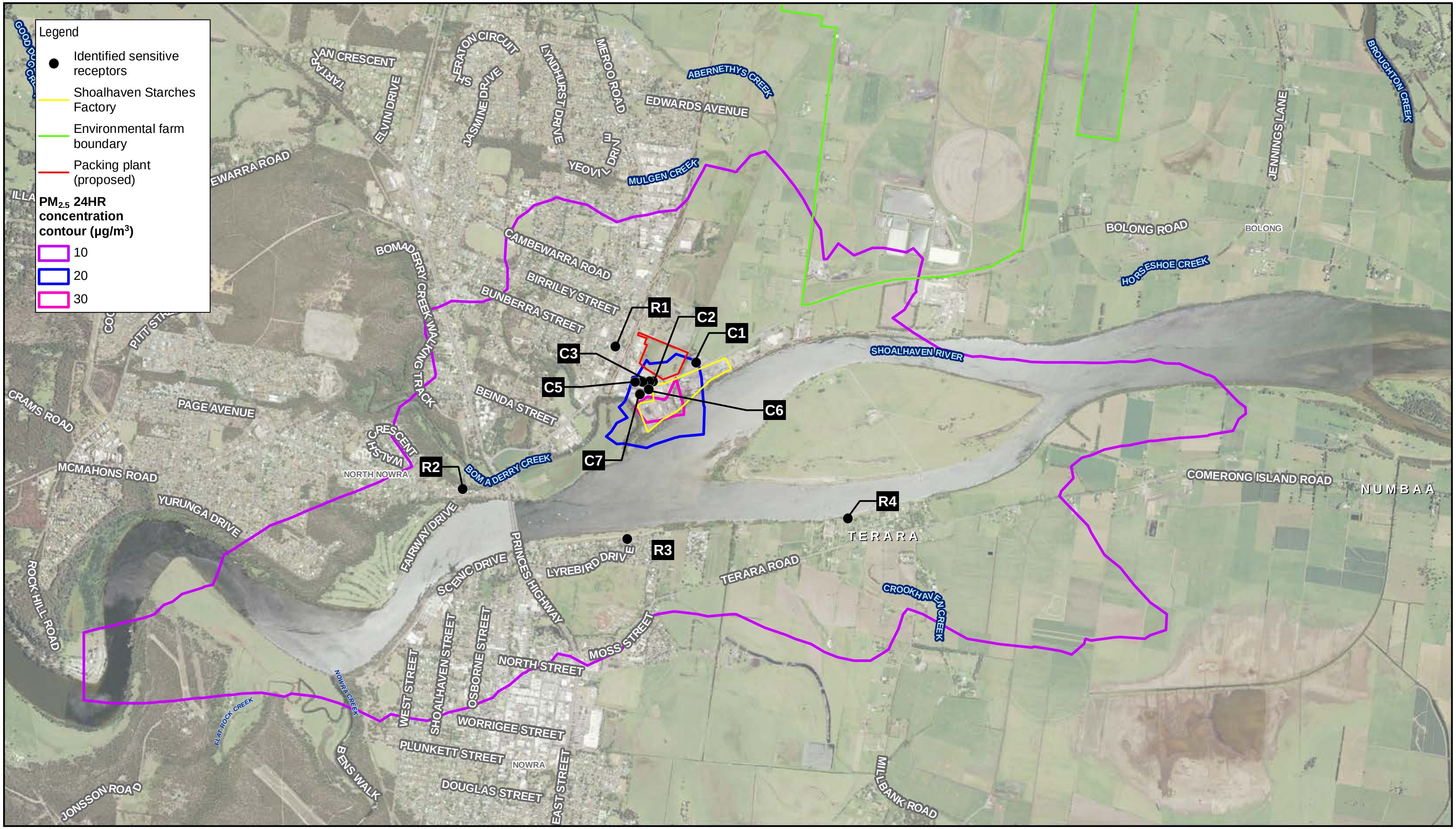
Print date: 30 Jun 2021 - 10:13

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Finance, Services & Innovation 2018. Created by: kpsroba



Paper Size ISO A4

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Metres

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

N

Manildra Group Pty Ltd
Shoalhaven Starches

Maximum Predicted Cumulative Ground Level $PM_{2.5}$ Concentrations (24-hour Average) (mitigation scenario)

Project No. 12548374
Revision No. 0
Date 30 Jun 2021

FIGURE 8.6

\\ghdnet\ghd\AU\Sydney\Projects\21\12534209\GIS\Maps\Deliverables\12548374\12548374_011_PM25CumulativeMitigation.mxd
Print date: 30 Jun 2021 - 10:16

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Finance, Services & Innovation 2018. Created by: kpsroba

8.3.2 Products of combustion

The primary pollutants in coal and gas fired boiler emissions are oxides of nitrogen (NO_x), formed by the high temperatures in the combustors, carbon monoxide (CO), VOCs, and polycyclic aromatic hydrocarbons (PAH) all formed by incomplete combustion of the fuel.

All pollutants have all been assessed against their relevant criteria from the Approved Methods.

Predicted levels for SO_2, NO_2, CO, HF and HCL for base and mitigation scenarios are provided in Table 8.14 to Table 8.23.

For the base scenario:

– Compliance was predicted at all receptors for SO_2, CO, HF and HCL
– The predicted levels for nitrogen dioxide exceed the criteria at all receptors assuming 100% of NO_x will be converted to NO_2 as per Method 1 (Section 8.1.1) of the Approved Methods. This is considered extremely conservative as in reality, only a fraction of the NO will be converted to NO_2.
– Therefore, a more detailed assessment has been undertaken using Method 2 (Section 8.2.2) of the Approved Methods. Method 2 is based on NO reacting with ozone in the atmosphere to form NO_2. Background ozone data was sourced from Kembla Grange for the year 2004. The calculated NO_2 levels using Method 2 are provided in Table 8.16. Using this method exceedances are predicted at commercial/industrial sensitive receptor C1 for two hours of the modelled year (0.02% of the time) and at receptor C2 for one hour of the modelled year C2 (0.05% of the time).

For the mitigation scenario:

– Compliance was predicted at all receptors for SO_2, CO, HF and HCL
– The predicted levels for nitrogen dioxide exceed the criteria at commercial/industrial sensitive receptors C1, C2, C3, C6 and C7 assuming 100% of NO_x will be converted to NO_2 as per Method 1 of the Approved Methods.
– Compliance was predicted at all receptors for NO_2 using Method 2 of the Approved Methods.

Effect of Mod 21 changes

Minor variances between Mod 21 base scenario and previous Mod 19 were predicted. These variances were attributed to fluctuations in combustion emission sampling data.

The Mod 21 mitigation scenario was predicted to reduce combustion pollutant impacts compared with Mod 21 base scenario. This is attributed to Mod 21 mitigation scenario use of gas as a fuel source to replace coal as air emissions from gas are typically lower than coal.

Table 8.14 Maximum predicted ground level Sulfur Dioxide concentrations (base scenario)

Receptor	Total impact (Incremental plus background) (µg/m³)			
Criteria, µg/m³	712 (10 min[1])	570 (1 hour)	228 (24 hour)	60 (Annual)
Background, µg/m³	No data[2]	57.6	15.7	1.6
Bomaderry (R1)	241.0	185.8	46.8	5.1
North Nowra (R2)	182.5	144.9	41.7	3.6
Nowra (R3)	218.4	170.0	34.3	2.6
Terara (R4)	170.5	136.5	24.4	2.2
C1	475.6	349.7	90.4	9.0
C2	552.6	403.5	69.8	9.7
C3	506.7	371.4	66.8	9.2
C4	427.1	315.9	64.8	8.4
C5	365.9	273.0	66.1	7.7
C6	467.5	344.0	75.0	10.0
C7	396.9	294.7	74.2	9.1

Note 1: The 10 minute concentrations were calculated from the hourly values by applying a peak to mean factor of $(60/10)^{0.2}$.

Note 2: The 10 minute background levels were assumed to be the same as the 1 hour background levels in the absence of monitoring data.

Table 8.15 Maximum predicted ground level Sulfur Dioxide concentrations (mitigation scenario)

Receptor	Total impact (Incremental plus background) (µg/m³)			
Criteria, µg/m³	712 (10 min[1])	570 (1 hour)	228 (24 hour)	60 (Annual)
Background, µg/m³	No data[2]	57.6	15.7	1.6
Bomaderry (R1)	189.6	149.8	39.4	4.4
North Nowra (R2)	150.5	122.5	36.0	3.2
Nowra (R3)	202.1	158.6	35.7	2.6
Terara (R4)	143.1	117.3	24.5	2.2
C1	468.2	344.6	95.3	8.9
C2	429.4	317.4	65.4	9.0
C3	392.6	291.7	61.9	8.5
C4	329.0	247.3	64.4	7.6
C5	280.7	213.5	62.6	6.8
C6	381.1	283.6	75.7	9.5
C7	323.5	243.4	77.7	8.4

Note 1: The 10 minute concentrations were calculated from the hourly values by applying a peak to mean factor of $(60/10)^{0.2}$.

Note 2: The 10 minute background levels were assumed to be the same as the 1 hour background levels in the absence of monitoring data.

Table 8.16 Maximum predicted ground level Nitrogen Dioxide concentrations (base scenario)

Receptor	Total impact (Incremental plus background) (µg/m³)		
Criteria, µg/m³	**246 (1 hour, Method 1)**	**246 (1 hour, Method 2)**	**62 (Annual)**
Background, µg/m³	**80.8**	**n/a**	**7.1**
Bomaderry (R1)	318.8	140.4	15.3
North Nowra (R2)	281.9	117.4	11.8
Nowra (R3)	369.7	199.6	10.9
Terara (R4)	323.4	183.2	9.9
C1	795.0	**268.1**	31.9
C2	795.6	**256.9**	34.1
C3	714.2	218.7	31.8
C4	615.3	167.4	27.9
C5	496.1	158.2	24.1
C6	714.7	178.2	35.4
C7	611.8	171.6	30.2

Table 8.17 Maximum predicted ground level Nitrogen Dioxide concentrations (mitigation scenario)

Receptor	Total impact (Incremental plus background) (µg/m³)		
Criteria, µg/m³	**246 (1 hour, Method 1)**	**246 (1 hour, Method 2)**	**62 (Annual)**
Background, µg/m³	**80.8**	**n/a**	**7.1**
Bomaderry (R1)	110.9	109.4	10.9
North Nowra (R2)	89.5	98.3	9.4
Nowra (R3)	140.2	133.0	8.8
Terara (R4)	78.9	122.4	8.2
C1	374.4	236.7	19.2
C2	319.9	151.3	19.1
C3	286.5	149.8	18.1
C4	228.6	145.7	16.3
C5	185.6	141.9	14.8
C6	301.1	151.2	19.8
C7	246.8	142.2	17.6

Table 8.18 Maximum predicted ground level Carbon Monoxide concentrations (base scenario)

Receptor	Total impact (Incremental plus background) (mg/m³)		
Criteria, µg/m³	**100 (15 min[1])**	**30 (1 hour)**	**10 (8 hour)**
Background, µg/m³	**No data[2]**	**1**	**0.6**
Bomaderry (R1)	1.05	1.04	0.62
North Nowra (R2)	1.04	1.03	0.62
Nowra (R3)	1.05	1.04	0.62
Terara (R4)	1.03	1.02	0.61
C1	1.14	1.10	0.68
C2	1.14	1.11	0.67
C3	1.13	1.09	0.66
C4	1.10	1.08	0.65
C5	1.08	1.06	0.64
C6	1.13	1.10	0.66
C7	1.11	1.08	0.65

Note 1: The 15 minute concentrations were calculated from the hourly values by applying a peak to mean factor of $(60/15)^{0.2}$.
Note 2: The 15 minute background levels were assumed to be the same as the 1 hour background levels in the absence of monitoring data.

Table 8.19 Maximum predicted ground level Carbon Monoxide concentrations (mitigation scenario)

Receptor	Total impact (Incremental plus background) (mg/m³)		
Criteria, µg/m³	**100 (15 min[1])**	**30 (1 hour)**	**10 (8 hour)**
Background, µg/m³	**No data[2]**	**1**	**0.6**
Bomaderry (R1)	1.05	1.04	0.62
North Nowra (R2)	1.05	1.04	0.62
Nowra (R3)	1.07	1.06	0.63
Terara (R4)	1.04	1.03	0.61
C1	1.17	1.13	0.70
C2	1.16	1.12	0.68
C3	1.14	1.11	0.67
C4	1.11	1.08	0.65
C5	1.09	1.07	0.65
C6	1.15	1.11	0.68
C7	1.13	1.10	0.66

Note 1: The 15 minute concentrations were calculated from the hourly values by applying a peak to mean factor of $(60/15)^{0.2}$.
Note 2: The 15 minute background levels were assumed to be the same as the 1 hour background levels in the absence of monitoring data.

Table 8.20 Maximum predicted ground level Hydrogen Fluoride concentrations (base scenario)

Receptor	Total impact (Incremental plus background) (μg/m³)			
Criteria, μg/m³	**1.5 (24 hour)**	**0.8 (7 day)**	**0.4 (30 day)**	**0.5 (90 day)**
Background, μg/m³	**No data**	**No data**	**No data**	**No data**
Bomaderry (R1)	0.37	0.12	0.08	0.07
North Nowra (R2)	0.31	0.09	0.07	0.04
Nowra (R3)	0.20	0.03	0.02	0.02
Terara (R4)	0.09	0.02	0.01	0.01
C1	0.84	0.32	0.14	0.09
C2	0.61	0.24	0.16	0.14
C3	0.58	0.23	0.15	0.13
C4	0.53	0.22	0.14	0.11
C5	0.57	0.20	0.13	0.11
C6	0.64	0.28	0.18	0.15
C7	0.62	0.26	0.18	0.14

Table 8.21 Maximum predicted ground level Hydrogen Fluoride concentrations (mitigation scenario)

Receptor	Total impact (Incremental plus background) (μg/m³)			
Criteria, μg/m³	**1.5 (24 hour)**	**0.8 (7 day)**	**0.4 (30 day)**	**0.5 (90 day)**
Background, μg/m³	**No data**	**No data**	**No data**	**No data**
Bomaderry (R1)	0.27	0.08	0.06	0.05
North Nowra (R2)	0.23	0.07	0.06	0.03
Nowra (R3)	0.21	0.04	0.02	0.02
Terara (R4)	0.09	0.02	0.01	0.01
C1	0.86	0.32	0.14	0.09
C2	0.52	0.21	0.14	0.11
C3	0.49	0.20	0.13	0.11
C4	0.50	0.18	0.12	0.10
C5	0.49	0.17	0.10	0.09
C6	0.61	0.25	0.16	0.13
C7	0.62	0.23	0.15	0.12

Table 8.22 99.9 percentile predicted ground level Hydrogen Chloride concentrations (base scenario)

Receptor	Averaging Period	Incremental Impact (mg/m^3)	Background Concentration (mg/m^3)	Total Impact (mg/m^3)	Criteria (mg/m^3)
Bomaderry (R1)	1 hour	0.001	-	0.001	0.14
North Nowra (R2)	1 hour	0.001	-	0.001	0.14
Nowra (R3)	1 hour	0.001	-	0.001	0.14
Terara (R4)	1 hour	0.000	-	0.000	0.14
C1	1 hour	0.002	-	0.002	0.14
C2	1 hour	0.002	-	0.002	0.14
C3	1 hour	0.002	-	0.002	0.14
C4	1 hour	0.002	-	0.002	0.14
C5	1 hour	0.001	-	0.001	0.14
C6	1 hour	0.002	-	0.002	0.14
C7	1 hour	0.002	-	0.002	0.14

Table 8.23 99.9 percentile predicted ground level Hydrogen Chloride concentrations (mitigation scenario)

Receptor	Averaging Period	Incremental Impact (mg/m^3)	Background Concentration (mg/m^3)	Total Impact (mg/m^3)	Criteria (mg/m^3)
Bomaderry (R1)	1 hour	0.001	-	0.001	0.14
North Nowra (R2)	1 hour	0.000	-	0.000	0.14
Nowra (R3)	1 hour	0.000	-	0.000	0.14
Terara (R4)	1 hour	0.000	-	0.000	0.14
C1	1 hour	0.002	-	0.002	0.14
C2	1 hour	0.001	-	0.001	0.14
C3	1 hour	0.001	-	0.001	0.14
C4	1 hour	0.001	-	0.001	0.14
C5	1 hour	0.001	-	0.001	0.14
C6	1 hour	0.001	-	0.001	0.14
C7	1 hour	0.001	-	0.001	0.14

8.3.3 PAH, VOCs and metals

The maximum predicted (99.9 percentile, 1-hour average) ground level incremental PAH, VOC and metal concentrations (with the exception of lead which is presented as a 100 percentile annually averaged concentration to align with its assessment criteria), within and beyond the factory site boundary for the base and mitigation scenarios are provided in Table 8.24 and Table 8.25 respectively. The predicted levels are significantly lower than the respective EPA principal toxic air pollutant criteria for all substances both within and beyond the site boundary.

Effect of Mod 21 changes

No new sources of PAH, VOC or metal emissions are proposed as part of Mod 21 base scenario compared to those assessed in Mod 19. Minor variations in predicted concentrations for Mod 21 mitigation scenario are attributed to the proposed boilers operation and fuel usage changes.

Table 8.24 Maximum predicted ground level PAH, VOC and metals concentrations (base scenario)

Receptor	Incremental Impact (mg/m^3)										
Pollutant	**PAH**	**VOC**	**Antimony**	**Arsenic**	**Cadmium**	**Mercury**	**Beryllium**	**Chromium**	**Manganese**	**Nickel**	**Lead**
Criteria	**4.00E-04 mg/m^3 (1 hour)**	**Individual VOCs (1 hour)**	**9.00E-03 mg/m^3 (1 hour)**	**9.00E-05 mg/m^3 (1 hour)**	**1.80E-05 mg/m^3 (1 hour)**	**1.80E-03 mg/m^3 (1 hour)**	**4.00E-06 mg/m^3 (1 hour)**	**9.00E-05 mg/m^3 (1 hour)**	**1.80E-02 mg/m^3 (1 hour)**	**1.80E-04 mg/m^3 (1 hour)**	**5.0E-04 mg/m^3 (Annual)[12]**
Bomaderry (R1)	1.2E-06	1.4E-03	1.2E-06	1.7E-06	1.1E-07	1.8E-07	1.0E-07	6.6E-07	1.7E-06	2.1E-06	1.6E-07
North Nowra (R2)	1.0E-06	1.4E-03	1.2E-06	1.7E-06	1.0E-07	1.6E-07	8.3E-08	6.6E-07	1.6E-06	2.1E-06	9.5E-08
Nowra (R3)	1.6E-06	1.7E-03	1.3E-06	2.2E-06	1.6E-07	2.0E-07	7.8E-08	8.8E-07	1.9E-06	2.5E-06	5.9E-08
Terara (R4)	7.7E-07	9.9E-04	7.4E-07	1.1E-06	8.6E-08	1.3E-07	5.9E-08	4.6E-07	1.2E-06	1.4E-06	3.4E-08
C1	4.0E-06	4.9E-03	4.0E-06	6.0E-06	3.7E-07	5.9E-07	2.8E-07	2.4E-06	5.6E-06	7.3E-06	4.0E-07
C2	3.5E-06	4.5E-03	3.4E-06	5.2E-06	3.9E-07	5.2E-07	2.5E-07	2.2E-06	4.8E-06	6.4E-06	4.4E-07
C3	3.2E-06	4.2E-03	3.2E-06	4.7E-06	3.6E-07	4.8E-07	2.3E-07	2.0E-06	4.4E-06	5.8E-06	4.1E-07
C4	2.6E-06	3.3E-03	2.5E-06	3.7E-06	2.7E-07	3.9E-07	1.9E-07	1.5E-06	3.6E-06	4.7E-06	3.5E-07
C5	2.2E-06	2.7E-03	2.1E-06	3.0E-06	2.1E-07	3.1E-07	1.7E-07	1.2E-06	2.9E-06	3.8E-06	3.0E-07
C6	3.3E-06	4.4E-03	3.3E-06	5.0E-06	3.8E-07	5.0E-07	2.3E-07	2.1E-06	4.6E-06	6.1E-06	4.7E-07
C7	2.5E-06	3.2E-03	2.5E-06	3.6E-06	2.9E-07	3.7E-07	2.0E-07	1.5E-06	3.4E-06	4.5E-06	4.0E-07
Maximum level (on site)	7.8E-06	8.3E-03	6.7E-06	1.1E-05	1.3E-06	9.0E-07	3.6E-07	4.2E-06	8.9E-06	1.2E-05	6.7E-07

[12] Lead criteria converted from $\mu g/m^3$ to mg/m^3 so that all results have consistent units

Table 8.25 Maximum predicted ground level PAH, VOC and metals concentrations (mitigation scenario)

Receptor	Incremental Impact (mg/m^3)										
Pollutant	**PAH**	**VOC**	**Antimony**	**Arsenic**	**Cadmium**	**Mercury**	**Beryllium**	**Chromium**	**Manganese**	**Nickel**	**Lead**
Criteria	**4.00E-04 mg/m^3 (1 hour)**	**Individual VOCs (1 hour)**	**9.00E-03 mg/m^3 (1 hour)**	**9.00E-05 mg/m^3 (1 hour)**	**1.80E-05 mg/m^3 (1 hour)**	**1.80E-03 mg/m^3 (1 hour)**	**4.00E-06 mg/m^3 (1 hour)**	**9.00E-05 mg/m^3 (1 hour)**	**1.80E-02 mg/m^3 (1 hour)**	**1.80E-04 mg/m^3 (1 hour)**	**5.0E-04 mg/m^3 (Annual)[13]**
Bomaderry (R1)	4.4E-07	1.7E-03	1.2E-06	1.8E-06	1.3E-07	1.8E-07	1.1E-07	7.8E-07	1.4E-06	2.2E-06	1.5E-07
North Nowra (R2)	4.1E-07	1.8E-03	1.2E-06	2.0E-06	1.4E-07	1.7E-07	1.1E-07	8.1E-07	1.4E-06	2.3E-06	9.0E-08
Nowra (R3)	6.0E-07	2.6E-03	1.7E-06	2.8E-06	2.0E-07	2.5E-07	1.5E-07	1.2E-06	2.0E-06	3.4E-06	6.3E-08
Terara (R4)	3.1E-07	1.2E-03	8.3E-07	1.3E-06	1.0E-07	1.4E-07	7.6E-08	5.7E-07	9.9E-07	1.6E-06	3.5E-08
C1	1.5E-06	6.5E-03	4.8E-06	7.4E-06	4.3E-07	6.8E-07	4.5E-07	3.0E-06	5.6E-06	8.9E-06	4.3E-07
C2	1.3E-06	5.7E-03	3.9E-06	6.2E-06	4.6E-07	5.7E-07	3.5E-07	2.6E-06	4.5E-06	7.4E-06	4.4E-07
C3	1.2E-06	5.2E-03	3.5E-06	5.6E-06	4.2E-07	5.2E-07	3.2E-07	2.4E-06	4.1E-06	6.7E-06	4.1E-07
C4	9.7E-07	4.1E-03	2.8E-06	4.4E-06	3.3E-07	4.1E-07	2.5E-07	1.9E-06	3.2E-06	5.2E-06	3.5E-07
C5	8.0E-07	3.4E-03	2.3E-06	3.6E-06	2.6E-07	3.3E-07	2.0E-07	1.6E-06	2.7E-06	4.3E-06	3.0E-07
C6	1.3E-06	5.7E-03	3.7E-06	5.9E-06	4.6E-07	5.5E-07	3.4E-07	2.5E-06	4.3E-06	7.1E-06	4.8E-07
C7	9.4E-07	4.1E-03	2.7E-06	4.2E-06	3.5E-07	4.0E-07	2.5E-07	1.8E-06	3.1E-06	5.1E-06	4.1E-07
Maximum level (on site)	2.6E-06	1.1E-02	9.0E-06	1.5E-05	1.6E-06	1.3E-06	7.2E-07	5.5E-06	9.5E-06	1.6E-05	7.4E-07

[13] Lead criteria converted from µg/m^3 to mg/m^3 so that all results have consistent units

9. Conclusions

GHD was engaged by Manildra to conduct an air quality and odour impact assessment for a proposed modification to the approved SSEP. The modification proposes to modify the packing plant, install an additional raw waste water tank within the Environmental Farm and increase the indirect cooking capacity by 50%.

In addition, Manildra propose to install additional approved biofilter capacity in the previously approved location to improve odour performance. It is recommended that Manildra have additional biofilter capacity installed prior to commissioning of Mod 21.

Odour dispersion modelling was undertaken for the quarter with maximum odour emissions (in accordance with the methodology adopted for past modification air quality assessments) (Quarter 2) and for the most recent quarter (Quarter 3).

Modelling of the quarter 2 predicted a marginal increase in odour impacts resulting in an exceedance at residential receptors R2 and R3. This exceedance was primarily attributed to high quarterly odour sampling results.

Modelling of the most recent quarter 3 predicted compliance of the odour criteria at all residential receptors.

A review of the site's odour complaint history shows three odour complaints in 2020 and two to date in 2021, reflecting the sites improved odour performance.

Dispersion modelling of particulates, combustion products, PAH, VOCs and metals was undertaken for base and mitigation scenarios.

For both base and mitigation scenarios, minor exceedances of the cumulative 24 hour PM_{10} and $PM_{2.5}$ criteria were predicted at commercial receptor C1. These particular matter exceedances were primarily attributed to high background concentrations that occurred on the days where exceedances were predicted.

For the base scenario, nitrogen dioxide concentrations were predicted to exceed the criteria at commercial/industrial sensitive receptor C1 for two hours of the modelled year (0.02% of the time) and C2 for one hour of the modelled year C2 (0.05% of the time) for the base scenario. There were no predicted exceedances of the nitrogen dioxide criteria in the mitigation scenario where the use of coal boiler 8 was replaced with the use of gas boiler 7 and gas boiler 8.

Therefore is it recommended that Manildra investigate opportunities to use gas fired boilers instead of coal. It is understood that Manildra will be incorporating the conversion of coal fired boilers to gas as part of the future proposal to construct a gas fired co-generation plant as part of the future Modification 23.

Compliance was predicted for all other air quality species for both scenarios.

Appendices

Appendix A

Meteorological analysis

The following section is taken from the Shoalhaven Starches Report on Ethanol Upgrade: Air Quality Assessment (GHD, 2008), and describes the meteorology of the area and how the dataset was compiled.

A1 Meteorology

The three-dimensional meteorological data for a CALPUFF model simulation are provided by CALMET[14], its meteorological pre-processor. CALMET requires meteorological input from surface weather station networks and upper air stations.

The following sub-sections describe the available meteorological data, how the data was applied and the features of the dispersion meteorological data used to run CALPUFF.

A1.1 Data Available

Wind data were collected at three locations within the Shoalhaven Starches facility. Of these three stations, only one station, the automated weather station (AWS) located near the storage ponds at the environmental farm (hereafter referred to as Farm AWS), is compliant with the Australian Standard for the measurement of horizontal wind for air quality applications (AS 2923:1987). The other two stations, in particular the weather station located at the factory, are compromised by building and equipment infrastructure. Wind data have been collected at the Farm AWS since 2003, with the most complete data set collected in 2004.

The nearest source of additional surface meteorological data was the Bureau of Meteorology (BoM) Nowra AWS located approximately 12 km to the west at the Royal Australian Navy base at Nowra (HMAS ALBATROSS). This data source was considered to be too far from the subject area to be site-representative.

The nearest source of upper air meteorological data was also the HMAS ALBATROSS site, which does irregular upper air soundings based on operational requirements. However, the time gap between these vertical atmospheric soundings is too large to be suitable for use as model input.

A1.2 Data Application

To take full advantage of the CALPUFF features, described in Section 7.1, and make use of the available meteorological data described above, a combined prognostic/diagnostic meteorological modelling approach was used to synthesise the three-dimensional meteorological data input required by CALPUFF.

The regional-scale prognostic meteorological model, TAPM[15], was used to simulate the meteorology over the subject site with consideration to the DECC *Approved Methods*. TAPM is an approved model for specialist applications and its use, as part of this assessment, is described in the next section.

The observations from the Farm AWS and Nowra AWS were first used for optimising and checking the performance of the prognostic model simulation.

Wind speed and wind direction data from the Farm AWS were then assimilated into the prognostic model.

The subsequent TAPM output (with assimilated Farm AWS data) was then passed to meteorological pre-processor model CALMET (version 5.5).

A2 Prognostic Meteorological Modelling

TAPM (version 3.0.7) was developed at CSIRO Division of Atmospheric Research as a PC-based prognostic modelling system that can predict regional scale three-dimensional meteorology. TAPM accesses databases of synoptic weather analyses from the Bureau of Meteorology. The model then provides the link between the

[14] Scire J.S., E.M. Insley, R.J. Yamartino, and M.E. Fernau, 1995: A User's Guide for the CALMET Meteorological Model. Report prepared for the USDA Forest Service by EARTH TECH, Concord, MA. See: http://www.src.com/calpuff/calpuff1.htm
[15] Hurley, P. The Air Pollution Model (TAPM) version 3. CSIRO Atmospheric Research Paper No. 31, 2005

synoptic large-scale flows and local climatology, which includes characterising such factors as local land use and topography, and their influence on atmospheric stability and mixing height.

TAPM was initially configured with a nested model grid coverage designed to capture:

– Broad scale synoptic flows
– Regional to local scale wind channelling
– The influence of local land use

The nested grids were then configured with surface characteristics, such as terrain elevation, surface type (land use and vegetation type), soil type and deep soil moisture content.

Specific model settings were:

– Four nested grids at 1 000 m, 3 000 m, 10 000 m and 25 000 m resolution, with 55 x 55 grid points. The grid was set to ensure the locations of the Farm AWS and Nowra AWS were within the inner nested grid
– Surface vegetation and precipitation processes were included, whereas, non-hydrostatic processes were not included

Following an initial model run, the model output from the grid point nearest to the Farm AWS was compared with data recorded at that station. Specifically, the predicted hourly ambient temperatures and the annual wind rose (wind speed and direction distributions) were compared with corresponding recordings. Model output from the model grid point nearest to the Nowra AWS was also compared with an annual wind rose derived from data recorded at that station.

Figure A1 shows the scatter plot of observed and predicted ambient temperature at the Farm AWS. The determined optimal model configuration produced a correlation coefficient of 0.88 for predicted temperature. The strong correlation between predicted and recorded temperature indicates that the model is accurately calculating the surface energy balance, which, in turn, adds confidence to the hourly varying predictions made for atmospheric stability and the height of the mixed layer.

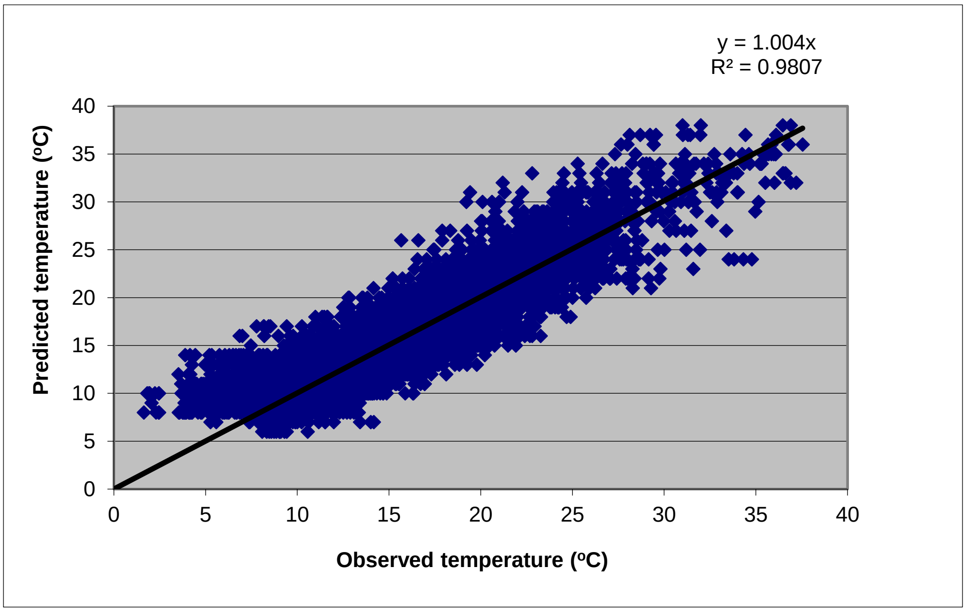


Figure A1 Scatter Plot of Observed and Predicted Ambient Temperature

A2.1 Wind Distribution

Figure A2 shows the predicted (a) and observed (b) wind roses for the location of the Nowra AWS. The directional distribution of winds predicted by TAPM shows reasonable agreement with the recorded observations and with the wind patterns expected for this region.

Figure A3 shows the predicted (a) and observed (b) wind roses for the location of the Farm AWS after the initial TAPM simulation. The directional distribution of winds predicted by TAPM shows reasonable agreement with the recorded wind patterns expected for this region.

The wind speed and direction observations from the Farm AWS were assimilated into the prognostic model simulation to improve the ability of the model to capture the effects of local wind channelling and low wind speed conditions. The improvement to wind direction distributions in the model output is clearly evident in Figure A3(c). The marked improvement in the capture of low wind events is examined below.

It is understood that TAPM performs reasonably well at simulating low wind speeds when the atmosphere is unstable but is known to perform relatively poorly during stable atmospheric conditions[16]. This is a critical factor in this assessment given that odour emissions occur 24-hours per day, resulting in predictions of maximum odour impact dominating during these conditions.

Figure A4 shows a histogram of wind speed distribution for observations at the Farm AWS, predictions from TAPM and predictions from TAPM after wind speed and direction data from the Farm AWS were assimilated into TAPM. It is clear from this figure that TAPM did reasonably well at originally predicting moderate to high wind speeds but did relatively poorly predicting low wind speeds. However, Figure A4 also shows that the representation of low winds in the TAPM output was significantly improved once the Farm AWS data were assimilated into the model.

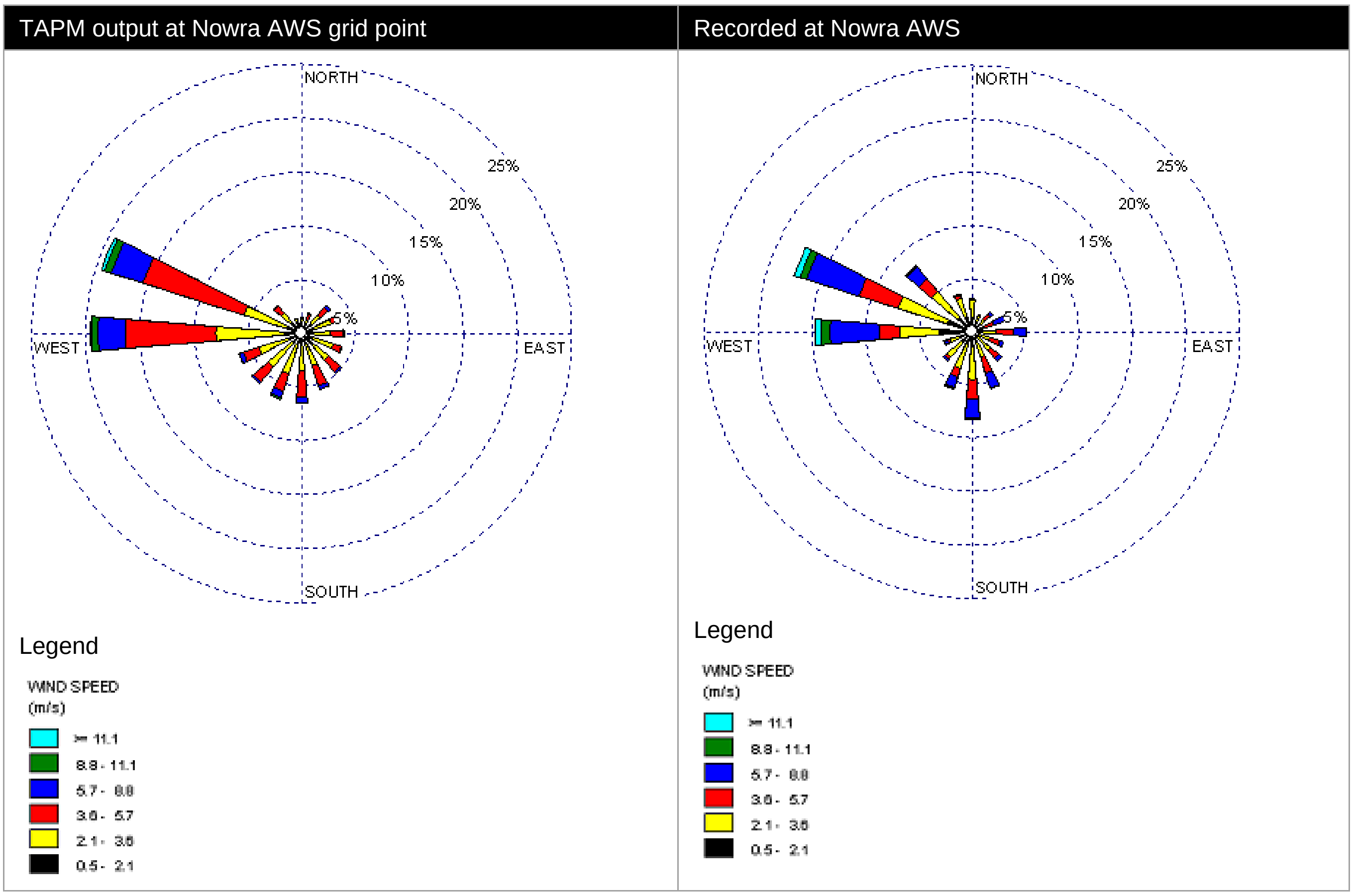


Figure A2 ***Nowra AWS - Annual Wind Roses (Year 2004)***

[16] Luhar, A., Hurley, P. and Rayner, K. Improving Land Surface Processes in TAPM. Part 2: Low Wind Stable Conditions. 14th IUAPPA World Congress 2007

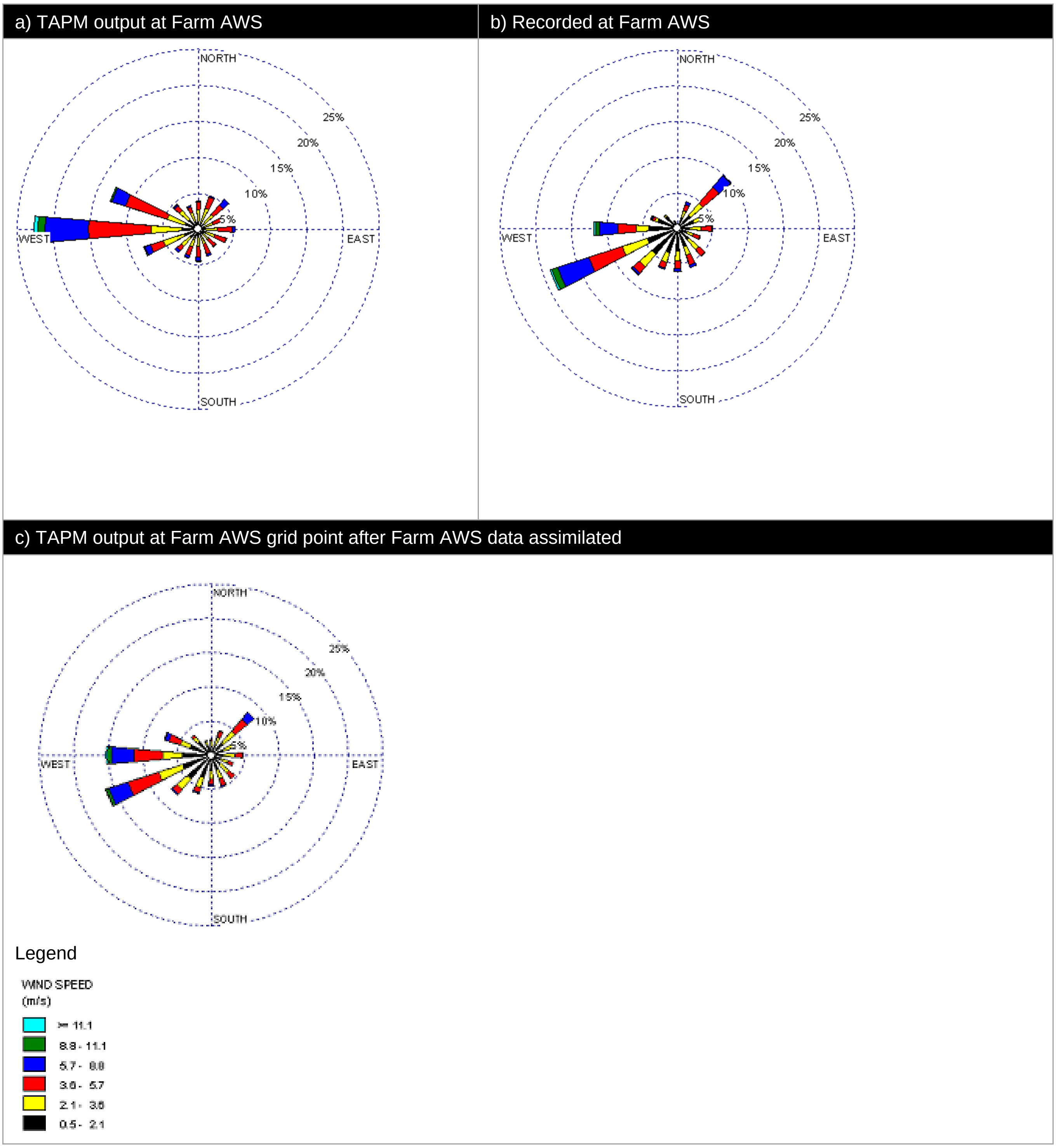


Figure A3 Farm AWS - Annual Wind Roses (year 2004)

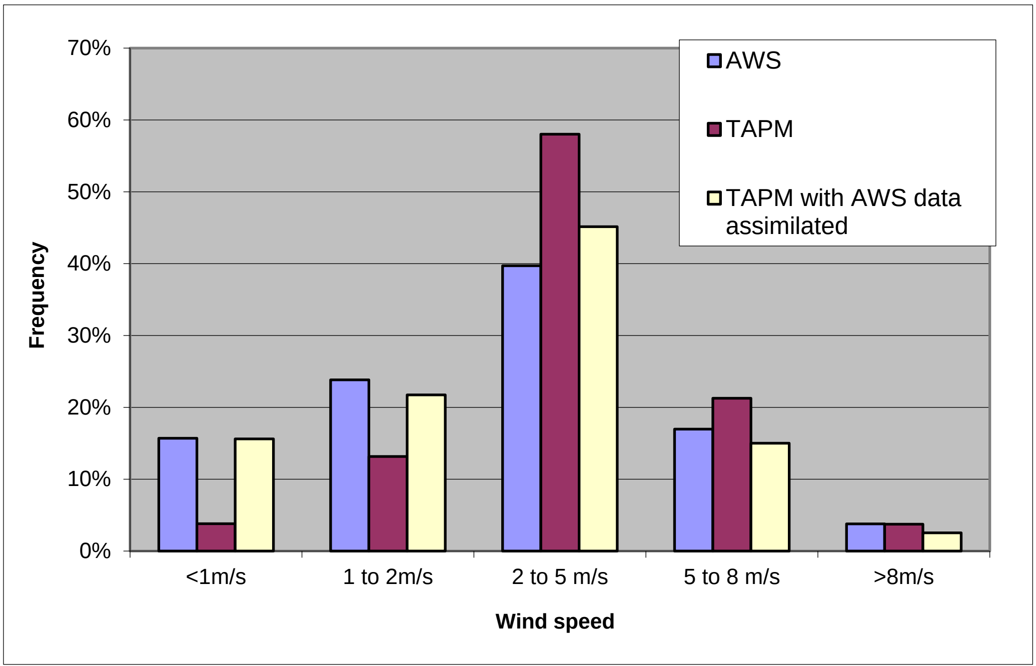


Figure A4 Wind Speed Distribution – TAPM and Farm AWS

To further investigate the effect of data assimilation on model output, a sensitivity analysis was conducted to compare the subsequent CALPUFF model predictions using meteorological input derived with and without the assimilation of observed wind speed and wind direction data from the Farm AWS into TAPM. Good agreement was found in the general pattern of dispersion (i.e. similar directions of poor dispersion), however, the highest ground level odour concentrations were predicted when the assimilated meteorological data file was used, which was expected given the higher frequency of light winds.

A3 Diagnostic Meteorological Model - CALMET

The TAPM output (with assimilated data) was then passed to model CALMET (version 5.5)[17], which is the 3D meteorological diagnostic model pre-processor to the CALPUFF 3D puff based dispersion model.

Hourly varying 3D meteorological data, at a 1000 m resolution, were extracted from the TAPM inner nested grid and passed to CALMET in their entirety as initial guess fields. Surface meteorological parameters and vertical profile data were also extracted from TAPM at a grid point near the factory, and used as if they were observations in the diagnostic model (i.e. pseudo-data).

CALMET was configured with a 15 km by 15 km grid at 200 m resolution and with local scale surface characteristics, such as terrain elevation and land use (e.g. forest or sparse growth, water or residential). The land use and terrain elevation information was derived from US Geological Survey and AusLig data, respectively, with adjustments based upon inspection of aerial photographs, topographical and land uses maps, and a site inspection.

CALMET was used to produce hourly site-representative winds and micrometeorological information, which was used with the CALPUFF 3D puff-based dispersion model to assess the impacts of the air pollutants on the surrounding land uses.

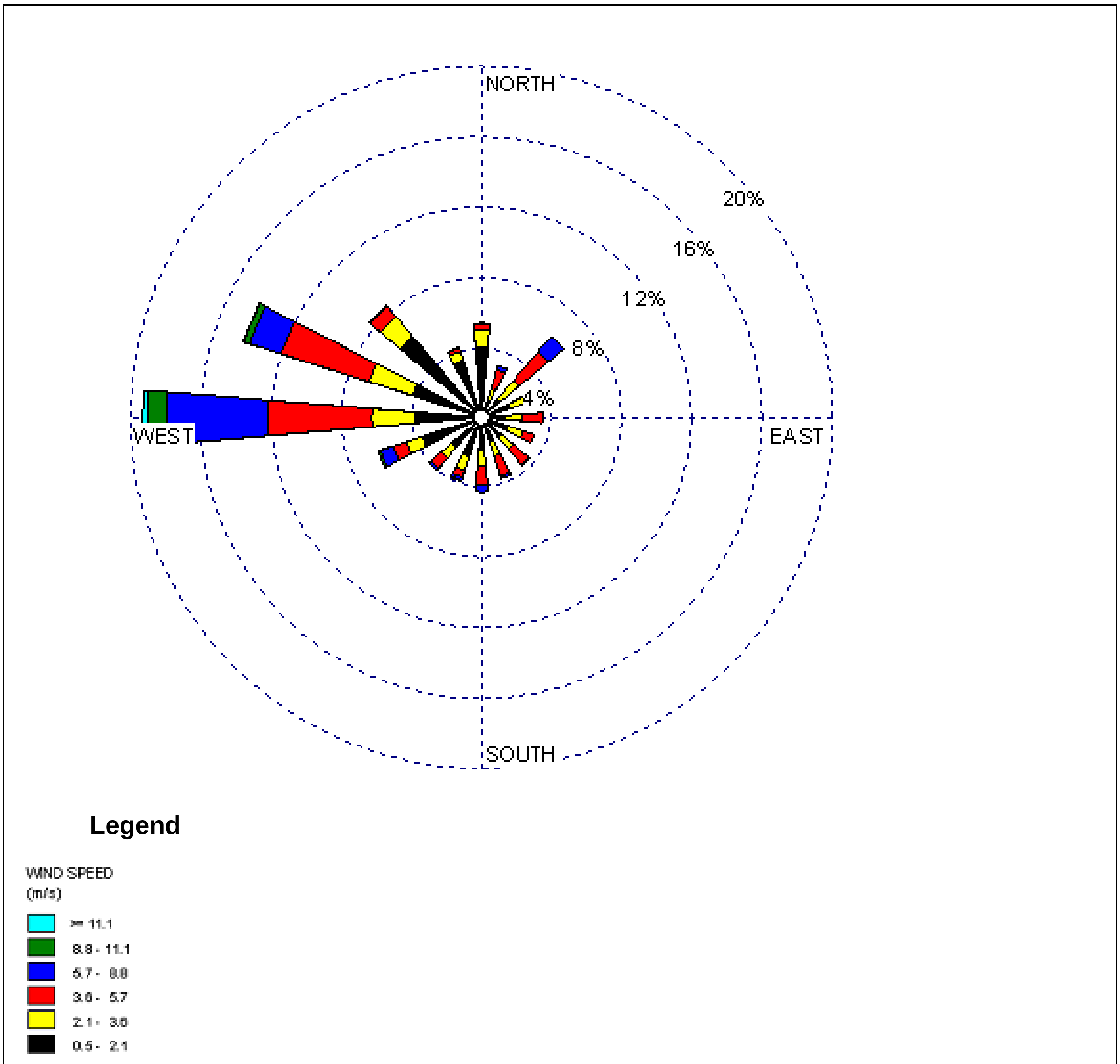
A3.1 Site-specific meteorology

Figure A5 shows a wind rose that illustrates the distribution of wind speed and direction at the location of the Factory. On an annual basis the prevailing winds are from the west with winds also from the west-north-west, north-west, west-south-west and north-east. The mean wind speed is 3.2 m/s, with higher speed winds associated

[17] Scire J.S., E.M. Insley, R.J. Yamartino, and M.E. Fernau, 1995: A User's Guide for the CALMET Meteorological Model. Report prepared for the USDA Forest Service by EARTH TECH, Concord, MA. See: http://www.src.com/calpuff/calpuff1.htm

with westerly winds with speeds up to 11 m/s; such speeds are not reached from other directions. The highest frequency of light winds occurs from the south-west, west and north.

Figure A6 provides a seasonal breakdown of the predicted wind distribution at the Factory, this figure reveals a north-easterly predominance during summer (sea-breeze) and a westerly predominance during the other seasons, in particular during winter.



Comments: Average wind speed = 3.2 m/s

Figure A5 Factory Annual Wind Rose - Year 2004

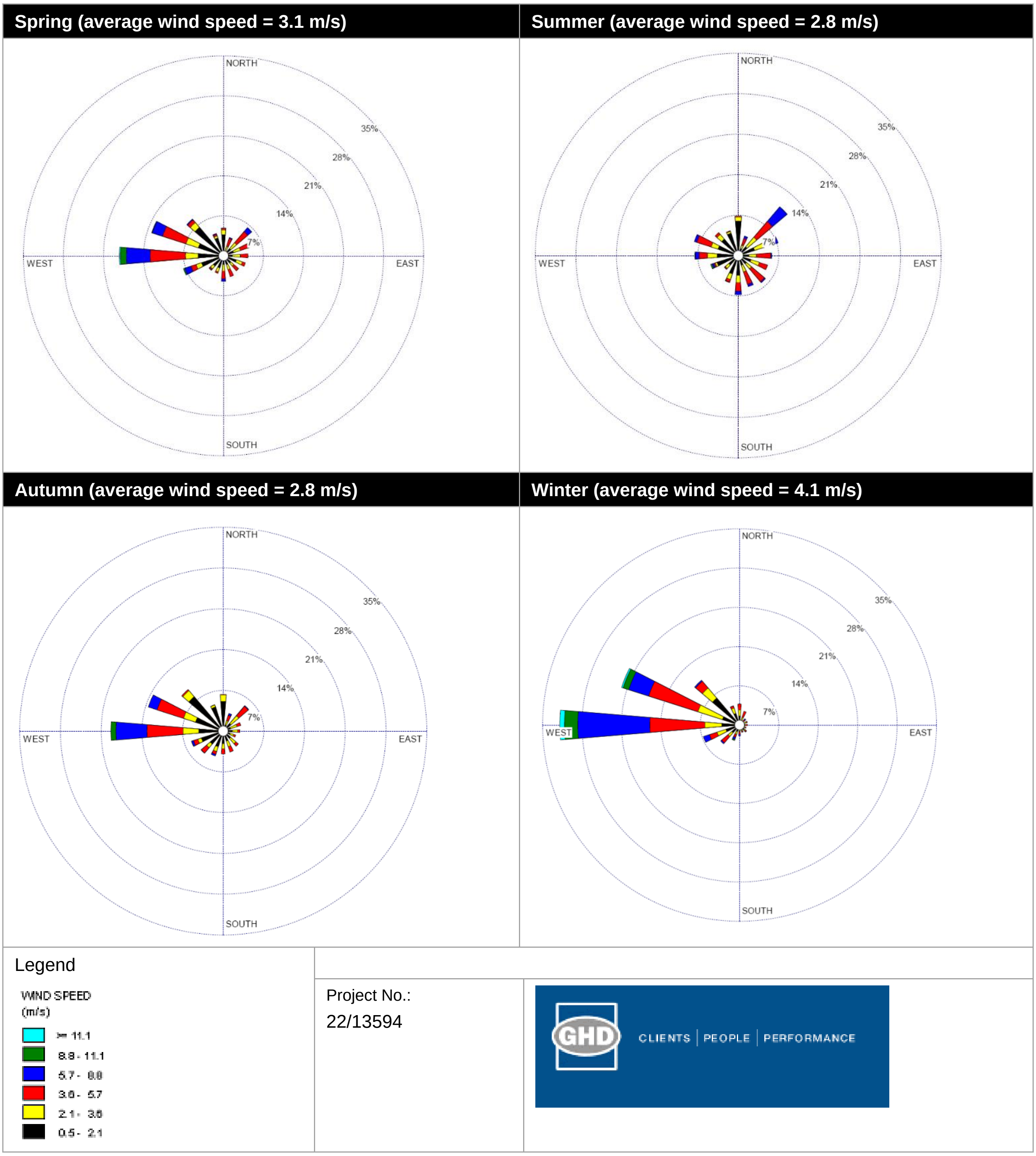


Figure A6 Factory Seasonal Wind Roses - Year 2004

A categorised measure of atmospheric stability is also output from the model. These can be broadly defined as listed in Table A1.

Table A.1 Atmospheric Stability Classes and Distribution

Stability Class	Description	Frequency of Occurrence[18]
A	Extremely unstable atmospheric conditions, occurring near the middle of day, with very light winds, no significant cloud.	2%
B	Moderately unstable atmospheric conditions occurring during mid-morning/mid-afternoon with light winds or very light winds with significant cloud.	14%
C	Slightly unstable atmospheric conditions occurring during early morning/late afternoon with moderate winds or lighter winds with significant cloud.	17%
D	Neutral atmospheric conditions. Occur during the day or night with stronger winds. Or during periods of total cloud cover, or during twilight (transition) period.	22%
E	Slightly stable atmospheric conditions occurring during the night-time with some cloud and/or light-moderate winds.	12%
F	Moderately stable atmospheric conditions occurring during the night-time with no significant cloud and light winds.	32%

Potential off-site odour impact would tend to be maximised when winds are light and the atmosphere is stable, conditions that typically occur during the early evening and night-time. Table A1 shows that these conditions occurred for approximately 44% of the time.

The occurrence of stable air flows is of significance as these generally provide the conditions for worst case dispersion of emissions to air from ground based (or near-ground based) sources, and hence potentially the highest impact to odour amenity. This is due to the limited mixing in the vertical plane of these light wind airflows, and hence less dilution of the emissions from the majority of odour sources, which are either at ground level or wake affected short stacks. Therefore, the distribution of light wind stable flows can define the directions of “poor odour dispersion” from the factory and environmental farm.

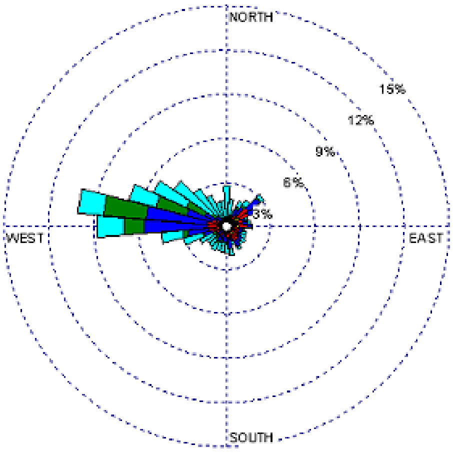
Vertical mixing of airflows can be brought about by two mechanisms. The first is mechanical mixing caused by the shear stresses as air moves over rough terrain. The second is via thermal convective mixing, which has the potential to occur significantly only during daytime. The occurrence of unstable and strong-wind neutral air flows generally provide the conditions for the highest ground level concentrations due to emissions to air from elevated stack sources, such as the coal-fired boiler exhaust stacks found at the factory.

A rose that illustrates the directional distribution of the predicted atmospheric stability is shown in Figure A7. During these stable periods, the regional scale cool air drainage flows down the river valley from the west to dominate the transport and dispersion of emissions to air from the factory and environmental farm. To a lesser extent, local slope drainage flows from the elevated terrain located to the north, west-north-west and west-south-west of the site would also generate these conditions for poor dispersion.

[18] Stability data in this table extracted from Factory meteorological data

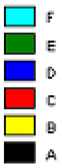
All stability classes	E & F Stability classes (stable conditions only)

All stability classes

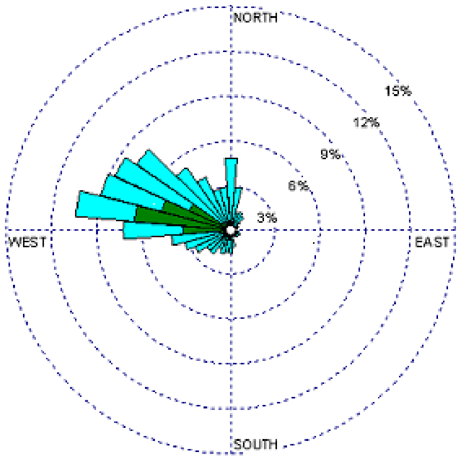


Legend

Stability Class



E & F Stability classes (stable conditions only)



Legend

Stability Class

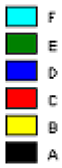


Figure A7 Factory Annual Stability Rose - Year 2008

Appendix B

Shoalhaven Starches Community Consultation Activities

B1 Shoalhaven Starches Community Consultation Activities

B1.1 Community Group Talks

Shoalhaven Starches have participated in numerous guest speaker roles to various local community organisations outlining the company's operations and new developments at the site. Examples include:

– Local Probus Clubs
– Local Rotary Clubs
– Lions Club
– U3A Shoalhaven
– Shoalhaven PCYC
– Shoalhaven Business Chamber Expos
– UOW Shoalhaven Careers Expos
– Nowra Historical Society
– Shoalhaven Safety Group WHS Forums
– Shoalhaven Myeloma Support Group
– Shoalhaven City Council Teacher to Teacher Industry Tour
– Shoalhaven Councillors Information Day & Site Tour

B1.2 Shoalhaven Starches Community Newsletter

Eight (8) Shoalhaven Starches Community Newsletter have been prepared and distributed by mail to approximately 30,000 homes in the Bomaderry/Nowra region in the last 3 years. The newsletter outlines the activities and projects ongoing at the Shoalhaven Starches site and has also been widely distributed electronically, and is listed online through our website and social media channels. A copy of the newsletters can be found at: https://www.manildra.com.au/shoalhaven-starches-newsletter.

In addition, a number of notification letters have been distributed to nearby affected residents on upcoming development on site. e.g. North Packing Plant, Gas Pipeline project.

B1.3 Community Consultative Committee

Shoalhaven Starches ran a community consultation committee however this no longer operates due to the dramatic decrease in odour complaints received and lack of interest from its previous members.

Appendix C

Complete odour emission inventory

Table C.1 Complete odour emission inventory (Mod 21 Q2)

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Boiler No. 2	45	BOILR2	tall wake free	40.0	0.65	29.8	30	8,309	Variable
Boiler No. 4	42	BOILR4	tall wake free	41.0	0.90	28.1	28	37,247	Variable
Combined Boiler Stack for No. 5 & 6 Boilers	35	BOILR5	tall wake free	54.0	2.1	16.7	412.5	94,550	Variable
Light phase recovery tank		DDG19	wake affected	11.0	0.1	3.3	362.2	74	170
Pellet Mill Silo (proposed)		PMFS	wake affected	23.0	0.2	7.0	320.0	173	398
Pellet Plant exhaust stack	46	PPES	tall wake free	49.2	1.5	10.9	323.2	70,900	Variable
Pellet silo (mill feed silo)		S12	wake affected	2.0	0.3	0.1	304.2	350	805
Stillage surge tank		SST	wake affected	2.0	0.2	3.3	359.7	173	397
Vent condenser drain		VCD	wake affected	24.1	0.3	0.3	300.2	4,419	10,163
Ethanol Recovery Scrubber Discharge	16	ERESC	wake affected	28.0	0.3	9.3	295.4	41,258	94,894
Fermenters (10-16)	44	FERM	tall wake free	21.0	0.3	3.1	302.7	2,000	4,600
Yeast propagators - tanks 4 & 5		YP45	wake affected	17.0	0.3	3.0	310.6	820	1,886
Cyclone and fabric filter		A4	wake affected	33.0	1.3	7.3	300.3	679	1,562
Cyclone and fabric filter		A5	wake affected	33.0	0.9	5.2	303.2	96	221
Cyclone and fabric filter		A6	wake affected	33.0	1.1	5.3	293.2	449	1,033

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Cyclone and fabric filter		A7	wake affected	33.0	1.1	10.2	322.2	932	2,144
Drum vacuum receiver		C4	wake affected	21.0	0.2	11.0	319.7	1,400	3,220
Dry gluten roof bin		S07	wake affected	25.0	0.7	0.1	328.2	4,500	10,350
Enzyme Tanks		B7	wake affected	6.0	0.5	0.3	327.2	2,042	4,696
Feed transfer to distillery		E22	wake affected	15.0	0.3	0.1	300.2	83	191
Flash Vessel Jet Cooker		C1	wake affected	21.0	0.1	0.1	350.2	970	2,231
Flour bin aspirator		S13A	wake affected	2.5	0.4	0.1	306.2	500	1,150
Flour bin aspirator		S13B	wake affected	2.5	0.4	0.1	306.2	500	1,150
Flour bin motor drive		S06	wake affected	24.0	0.3	0.1	307.2	283	651
Flour mill stack proposed and approved 1		FMP2	wake affected	31.8	0.7	4.4	322.2	266	612
Flour mill stack proposed and approved 2		FMP1	wake affected	33.4	0.9	4.2	300.3	205	472
Retention - tank 2 (now located in adjacent tank)		GRT	wake affected	21.0	0.2	18.0	360.2	4,535	10,430
High protein dust collector		S08	wake affected	24.5	0.4	0.1	316.2	600	1,380
Incondensable gases vent		D6	wake affected	13.0	0.2	0.6	309.0	558	1,284
Ion exchange effluent tank		C18	wake affected	2.5	0.5	0.1	307.2	250	575
Jet cooker 1 - retention tank		E13	wake affected	10.0	0.3	0.1	362.2	1,067	2,454

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Jet cooker 2 & 4 - Retention		E7	wake affected	9.0	0.1	3.1	373.2	851	1,956
Molecular Sieve - Vacuum drum		D2	wake affected	10.0	0.1	13.0	337.2	1,350	3,105
No. 1 Gluten Dryer baghouse	8	S02	wake affected	25.5	3.2	0.1	344.4	9,800	22,540
No. 1 Starch Dryer	12	S01	wake affected	26.0	1.3	6.8	309.1	3,200	7,360
No. 2 Gluten Dryer baghouse (No 2 Starch Dryer)	9	S04	wake affected	27.0	3.2	0.1	336.0	6,000	13,800
No. 3 Gluten Dryer baghouse	10	S03	wake affected	21.0	2.5	11.6	343.1	32,000	73,600
No. 3 Starch Dryer	13	S18	wake affected	20.0	1.2	20.0	307.2	6,800	15,640
No. 4 Gluten Dryer baghouse	11	S05	wake affected	30.0	2.7	16.0	346.5	20,000	46,000
No. 4 Starch Dryer	14	S19	wake affected	20.0	1.2	21.2	309.8	2,500	5,750
No. 5 Ring Dryer Starch		SDR5	wake affected	25.0	1.2	0.1	320.0	4,625	10,638
No. 5 Starch Dryer (existing)	47	SD5C	wake affected	33.5	2.4	2.9	340.3	2,123	4,882
No. 5 Starch Dryer (new)		SD5N	wake affected	30.0	2.4	14.7	340.3	10,877	25,018
No. 6 Gluten Dryer		GD6	wake affected	35.0	1.7	19.1	346.2	12,568	28,906
No. 7 Gluten Dryer		GD7	wake affected	29.0	1.8	19.3	341.2	9,553	21,972
Spray dryer		S20	wake affected	19.0	1.4	0.1	335.2	738	1,697
Starch factory rejects collection tank		E10	wake affected	8.0	0.1	0.1	308.2	183	421

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Large Starch Silo 1		PPL1	wake affected	26.5	0.2	6.8	323.3	86	199
Large Starch Silo 2		PPL2	wake affected	26.5	0.2	6.8	323.3	86	199
Medium Gluten Silo 1		PPM1	wake affected	20.7	0.2	6.8	322.7	173	398
Medium Gluten Silo 2		PPM2	wake affected	20.7	0.2	6.8	322.7	173	398
Medium Gluten Silo 3		PPM3	wake affected	20.7	0.2	6.8	322.7	173	398
Small Gluten Silo		PPS1	wake affected	34.3	0.2	18.6	322.7	92	211
Small Starch Silo		PPS2	wake affected	34.3	0.2	18.6	318.5	35	81
Biofilter A	40	BIO1	area					1,307	Variable
Biofilter B	41	BIO2	area					1,208	Variable
Biofilter C		BIO3	area					1,089	Variable
Biofilter D		BIO4	area					1,281	Variable
Effluent storage dam 1	19	PO1	area					948	Variable
Effluent storage dam 2	20	PO2	area					687	Variable
Effluent storage dam 3	21	PO3	area					1,626	Variable
Effluent storage dam 5	23	PO5	area					1,248	Variable
Effluent storage dam 6	24	PO6	area					1,435	Variable
Sulphur Oxidisation Basin	25	SOBAS	area					489	Variable
Membrane bio-reactor		MBR	wake affected					54	Variable
DDG load out shed - awning		DDG35	volume					923	2,123
DDG product storage sheds		DDG34	volume					1,023	2,353
DDG tent storage area		DDG36	volume					1,929	4,437

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Pellet plant fugitives (discharged direct to atmosphere)		PPF	wake affected					5,771	13,273
Farm tank		F18	volume					3,833	8,817
Column washing vent		CWV	wake affected	48.0	0.1	8.8	312.1	1,218	2,801
Flour Mill B		FMBA	wake affected	39.5	0.7	12.2	322.2	687	1,581
Flour Mill B		FMBB	wake affected	39.5	1.0	2.8	322.2	214	492
Flour Mill B		FMBC	wake affected	39.5	1.0	4.9	322.2	659	1,516
Flour Mill B		FMBD	wake affected	39.5	0.7	29.1	300.3	748	1,720
Flour Mill B		FMBE	wake affected	39.5	1.1	10.2	300.3	748	1,720
Flour Mill B		FMBF	wake affected	39.5	1.1	3.5	300.3	566	1,301
Flour Mill C		FMC1	wake affected	37.6	0.7	12.2	322.2	687	1,581
Flour Mill C		FMC2	wake affected	37.6	0.7	6.5	293.2	214	492
Flour Mill C		FMC3	wake affected	37.6	0.7	11.7	322.2	659	1,516
Gluten dryer no. 8		GD8	wake affected	29.0	1.9	19.1	346.2	12,568	28,906
Product dryer no. 9		PD9	wake affected	35.6	0.9	15.3	345.5	9,800	22,540
Beverage Ethanol D500 Vent (Column washing vent 2)		CWV2	wake affected	55.0	0.1	8.8	312.1	1,218	2,801

Table C.2 Complete odour emission inventory (Mod 21 Q3)

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Boiler No. 2	45	BOILR2	tall wake free	40.0	0.65	29.8	30	7,025	Variable
Boiler No. 4	42	BOILR4	tall wake free	41.0	0.90	28.1	28	29,207	Variable
Combined Boiler Stack for No. 5 & 6 Boilers	35	BOILR5	tall wake free	54.0	2.1	16.7	412.5	102,780	Variable
Light phase recovery tank		DDG19	wake affected	11.0	0.1	3.3	362.2	74	170
Pellet Mill Silo (proposed)		PMFS	wake affected	23.0	0.2	7.0	320.0	173	398
Pellet Plant exhaust stack	46	PPES	tall wake free	49.2	1.5	10.9	323.2	40,442	Variable
Pellet silo (mill feed silo)		S12	wake affected	2.0	0.3	0.1	304.2	350	805
Stillage surge tank		SST	wake affected	2.0	0.2	3.3	359.7	173	397
Vent condenser drain		VCD	wake affected	24.1	0.3	0.3	300.2	4,419	10,163
Ethanol Recovery Scrubber Discharge	16	ERESC	wake affected	28.0	0.3	9.3	295.4	15,198	34,956
Fermenters (10-16)	44	FERM	tall wake free	21.0	0.3	3.1	302.7	2,804	6,449
Yeast propagators - tanks 4 & 5		YP45	wake affected	17.0	0.3	3.0	310.6	820	1,886
Cyclone and fabric filter		A4	wake affected	33.0	1.3	7.3	300.3	679	1,562
Cyclone and fabric filter		A5	wake affected	33.0	0.9	5.2	303.2	96	221
Cyclone and fabric filter		A6	wake affected	33.0	1.1	5.3	293.2	449	1,033
Cyclone and fabric filter		A7	wake affected	33.0	1.1	10.2	322.2	932	2,144

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Drum vacuum receiver		C4	wake affected	21.0	0.2	11.0	319.7	1,400	3,220
Dry gluten roof bin		S07	wake affected	25.0	0.7	0.1	328.2	4,500	10,350
Enzyme Tanks		B7	wake affected	6.0	0.5	0.3	327.2	2,042	4,696
Feed transfer to distillery		E22	wake affected	15.0	0.3	0.1	300.2	83	191
Flash Vessel Jet Cooker		C1	wake affected	21.0	0.1	0.1	350.2	970	2,231
Flour bin aspirator		S13A	wake affected	2.5	0.4	0.1	306.2	500	1,150
Flour bin aspirator		S13B	wake affected	2.5	0.4	0.1	306.2	500	1,150
Flour bin motor drive		S06	wake affected	24.0	0.3	0.1	307.2	283	651
Flour mill stack proposed and approved 1		FMP2	wake affected	31.8	0.7	4.4	322.2	266	612
Flour mill stack proposed and approved 2		FMP1	wake affected	33.4	0.9	4.2	300.3	205	472
Retention - tank 2 (now located in adjacent tank)		GRT	wake affected	21.0	0.2	18.0	360.2	4,535	10,430
High protein dust collector		S08	wake affected	24.5	0.4	0.1	316.2	600	1,380
Incondensable gases vent		D6	wake affected	13.0	0.2	0.6	309.0	558	1,284
Ion exchange effluent tank		C18	wake affected	2.5	0.5	0.1	307.2	250	575
Jet cooker 1 - retention tank		E13	wake affected	10.0	0.3	0.1	362.2	1,067	2,454
Jet cooker 2 & 4 - Retention		E7	wake affected	9.0	0.1	3.1	373.2	851	1,956

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Molecular Sieve - Vacuum drum		D2	wake affected	10.0	0.1	13.0	337.2	1,350	3,105
No. 1 Gluten Dryer baghouse	8	S02	wake affected	25.5	3.2	0.1	344.4	7,136	16,413
No. 1 Starch Dryer	12	S01	wake affected	26.0	1.3	6.8	309.1	6,358	14,623
No. 2 Gluten Dryer baghouse (No 2 Starch Dryer)	9	S04	wake affected	27.0	3.2	0.1	336.0	3,362	7,733
No. 3 Gluten Dryer baghouse	10	S03	wake affected	21.0	2.5	11.6	343.1	11,540	26,542
No. 3 Starch Dryer	13	S18	wake affected	20.0	1.2	20.0	307.2	1,942	4,467
No. 4 Gluten Dryer baghouse	11	S05	wake affected	30.0	2.7	16.0	346.5	9,768	22,466
No. 4 Starch Dryer	14	S19	wake affected	20.0	1.2	21.2	309.8	1,848	4,250
No. 5 Ring Dryer Starch		SDR5	wake affected	25.0	1.2	0.1	320.0	3,378	7,768
No. 5 Starch Dryer (existing)	47	SD5C	wake affected	33.5	2.4	2.9	340.3	3,172	7,296
No. 5 Starch Dryer (new)		SD5N	wake affected	30.0	2.4	14.7	340.3	16,256	37,388
No. 6 Gluten Dryer		GD6	wake affected	35.0	1.7	19.1	346.2	12,568	28,906
No. 7 Gluten Dryer		GD7	wake affected	29.0	1.8	19.3	341.2	9,553	21,972
Spray dryer		S20	wake affected	19.0	1.4	0.1	335.2	738	1,697
Starch factory rejects collection tank		E10	wake affected	8.0	0.1	0.1	308.2	183	421
Large Starch Silo 1		PPL1	wake affected	26.5	0.2	6.8	323.3	86	199

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Large Starch Silo 2		PPL2	wake affected	26.5	0.2	6.8	323.3	86	199
Medium Gluten Silo 1		PPM1	wake affected	20.7	0.2	6.8	322.7	173	398
Medium Gluten Silo 2		PPM2	wake affected	20.7	0.2	6.8	322.7	173	398
Medium Gluten Silo 3		PPM3	wake affected	20.7	0.2	6.8	322.7	173	398
Small Gluten Silo		PPS1	wake affected	34.3	0.2	18.6	322.7	92	211
Small Starch Silo		PPS2	wake affected	34.3	0.2	18.6	318.5	35	81
Biofilter A	40	BIO1	area					2,400	Variable
Biofilter B	41	BIO2	area					3,192	Variable
Biofilter C		BIO3	area					1,089	Variable
Biofilter D		BIO4	area					1,281	Variable
Effluent storage dam 1	19	PO1	area					948	Variable
Effluent storage dam 2	20	PO2	area					687	Variable
Effluent storage dam 3	21	PO3	area					1,626	Variable
Effluent storage dam 5	23	PO5	area					1,248	Variable
Effluent storage dam 6	24	PO6	area					1,435	Variable
Sulphur Oxidisation Basin	25	SOBAS	area					489	Variable
Membrane bio-reactor		MBR	wake affected					54	Variable
DDG load out shed - awning		DDG35	volume					923	2,123
DDG product storage sheds		DDG34	volume					1,023	2,353
DDG tent storage area		DDG36	volume					1,929	4,437
Pellet plant fugitives (discharged direct to atmosphere)		PPF	wake affected					5,771	13,273

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Farm tank		F18	volume					3,833	8,817
Column washing vent		CWV	wake affected	48.0	0.1	8.8	312.1	1,218	2,801
Flour Mill B		FMBA	wake affected	39.5	0.7	12.2	322.2	687	1,581
Flour Mill B		FMBB	wake affected	39.5	1.0	2.8	322.2	214	492
Flour Mill B		FMBC	wake affected	39.5	1.0	4.9	322.2	659	1,516
Flour Mill B		FMBD	wake affected	39.5	0.7	29.1	300.3	748	1,720
Flour Mill B		FMBE	wake affected	39.5	1.1	10.2	300.3	748	1,720
Flour Mill B		FMBF	wake affected	39.5	1.1	3.5	300.3	566	1,301
Flour Mill C		FMC1	wake affected	37.6	0.7	12.2	322.2	687	1,581
Flour Mill C		FMC2	wake affected	37.6	0.7	6.5	293.2	214	492
Flour Mill C		FMC3	wake affected	37.6	0.7	11.7	322.2	659	1,516
Gluten dryer no. 8		GD8	wake affected	29.0	1.9	19.1	346.2	12,568	28,906
Product dryer no. 9		PD9	wake affected	35.6	0.9	15.3	345.5	7,136	16,413
Beverage Ethanol D500 Vent (Column washing vent 2)		CWV2	wake affected	55.0	0.1	8.8	312.1	1,218	2,801

Appendix D

Site sampling reports

Appendix C contains the following sampling reports:

- Stephenson Environmental Management Australia. (2020) EPL Odour Emission Survey Quarter 2, 2020-2021
- Stephenson Environmental Management Australia. (2020a) EPL Odour Emission Survey Quarter 3, 2020-2021

Stephenson

Environmental Management Australia

EPL ODOUR EMISSION SURVEY QUARTER 2, 2020-2021

SHOALHAVEN STARCHES PTY LTD

BOMADERRY, NSW

PROJECT NO.:	7095/S25548A/20
DATES OF SURVEY:	5 & 12 AUGUST AND 8 & 28 OCTOBER, 2020
DATE OF INTERIM REPORT ISSUE:	28 AUGUST, 2020
DATE OF FINAL REPORT ISSUE:	4 JANUARY, 2021

Stephenson
Environmental Management Australia

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EPL ODOUR EMISSION SURVEY QUARTER 2, 2020-2021

SHOALHAVEN STARCHES PTY LTD

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P W STEPHENSON

J WEBER

M KIMBER

TABLE OF CONTENTS

1 INTRODUCTION 3
2 MONITORING REQUIREMENTS 4
2.1 ENVIRONMENT PROTECTION LICENCE 883 (ISSUED 18 DECEMBER 2015) 4
2.1.1 CONDITION P1 LOCATION OF MONITORING/DISCHARGE POINTS AND AREAS 4
2.1.2 CONDITION M2 – MONITORING CONCENTRATION OF DISCHARGED POLLUTANTS 5
3 PRODUCTION CONDITIONS 7
4 ODOUR EMISSION TEST RESULTS 8
5 CONCLUSIONS 10
6 TEST METHODS 21
6.1 ODOUR MEASUREMENT/DYNAMIC OLFACTOMETRY 21
6.1.1 ODOUR PANEL SELECTION 22
6.1.2 ODOUR TERMINOLOGY 22
6.2 EXHAUST GAS VELOCITY 22
6.3 EXHAUST GAS TEMPERATURE 23
6.4 OXYGEN (O_2) 23
6.5 MOISTURE 23
6.6 ACCURACY 23
APPENDIX A – EMISSION TEST RESULTS I
APPENDIX B – CERTIFICATES OF ANALYSIS I
APPENDIX C – DETAILS OF INSTRUMENT CALIBRATION I
APPENDIX D – SAMPLE LOCATIONS I

TABLE OF TABLES

TABLE 2-1 LOCATION OF ODOUR MONITORING/DISCHARGE POINTS AND AREAS 4
TABLE 2-2 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 8, 9, 10, 11, 12, 13, 14, 16 & 47) 5
TABLE 2-3 SAMPLING AND ANALYSIS OF DIFFUSE SOURCES (POINTS 19, 20, 21 & 23, 24 & 25) 5
TABLE 2-4 SAMPLING AND ANALYSIS OF SOURCES (POINTS 39, 40, 41, 44 & 46) 5
TABLE 2-5 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 35, 42 & 45) 6
TABLE 4-1 MEASURED EMISSION CONCENTRATION TEST RESULTS POINT SOURCES, QUARTER 2, 2020 8
TABLE 4-2 MEASURED EMISSION CONCENTRATION TEST RESULTS DIFFUSE SOURCES, QUARTER 2, 2020 9
TABLE 6-1 ESTIMATION OF MEASUREMENT UNCERTAINTY 23

TABLE OF FIGURES

FIGURE 5-1 ODOUR EMISSION CONCENTRATIONS, GLUTEN DRYERS NO.1, 2, 3 & 4 (EPA 8, 9, 10 & 11) .. 11
FIGURE 5-2 ODOUR EMISSION CONCENTRATIONS, STARCH DRYERS NO.1, 3 & 4 (EPA 12, 13 &14) 12
FIGURE 5-3 ODOUR EMISSION CONCENTRATIONS, STARCH DRYER 5 (EPA 47) 12
FIGURE 5-4 ODOUR EMISSION CONCENTRATIONS, FERMENTERS (EPA 44) 14
FIGURE 5-5 ODOUR EMISSION CONCENTRATIONS, CARBON DIOXIDE SCRUBBER OUTLET (EPA 16) 15
FIGURE 5-6 ODOUR EMISSION CONCENTRATIONS, COMBINED BOILER 5 & 6 STACK (EPA 35) 16
FIGURE 5-7 ODOUR EMISSION CONCENTRATIONS, BOILER 4 STACK (EPA 42) 17
FIGURE 5-8 ODOUR EMISSION CONCENTRATIONS, BOILER 2 STACK (EPA 45) 18

FIGURE 5-9 ODOUR EMISSION CONCENTRATIONS, BIOFILTERS (EPA 39, 40, 41) 19
FIGURE 5-10 ODOUR EMISSION CONCENTRATIONS, DDG PELLET PLANT (EPA 46) 20

TABLE OF TABLES – APPENDICES

TABLE A-1 EMISSION TEST RESULTS – GLUTEN DRYERS NO. 1, 2, 3 & 4 II
TABLE A-2 EMISSION TEST RESULTS – STARCH DRYERS NO.1, 3, 4 & 5 III
TABLE A- 3 EMISSION TEST RESULTS – BOILERS NO. 5&6, 4 & 2 IV
TABLE A-4 EMISSION TEST RESULTS – FERMENTER 13 & CO_2 SCRUBBER OUTLET V
TABLE A- 5 EMISSION TEST RESULTS – INLET TO BIOFILTERS, DDG EVAPORATORS 1, 2, 3 & 4 VI
TABLE A- 6 EMISSION TEST RESULTS DDG PELLET PLANT VII
TABLE A- 7 EMISSION TEST RESULTS – BIOFILTER OUTLETS VIII

TABLE C- 1 INSTRUMENT CALIBRATION DETAILS DAY 1 II
TABLE C- 2 INSTRUMENT CALIBRATION DETAILS DAY 2 III
TABLE C- 3 INSTRUMENT CALIBRATION DETAILS DAY 3 IV
TABLE C-4 INSTRUMENT CALIBRATION DETAILS DAY 4 V

TABLE OF FIGURES – APPENDICES

FIGURE D-1 GLUTEN DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC II
FIGURE D-2 GLUTEN DRYER NO. 1 – SAMPLE LOCATION III
FIGURE D-3 GLUTEN DRYER NO. 2 –SAMPLE LOCATION SCHEMATIC IV
FIGURE D-4 GLUTEN DRYER NO. 2 – ODOUR SAMPLE LOCATION AT DUCT EXIT V
FIGURE D-5 GLUTEN DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC VI
FIGURE D-6 GLUTEN DRYER NO. 3 – SAMPLE LOCATION VII
FIGURE D-7 GLUTEN DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC VIII
FIGURE D-8 GLUTEN DRYER NO. 4 – SAMPLE LOCATION IX
FIGURE D-9 STARCH DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC X
FIGURE D-10 STARCH DRYER NO. 1 – SAMPLE LOCATION XI
FIGURE D-11 STARCH DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC XII
FIGURE D-12 STARCH DRYER NO. 3 – SAMPLE LOCATION XIII
FIGURE D-13 STARCH DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC XIV
FIGURE D-14 STARCH DRYER NO. 4 – SAMPLE LOCATION XV
FIGURE D-15 STARCH DRYER NO. 5 – SAMPLE LOCATION SCHEMATIC XVI
FIGURE D-16 STARCH DRYER NO. 5 – SAMPLE LOCATION XVII
FIGURE D-17 FERMENTERS – SAMPLE LOCATION SCHEMATIC XVIII
FIGURE D-18 FERMENTERS – SAMPLE LOCATION XIX
FIGURE D-19 CO_2 SCRUBBER OUTLET – SAMPLE LOCATION SCHEMATIC XX
FIGURE D-20 BOILER NOS. 5 & 6 – SAMPLE LOCATION SCHEMATIC XXI
FIGURE D-21 BOILER NOS. 5 & 6 – SAMPLE LOCATION XXII
FIGURE D-22 BOILER NO. 4– SAMPLE LOCATION SCHEMATIC XXIII
FIGURE D-23 BOILER NO 4 – SAMPLE LOCATION XXIV
FIGURE D-24 BOILER NO 2 – SAMPLE LOCATION SCHEMATIC XXV
FIGURE D-25 BIOFILTER INLET – SAMPLE LOCATION SCHEMATIC XXVI
FIGURE D-26 BIOFILTER OUTLET EAST EPL ID 40 & 41 – SAMPLE LOCATION XXVII
FIGURE D-27 BIOFILTER OUTLET WEST EPL ID 41 – SAMPLE LOCATION XXVII
FIGURE D-28 DDG PELLET PLANT STACK – SAMPLE LOCATION SCHEMATIC XXVIII
FIGURE D-29 DDG PELLET PLANT STACK – SAMPLE LOCATION PHOTOGRAPH XXIX

1 INTRODUCTION

Stephenson Environmental Management Australia (SEMA) was requested by Shoalhaven Starches Pty Limited to conduct an odour emission survey at their manufacturing complex in Bomaderry, New South Wales (NSW).

The objective of the survey is to comply with Condition M2.1 of the Environment Protection Licence (EPL) No. 883 issued by the Environment Protection Authority (EPA). The EPA is now part of the Office of Environment and Heritage (OEH).

Section 2 of this report outlines Conditions P1 and M2 which identify the potential point and diffuse odour sources and the sampling and analysis methods respectively required by the OEH. This survey monitored the quarterly odour concentrations as required in section M2.2 of EPL 883.

In addition, the Carbon Dioxide (CO_2) Scrubber Inlet sampling point, which currently is not listed in EPL 883 and therefore does not have an EPA Identification No., was also sampled.

The DDG Pellet Plant Stack sampling port was inaccessible so measurements were taken from the DDG Cooler Silo and DDG Pellet Cooler East stack. They have a partial contribution to EPA Identification No. 46.

The quarters are defined as below:

- Quarter 1 May to July inclusive
- Quarter 2 August to October inclusive
- Quarter 3 November to January inclusive
- Quarter 4 February to April inclusive

Quarter 2, 2020-2021 odour test results are presented in this report. These tests were conducted on the 5th and 12th August and the 8th and 28th October, 2020.

2 MONITORING REQUIREMENTS

2.1 ENVIRONMENT PROTECTION LICENCE 883 (ISSUED 18 DECEMBER 2015)

2.1.1 CONDITION P1 LOCATION OF MONITORING/DISCHARGE POINTS AND AREAS

Table 2-1 identifies the point and diffuse sources as defined by the OEH that relate to this survey as per most recent version of EPL No. 883 dated 20 June 2018.

TABLE 2-1 LOCATION OF ODOUR MONITORING/DISCHARGE POINTS AND AREAS

EPL ID. No.	Location	Odour Samples TM OM-7/8	Frequency as per M2.2 EPL 883
8	No. 1 Gluten Dryer	1	Quarterly
9	No. 2 Gluten/Starch Dryer*	1	Quarterly
10	No. 3 Gluten Dryer	1	Quarterly
11	No. 4 Gluten Dryer	1	Quarterly
12	No. 1 Starch Dryer	1	Quarterly
13	No. 3 Starch Dryer	1	Quarterly
14	No. 4 Starch Dryer	1	Quarterly
16	CO_2 Scrubber outlet	1	Quarterly
Not specified	CO_2 Scrubber inlet	1	--
19	Effluent Storage Dam 1	1	Yearly
20	Effluent Storage Dam 2	1	Yearly
21	Effluent Storage Dam 3	1	Yearly
23	Effluent Storage Dam 5	1	Yearly
24	Effluent Storage Dam 6	1	Yearly
25	Sulphur Oxidisation Pond	1	Yearly
35	Combined Stack Boilers No.5 & 6	1	Quarterly
39	Inlet Pipe to Biofilters A & B (DDG Evaporators 1, 2 & 3)	1	Quarterly
39A	Inlet Pipe to Biofilters A & B (DDG Evaporator 4)	1	Quarterly
40	Outlet of Biofilter A	2	Quarterly
41	Outlet of Biofilter B	2	Quarterly
42	Boiler No.4	1	Quarterly
44	Fermenter	1	Quarterly
45	Boiler No.2	1	Quarterly
46	DDG Pellet Plant Stack	1	Quarterly
47	No. 5 Starch Dryer	1	Quarterly

2.1.2 CONDITION M2 – MONITORING CONCENTRATION OF DISCHARGED POLLUTANTS

Condition M2.1 states: *For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency specified in the opposite columns.*

Key to Tables 2.2 to 2.5:

%	=	percent
°C	=	degrees Celsius
g/g.mole	=	grams per gram mole
kg/m³	=	kilograms per cubic metre
m/s	=	metres per second
m³/s	=	cubic metres per second
mg/m³	=	milligrams per cubic metre
OM	=	Other Method
ou	=	odour units
TM	=	Test Method

TABLE 2-2 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 8, 9, 10, 11, 12, 13, 14, 16 & 47)

Pollutant	Units	Frequency	Approved Method
Dry Gas Density	kg/m³	Quarterly	TM-23
Flow	m³/s	Quarterly	TM-2
Moisture	%	Quarterly	TM-22
Molecular Weight of stack gases	g/g-mole	Quarterly	TM-23
Odour	ou	Quarterly	OM-7
Oxygen	%	Quarterly	TM-25
Temperature	°C	Quarterly	TM-2
Velocity	m/s	Quarterly	TM-2

TABLE 2-3 SAMPLING AND ANALYSIS OF DIFFUSE SOURCES (POINTS 19, 20, 21 & 23, 24 & 25)

Pollutant	Units	Frequency	Approved Method
Odour	ou	Annual	OM-7

TABLE 2-4 SAMPLING AND ANALYSIS OF SOURCES (POINTS 39, 40, 41, 44 & 46)

Pollutant	Units	Frequency	Approved Method
Odour	ou	Quarterly	OM-7

TABLE 2-5 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 35, 42 & 45)

Pollutant	Units	Frequency	Approved Method
Cadmium	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Mercury	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Moisture	%	Quarterly	TM-22
Molecular weight of stack gases	g/g.mole	Quarterly	TM-23
Nitrogen Oxides	mg/m^3	Quarterly	TM-11
Odour	ou	Quarterly	OM-7
Opacity	%	Quarterly	CEM-1
Oxygen	%	Quarterly	TM-25
Sulphur Dioxide	mg/m^3	Annual	TM-4
Temperature	^oC	Quarterly	TM-2
Total Solid Particles	mg/m^3	Quarterly	TM-15
Type 1 & Type 2 substances in aggregate	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Velocity	m/s	Quarterly	TM-2
Volatile Organic Compounds as n-propane equivalent	mg/m^3	Quarterly	TM-34
Volumetric Flowrate	m^3/s	Quarterly	TM-2

3 PRODUCTION CONDITIONS

Shoalhaven Starches personnel considered the factory and the ethanol distillery were operating under typical conditions on the days of testing.

One exception is that Gluten Dryer No.1 (EPA ID 8) has had a new silencer and supporting ductwork installed to replace the previous unit. However, the sampling ports have not been re-installed in this new ductwork. Therefore, access to the inside of the duct is no longer available. Thus, exhaust gas flow measurements were unable to be taken.

However, odour measurements were taken from the duct outlet to atmosphere. To enable calculation of the Mass Odour Emission Rate (MOER), exhaust gas flow measurements have been based on the most recent previous quarterly monitoring results; that is, Quarter 1, 2020 results.

Access to the DDG Pellet Plant Stack (EPA 46) was inaccessible, so measurements were taken from the DDG Pellet Cooler East and the DDG Pellet Silo, which have a partial contribution to EPA 46.

4 ODOUR EMISSION TEST RESULTS

SEMA performed the sampling and the odour analysis was performed by Odour Research Laboratories Australia (ORLA). SEMA and ORLA are both NATA accredited (No.15043) facilities to ISO 17025 for this.

The NATA accredited ORLA Olfactometry Test Reports 7095/ORLA/01 and 7095/ORLA/02 are presented in Appendix B.

Exhaust gas flow and emission tests results from measured sources are detailed in Tables A-1 to A-7, Appendix A.

Appendix C details calibration of instruments used to take measurements.

Appendix D shows sample locations.

Tables 4-1 summarise the odour emission concentrations for the point sources measured in Quarter 2, 2020.

TABLE 4-1 MEASURED EMISSION CONCENTRATION TEST RESULTS POINT SOURCES, QUARTER 2, 2020

EPA ID No.	Description	Date	Odour Concentration (ou)
8	No.1 Gluten Dryer	12.08.2020	660
9	No.2 Gluten Dryer	05.08.2020	430
10	No.3 Gluten Dryer	05.08.2020	850
11	No.4 Gluten Dryer	05.08.2020	720
12	No.1 Starch Dryer	05.08.2020	250
13	No.3 Starch Dryer	12.08.2020	400
14	No.4 Starch Dryer	12.08.2020	140
16	Carbon Dioxide Scrubber Outlet	05.08.2020	17,500
--	Carbon Dioxide Scrubber Inlet	05.08.2020	11,300
35	Combined Stack No.5 & 6 Boilers	12.08.2020	2,000
42	Boiler No.4 Outlet	12.08.2020	2,180
44	Fermenter (No. 13)	05.08.2020	10,300
45	Boiler No.2 Outlet	12.08.2020	1,100
47	No.5 Starch Dryer	12.08.2020	250
Part 46*	DDG Pellet Cooler East	28.10.2020	6200
Part 46*	DDG Pellet Silo	28.10.2020	8800

Key:

ou = odour units

-- = Not listed in EPL 883, no EPL ID number

Part 46* = Partial contribution to EPA ID 46, as EPA ID 46 stack was inaccessible

TABLE 4-2 MEASURED EMISSION CONCENTRATION TEST RESULTS DIFFUSE SOURCES, QUARTER 2, 2020

EPA ID No.	Description	Date	Odour Concentration (ou)
39	Inlet to Biofilters A & B DDG Evaporators 1, 2 & 3	8.10.2020	15,600
39A	Inlet to Biofilters A & B DDG Evaporators 4	8.10.2020	41,900
40	Outlet of Biofilter A (east)	8.10.2020	1,200
40	Outlet of Biofilter A (west)	8.10.2020	1,400
41	Outlet of Biofilter B (east)	8.10.2020	4,000
41	Outlet of Biofilter B (west)	8.10.2020	6,200

5 CONCLUSIONS

The comparative results of the odour sampling and analysis, over time, that have been undertaken by SEMA at Shoalhaven Starches manufacturing facility at Bomaderry are graphically presented in Figures 5-1 to 5-8.

Figure 5-1 presents graphical representations of odour concentrations recorded for Gluten Dryers No.1, 2, 3 and 4 since autumn 2005.

Figure 5-2 presents graphical representations of odour concentrations recorded for Starch Dryers No.1, 3 and 4 since autumn 2005.

Figure 5-3 graphically shows the Starch Dryer No. 5 emission concentrations since spring 2017.

Figure 5-4 graphically shows the Fermenter emission concentrations since summer 2007-2008.

Figure 5-5 illustrates odour emission concentrations from the Carbon Dioxide Scrubber since autumn 2013.

Figures 5-6 and 5-7 graphically show the Combined Boiler 5 and 6 stack and the Boiler No.4 stack emission concentrations since summer 2013-2014 respectively.

Figure 5-8 shows the Boiler 2 stack emission concentrations since winter 2019.

Figure 5-9 graphically shows the Bio-filter inlet and outlet emission concentrations since autumn 2010.

Figure 5-10 graphically shows the DDG Pellet plant stack emission concentrations since spring 2016.

FIGURE 5-1 ODOUR EMISSION CONCENTRATIONS, GLUTEN DRYERS NO.1, 2, 3 & 4 (EPA 8, 9, 10 & 11)

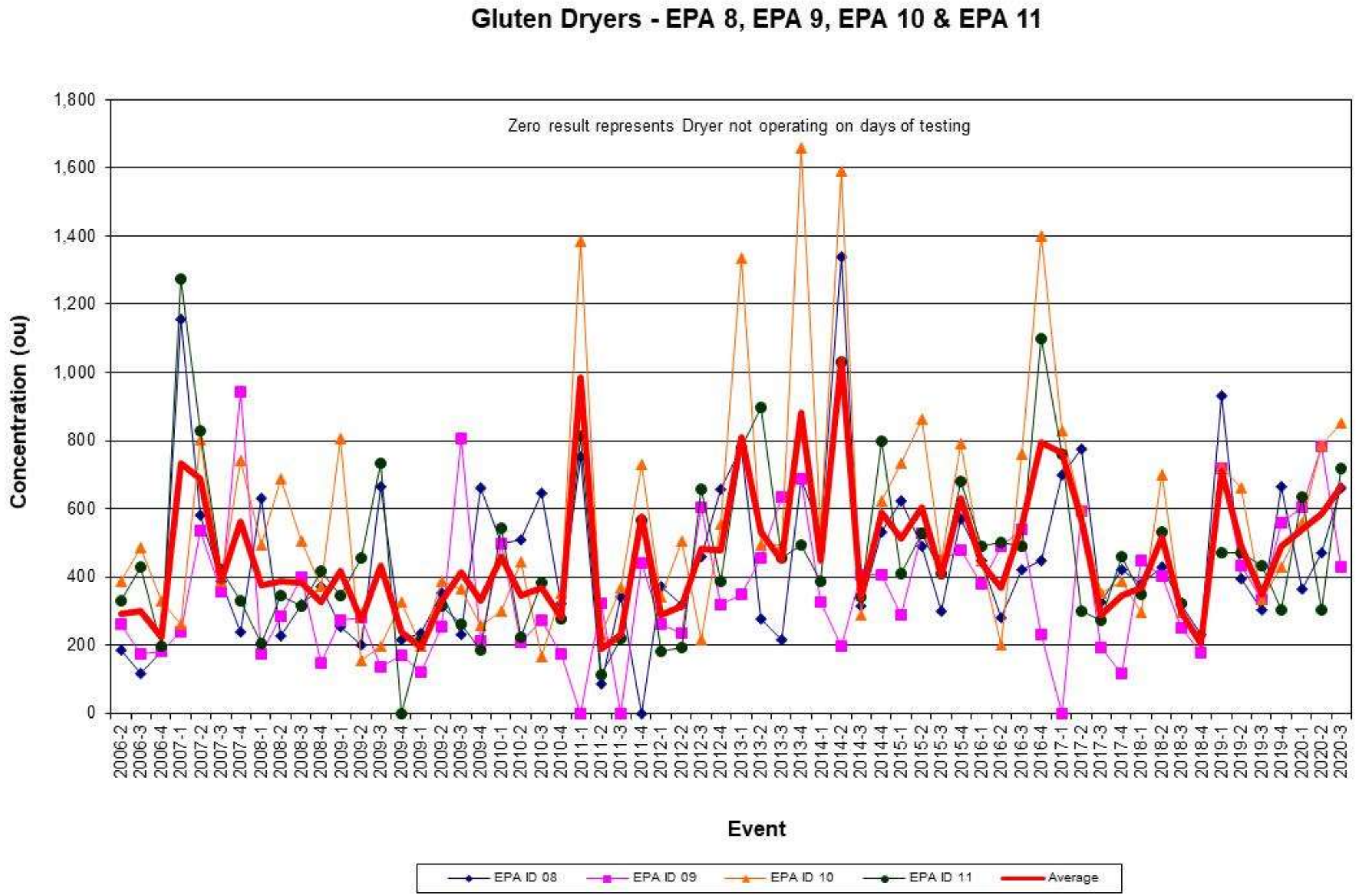


FIGURE 5-2 ODOUR EMISSION CONCENTRATIONS, STARCH DRYERS NO.1, 3 & 4 (EPA 12, 13 &14)

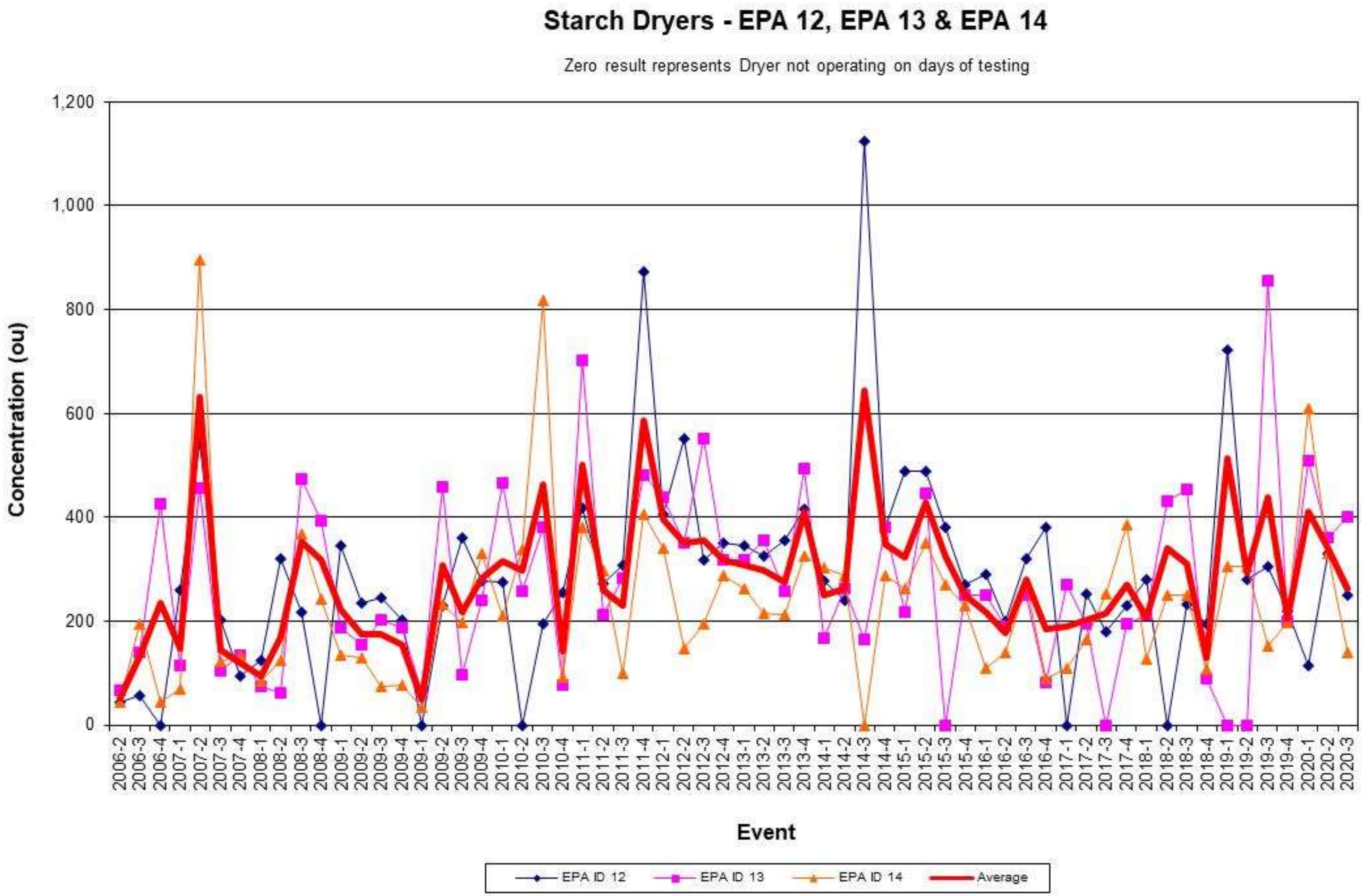


FIGURE 5-3 ODOUR EMISSION CONCENTRATIONS, STARCH DRYER 5 (EPA 47)

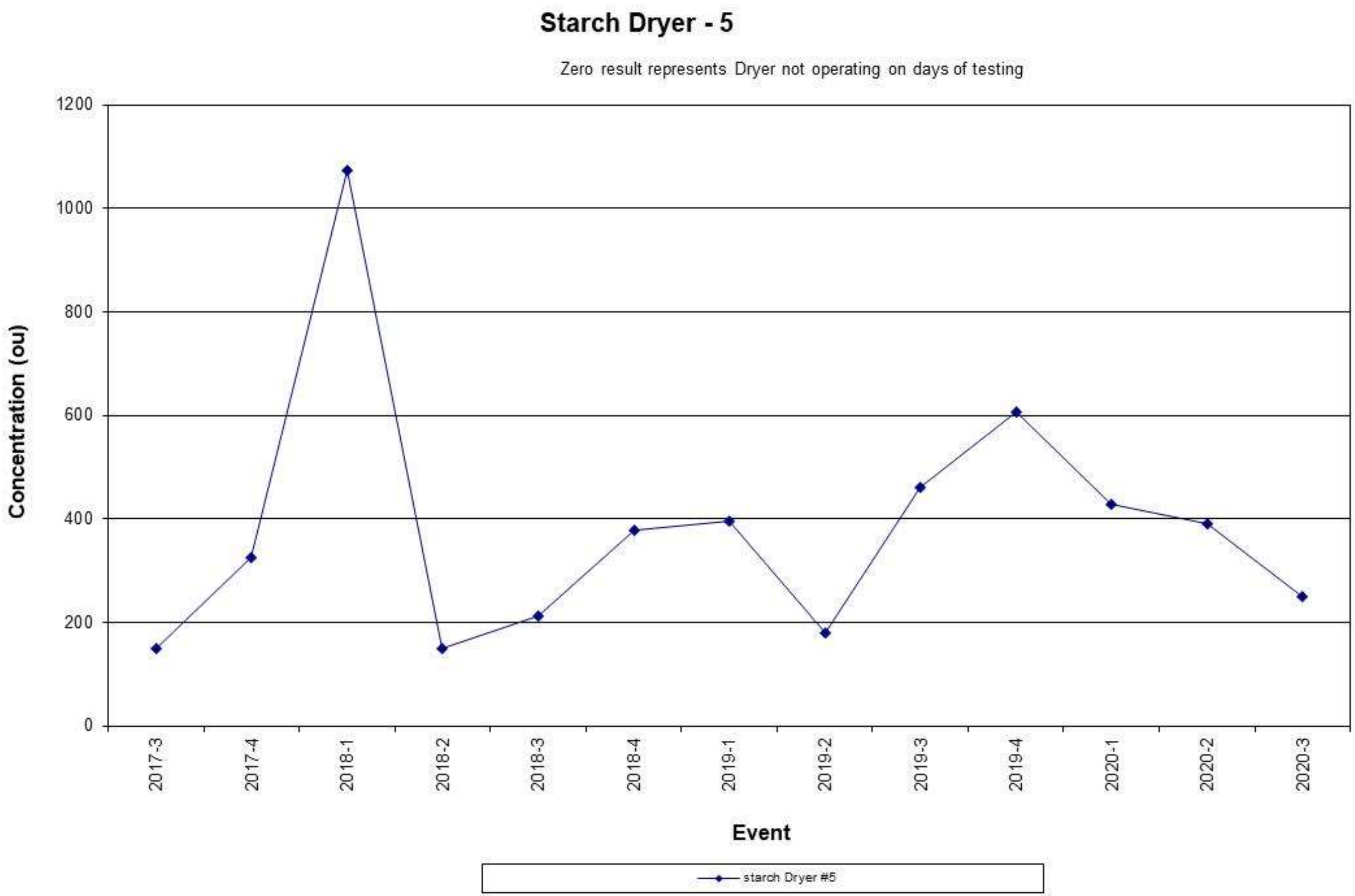


FIGURE 5-4 ODOUR EMISSION CONCENTRATIONS, FERMENTERS (EPA 44)

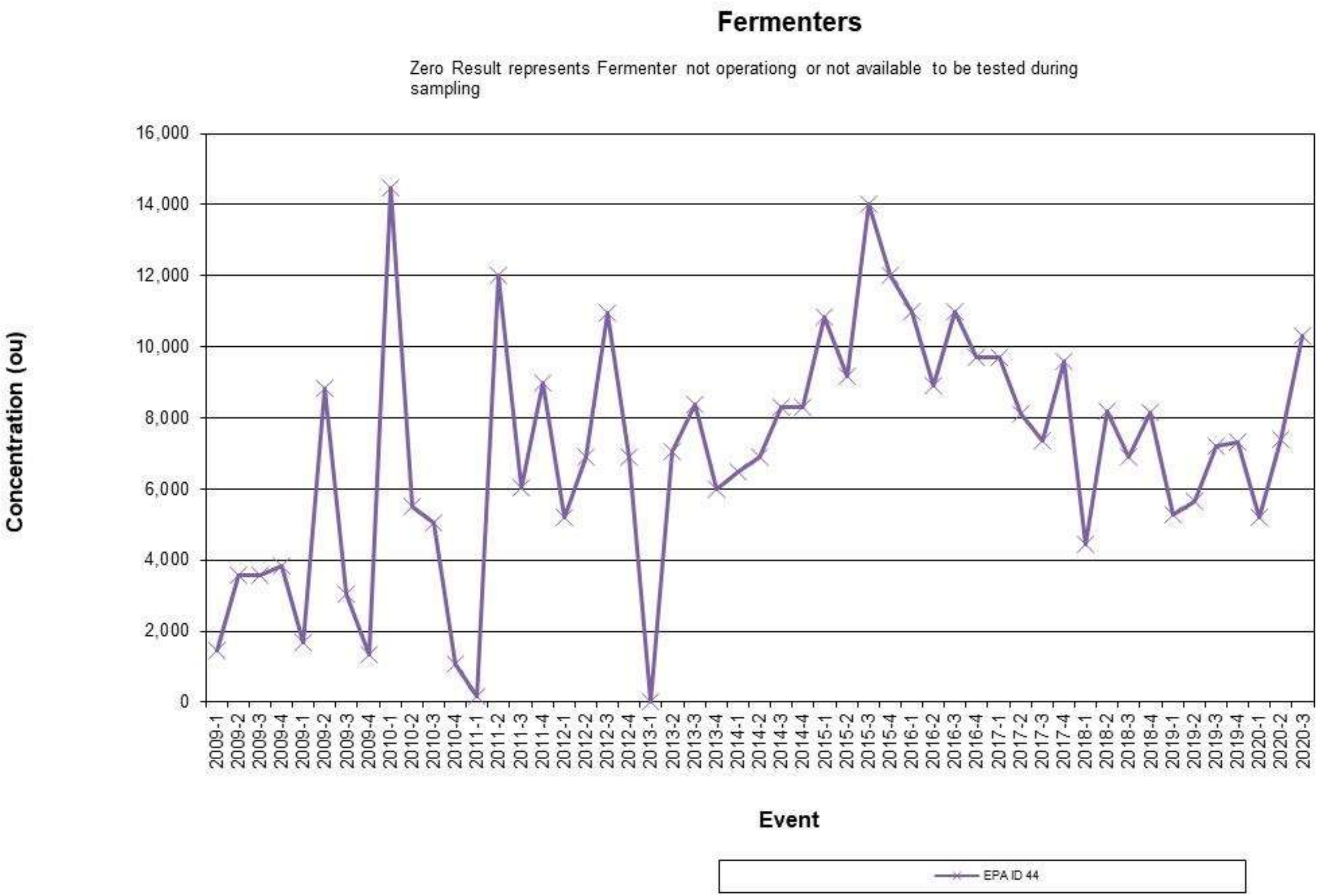


FIGURE 5-5 ODOUR EMISSION CONCENTRATIONS, CARBON DIOXIDE SCRUBBER OUTLET (EPA 16)

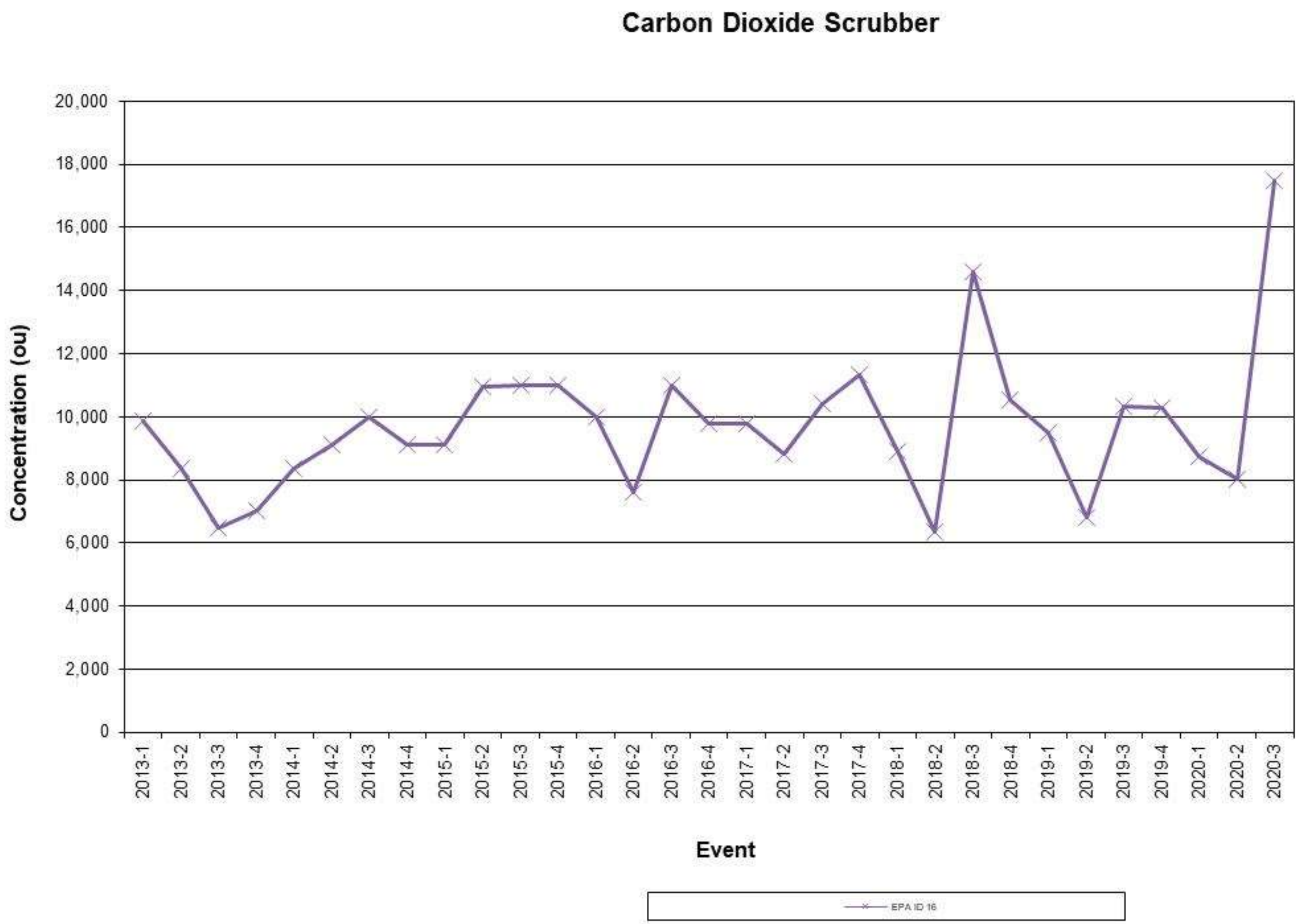


FIGURE 5-6 ODOUR EMISSION CONCENTRATIONS, COMBINED BOILER 5 & 6 STACK (EPA 35)

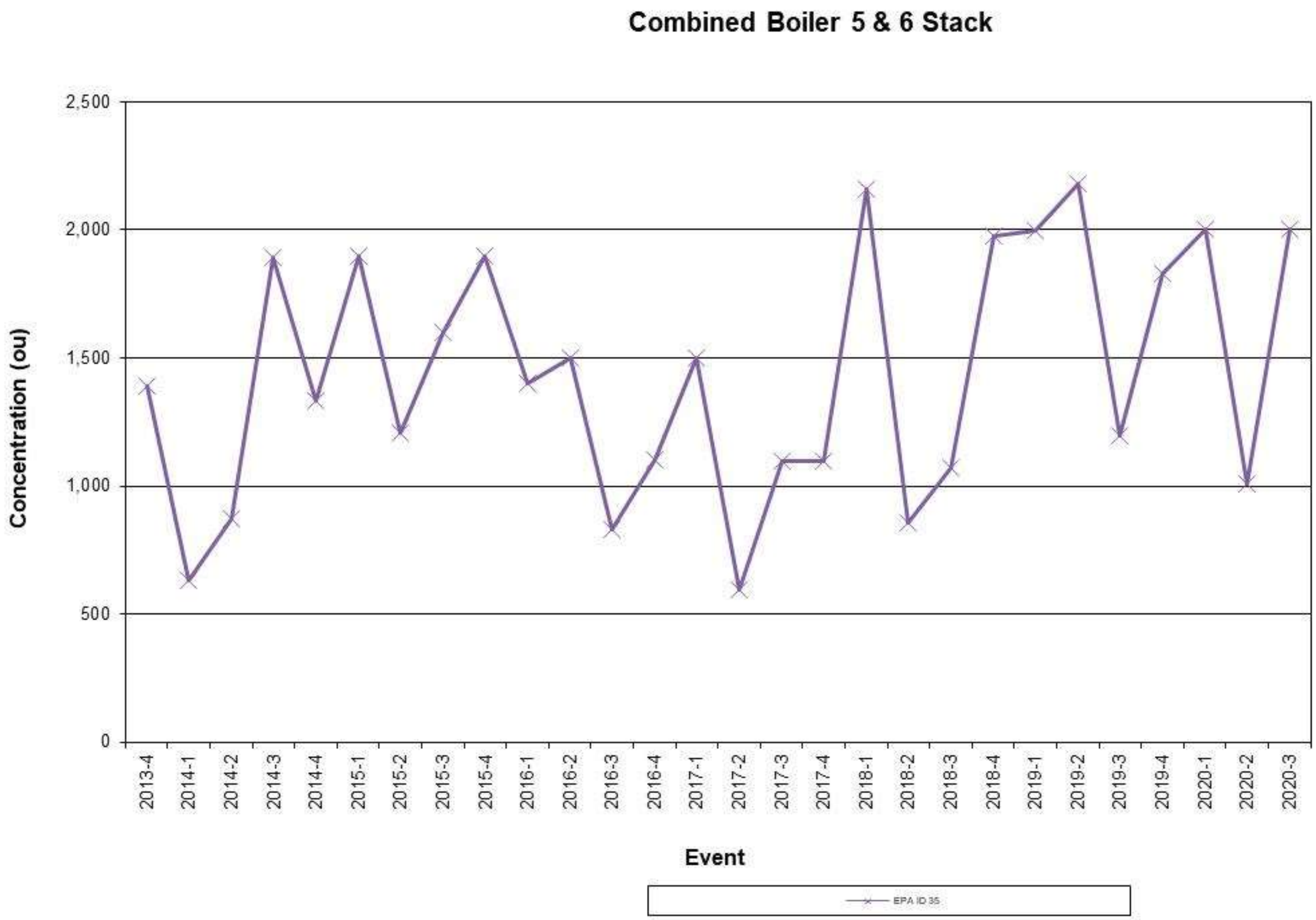


FIGURE 5-7 ODOUR EMISSION CONCENTRATIONS, BOILER 4 STACK (EPA 42)

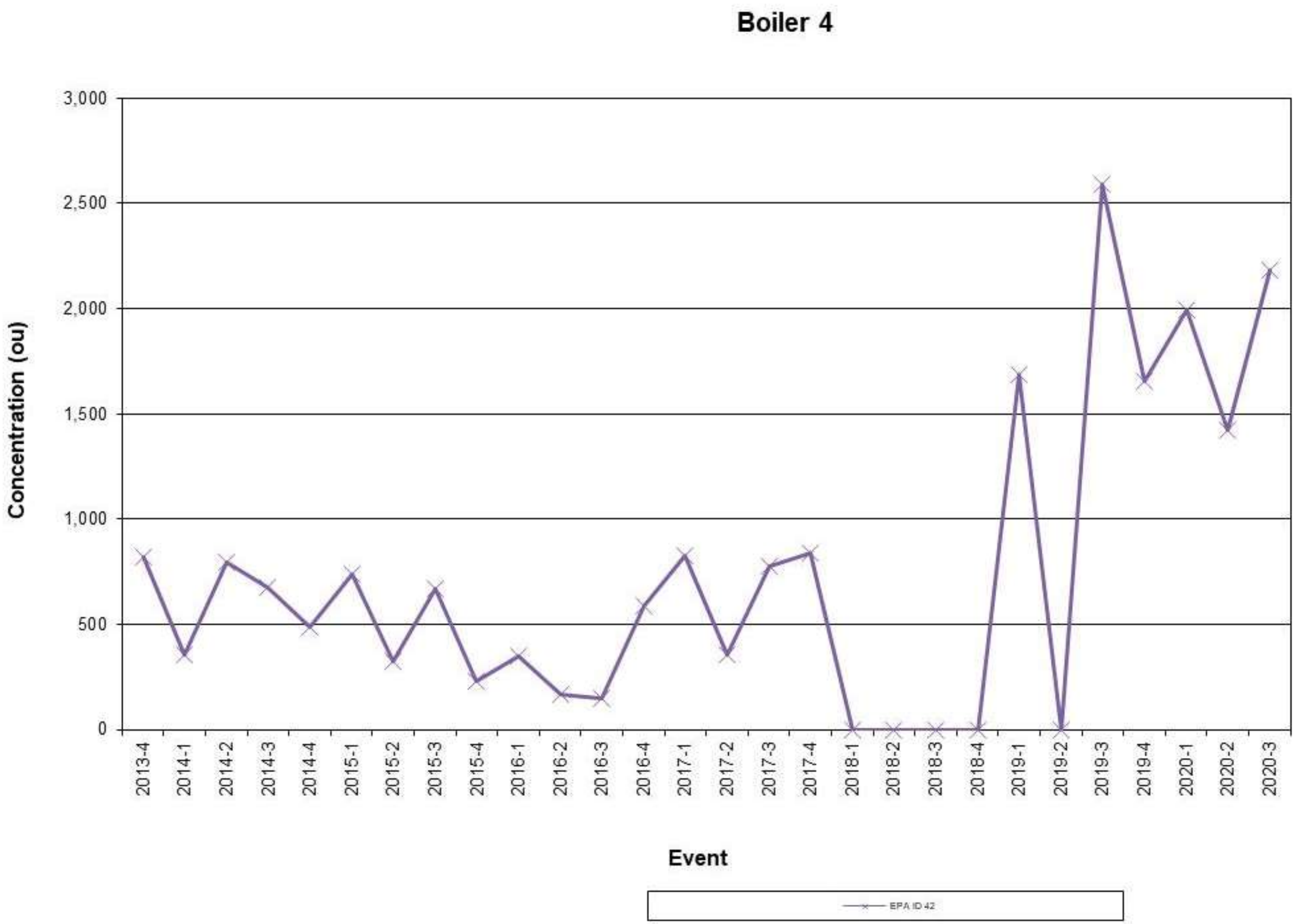


FIGURE 5-8 ODOUR EMISSION CONCENTRATIONS, BOILER 2 STACK (EPA 45)

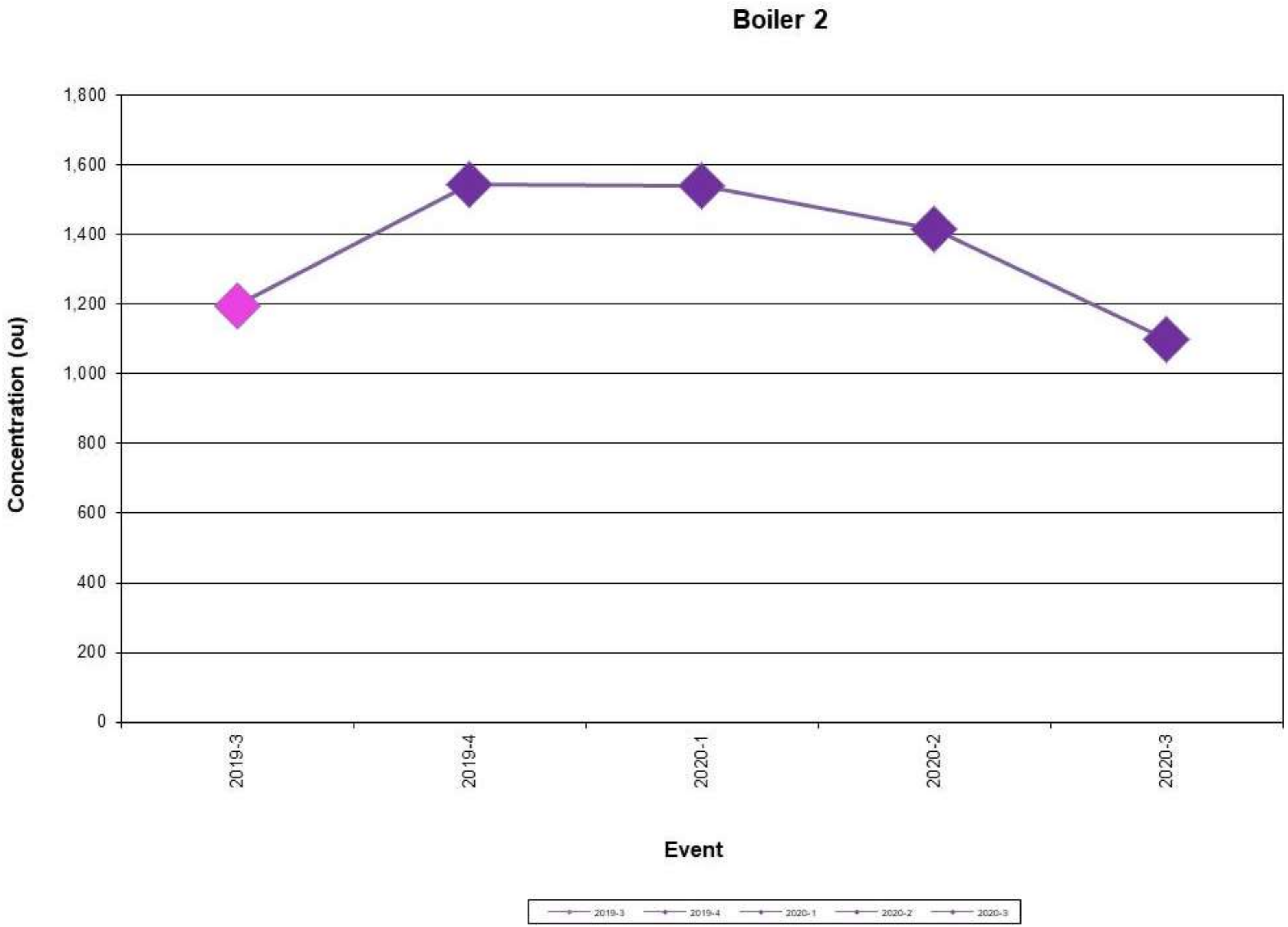


FIGURE 5-9 ODOUR EMISSION CONCENTRATIONS, BIOFILTERS (EPA 39, 40, 41)

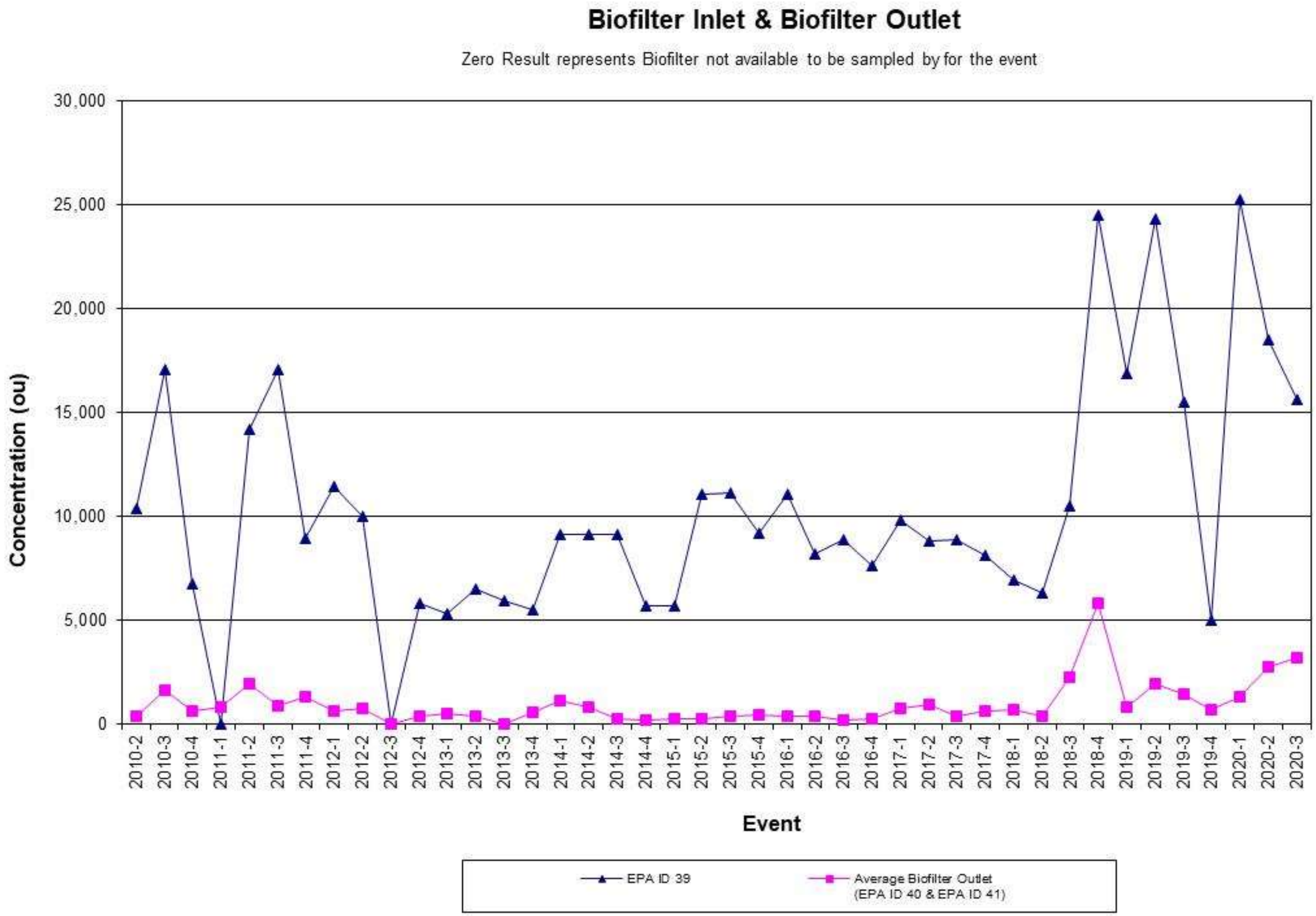
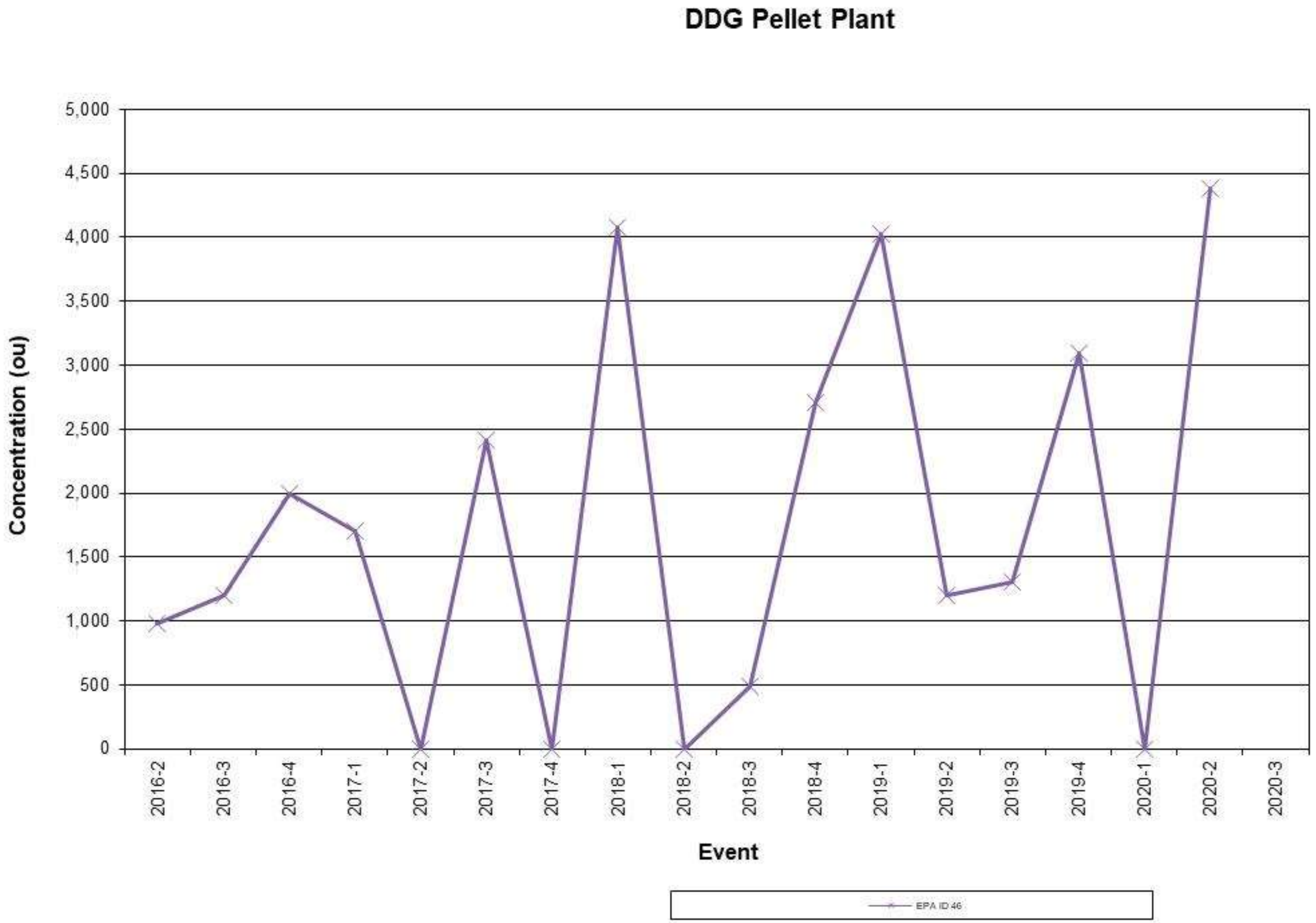


FIGURE 5-10 ODOUR EMISSION CONCENTRATIONS, DDG PELLET PLANT (EPA 46)



6 TEST METHODS

6.1 ODOUR MEASUREMENT/DYNAMIC OLFACTOMETRY

(AS 4323.3 & AS 4323.4 and OM-7 and OM-8)

Samples were collected in 30L Nalophane sampling bags which are enclosed in airtight plastic containers. Surface samples were collected utilising an equilibrium flux hood or witches hat flux hood.

Odorous gas for analysis was drawn through a Teflon (PTFE) sample probe. The gas then passes through a Teflon (PTFE) tube connected to the Nalophane sampling bag. The sampling pump is connected to the airtight plastic container to provide a sample gas flow-rate of approximately 0.5 – 1.5 litres per minute. After the required volume has been sampled, the pump is stopped and the bag sealed with a stainless steel valve. Two samples were collected from each site.

Using a triangular forced choice olfactometer, the Nalophane bag of odour sample was dynamically diluted to various concentrations with dry odour free air.

The diluted sample was then presented to a panel of screened panellists as one of these airflows. The panellists then recorded if they could detect any odour and from which flow. The other two flows were discharging odour free air.

The odour is always presented to the panellists in ascending concentration; that is, from lower to higher concentration. The panellists are required at each dilution level to give a response as to what they are smelling from the flows (forced choice methodology). The response options for the panellists are:

'Guess'	Unable to determine which air flow contains the diluted odours
'Inkle'	Thinks that one of the flows could be different from the other two flows
'Detect' or 'Certain'	Is confident that one of the airflows smells different from the other two flows. Not necessarily able to say what the smell is.
'Recognise'	Thinks that one of the flows could be different from the other two flows and is able to: ▪ Assign a 'hedonic tone' (pleasantness scale number) to the odour ranging from –10 to 10 and/or ▪ Able to assign a character to the colour, as in 'it smells like …' *Note: that the Recognise level concentration and Hedonic Tone and Odour descriptors are obtained with the diluted odour, panellists are not exposed to the full strength odour.*

The percentage panel response and dilution levels used were then entered into a computer programme to determine the 50% panel response. This dilution level corresponds to the odour concentration of the sample.

Sampling and dilution lines are constructed from teflon, stainless or glass to prevent contamination of the sample.

The sampling and the dilution procedures used were in accordance with OEH NSW Method OM-7 and OM-8, which are based on Standards Association of Australia, AS4323.3 and AS4323.4.

6.1.1 ODOUR PANEL SELECTION

Odour panellists must meet certain criteria to qualify as and remain panellists. Their average sensitivity to n-Butanol must be between 20 and 80 parts per billion (ppb) and their variability in response to n-Butanol must be within a certain range.

Panellists are screened against n-Butanol before every panel session to ensure they are in compliance.

Panellists should not suffer from respiratory complaints, nor should they eat or smoke or drink anything but water during the half hour preceding or during the test period and their person and clothing should be odour free and have not been exposed to an odorous environment before testing.

6.1.2 ODOUR TERMINOLOGY

The odour level is expressed in odour units and for mixed odours is analogous to concentration expressed in parts per billion. The odour detection level is defined as the ratio of *the volume that a sample of odorous gas would occupy when diluted to the threshold of detection of that odour* to *the volume of the sample*. In simpler terms, the ratio indicated the number of dilutions necessary to reduce the odour to its threshold of detection or odour detection threshold. This ratio is expressed in odour units or number of dilutions to detection threshold. For example, a value of 2,000 odour units would mean the volume of the initial sample of odorous gas would need to be diluted 2,000 times before the odour would just be detectable to the average human nose, that is, at the odour detection threshold.

6.2 EXHAUST GAS VELOCITY

(OEH NSW TM-2 and USEPA Method 12)

Velocity profiles were obtained across the stack utilising an Airflow Developments Ltd. S-type pitot tube and digital manometer.

6.3 EXHAUST GAS TEMPERATURE

(OEH NSW TM- 2, 3 & 4 and USEPA Methods 2, 3 & 4)

The exhaust gas temperature was measured using a Digital thermometer (0-1200°C) connected to a chromel/alumel (K-type) thermocouple probe.

6.4 OXYGEN (O_2)

(OEH NSW TM-24 and USEPA Method 3A)

O_2 was analysed by a Testo 350 analyser.

6.5 MOISTURE

(OEH NSW TM-22 and USEPA Method 4)

Moisture from the stack was determined in accordance with OEH NSW TM-22 and USEPA Method 4. In particular, M4 Section 2.2.1 which nominates a moisture approximation method used to enable calculation of isokinetic sampling rates and where isokinetic sampling is not required such as odour sampling.

6.6 ACCURACY

All results are quoted on a dry basis. SEMA has adopted the following (Table 6-1) uncertainties for various stack testing methods.

TABLE 6-1 ESTIMATION OF MEASUREMENT UNCERTAINTY

Pollutant	Methods	Uncertainty
Moisture	AS4323.2, TM-22, USEPA 4	25%
Odour	AS4323.3, AS4323.4	3 times
Oxygen and Carbon Dioxide	TM-24, TM-25, USEPA 3A	1% actual
Velocity	AS4323.1, TM-2, USEPA 2A & 2C	5%

Key:

Unless otherwise indicated the uncertainties quoted have been determined @ 95% level of Confidence level (i.e. by multiplying the repeatability standard deviation by a co-efficient equal to 1.96) (Source – Measurement Uncertainty)

Sources: *Measurement Uncertainty – implications for the enforcement of emission limits by Maciek Lewandowski (Environment Agency) & Michael Woodfield (AEAT) UK*

Technical Guidance Note (Monitoring) M2 Monitoring of stack emissions to air Environment Agency Version 3.1 June 2005.

APPENDIX A – EMISSION TEST RESULTS

Glossary:

%	=	percent
^oC	=	degrees celsius
am^3/min	=	cubic metre of gas at actual conditions per minute
Normal Volume (m^3)	=	cubic metre at 0°C and 760 mm pressure and 1 atmosphere
am^3	=	cubic metre of gas at actual conditions
g/g mole	=	grams per gram mole
g/s	=	grams per second
hrs	=	hours
kg/m^3	=	kilograms per cubic metre
kPa	=	kilo Pascals
m^2	=	square metre
m/s	=	metre per second
m^3/sec	=	cubic metre per second at 0^0C and 1 atmosphere
mg	=	milligrams
mg/ m^3	=	milligrams per cubic metre at 0^oC and 1 atmosphere
O_2	=	oxygen

Abbreviations for names of SEMA staff who completed either Sampling or Analysis or QA Checking

PWS	=	Peter W Stephenson
JW	=	Jay Weber

TABLE A-1 EMISSION TEST RESULTS – GLUTEN DRYERS NO. 1, 2, 3 & 4

Emission Test Results				
Project Number	**7095**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 8 Gluten Dryer 1***	**EPA ID 9 Gluten Dryer 2**	**EPA ID 10 Gluten Dryer 3**	**EPA ID 11 Gluten Dryer 4**
Date	05-Aug-20	05-Aug-20	05-Aug-20	05-Aug-20
	Dry			
Run	1			
Method	TM-1, TM-2 & TM-22			
Flow Start Time (hrs)	12:07	10:30	12:00	11:32
Flow Stop Time (hrs)	12:24	10:40	12:21	11:53
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	71.4	63	70.1	73.5
Stack Cross-Sectional area (m^2)	1.431	1.094	4.410	2.310
Average Stack Gas Velocity (m/s)	14.0	18.1	11.6	16.0
Actual Gas Flow Volume (am^3/min)	1,201	1,190	3,080	2,222
Total Normal Gas Flow Volume (m^3/min)	887	837	2,253	1,651
Total Normal Gas Flow Volume (m^3/s)	14.8	14.0	37.6	27.5
Total Stack Pressure (kPa)	101.4	92.1	101.4	101.1
Moisture Content (% by volume)	6.9	4.8	8.1	5.5
Molecular Weight Dry Stack Gas (g/gmole)	28.8	28.8	28.8	28.8
Dry Gas Density (kg/m^3)	1.29	1.29	1.29	1.29
Oxygen (%)	20.9	20.90	20.9	20.9
Analysis	**Odour**	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5417	5407	5408	5409
SEMA Number	728041	728032	728033	728034
Sample Start Time (hrs)	12:14	10:35	12:11	11:43
Sample Finish Time (hrs)	12:24	10:40	12:21	11:53
Odour Concentration (As Received) (ou)	660	430	850	720
Odour Concentration (Final) (ou)	**660**	**430**	**850**	**720**
Normal MOER (As Received) (ou m^3/s)	9,800	6,000	32,000	20,000
Normal MOER (Final) (ou m^3/s)	9,800	6,000	32,000	20,000
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit	No Limit
Sample storage period prior to disposal	2 days	2 days	2 days	2 days
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

* Re. Gluten Dryer No.1 (EPA ID 8), odour measurements were taken. However, new silencer and ductwork no longer enable access to the duct. Thus, flow measurements were unable to be taken. To enable calculation of the MOER, flow measurements have been based on previous Quarter 1, 2020 results.

TABLE A-2 EMISSION TEST RESULTS – STARCH DRYERS NO.1, 3, 4 & 5

Emission Test Results				
Project Number	**7095**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 12 Starch Dryer 1**	**EPA ID 13 Starch Dryer 3**	**EPA ID 14 Starch Dryer 4**	**EPA ID 47 Starch Dryer 5**
Date	05-Aug-20	12-Aug-20	12-Aug-20	12-Aug-20
	Dry			
Run	1			
Method	TM-1, TM-2 & TM-22			
Flow Start Time (hrs)	11:10	11:21	11:22	10:29
Flow Stop Time (hrs)	11:31	11:43	11:43	10:30
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	36.1	34.2	36.8	67.3
Stack Cross-Sectional area (m^2)	2.250	1.000	1.000	4.524
Average Stack Gas Velocity (m/s)	6.8	20.0	21.2	15.3
Actual Gas Flow Volume (am^3/min)	920	1,200	1,273	4,156
Total Normal Gas Flow Volume (m^3/min)	773	1,018	1,064	3,173
Total Normal Gas Flow Volume (m^3/s)	12.9	17.0	17.7	52.9
Total Stack Pressure (kPa)	101.05	101.44	101.42	101.42
Moisture Content (% by volume)	4.6	4.6	5.3	5.0
Molecular Weight Dry Stack Gas (g/gmole)	28.8	28.8	28.8	28.8
Dry Gas Density (kg/m^3)	1.29	1.29	1.29	1.29
Oxygen (%)	20.9	20.9	20.9	20.9
Analysis	**Odour**	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5406	5415	5416	5413A
SEMA Number	728031	728039	728040	728038
Sample Start Time (hrs)	11:21	11:33	11:33	10:40
Sample Finish Time (hrs)	11:31	11:43	11:43	10:50
Odour Concentration (As Received) (ou)	250	400	140	250
Odour Concentration (Final) (ou)	**250**	**400**	**140**	**250**
Normal MOER (As Received) (ou m^3/s)	3,200	6,800	2,500	13,000
Normal MOER (Final) (ou m^3/s)	3,200	6,800	2,500	13,000
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days	2 days	2 days
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

TABLE A- 3 EMISSION TEST RESULTS – BOILERS NO. 5&6, 4 & 2

Emission Test Results			
Project Number	**7095**		
Project Name	**Shoalhaven Starches**		
Test Location	**EPA ID 35 Boilers 5&6**	**EPA ID 42 Boiler 4**	**EPA ID 45 Boiler 2**
Date	12-Aug-20	12-Aug-20	12-Aug-20
	Dry		
Run	1		
Method	TM-1, TM-2 & TM-22		
Flow Start Time (hrs)	12:32	13:12	13:58
Flow Stop Time (hrs)	12:53	13:32	14:20
Inlet/Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	139.5	164.6	216.0
Stack Cross-Sectional area (m^2)	3.142	1.057	0.950
Average Stack Gas Velocity (m/s)	16.7	18.8	10.4
Actual Gas Flow Volume (am^3/min)	3,143.1	1,194.9	592.4
Total Normal Gas Flow Volume (m^3/min)	1,978.0	708.3	316.9
Total Normal Gas Flow Volume (m^3/s)	32.966	11.805	5.282
Total Stack Pressure (kPa)	101.36	101.64	101.52
Moisture Content (% by volume)	5.0	5.3	4.4
Molecular Weight Dry Stack Gas (g/gmole)	30.1	29.8	30.080
Dry Gas Density (kg/m^3)	1.34	1.33	1.34
Oxygen (%)	8.4	10.0	8.4
Analysis	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5418	5419	5420
SEMA Number	728042	728043	728044
Sample Start Time (hrs)	12:43	13:22	14:10
Sample Finish Time (hrs)	12:53	13:32	14:20
Odour Concentration (As Received) (ou)	2,000	2,180	1,100
Odour Concentration (Final) (ou)	**2,000**	**2,180**	**1,100**
Normal MOER (As Received) (ou m^3/s)	66,000	26,000	5,800
Normal MOER (Final) (ou m^3/s)	66,000	26,000	5,800
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days	2 days
Calculations entered by	JW	JW	JW
Calculations checked by	PWS	PWS	PWS

TABLE A-4 EMISSION TEST RESULTS – FERMENTER 13 & CO_2 SCRUBBER OUTLET

Emission Test Results		
Project Number	**7095**	
Project Name	**Shoalhaven Starches**	
Test Location	**EPA ID 44 Fermenter 13**	**EPA ID 16 CO_2 Scrubber outlet**
Date	05-Aug-20	05-Aug-20
	Dry	
Run	1	
Method	TM-1,TM-2 & TM-22	
Flow Start Time (hrs)	12:54	13:04
Flow Stop Time (hrs)	13:15	13:25
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	29.7	22.4
Stack Cross-Sectional area (m^2)	0.071	0.196
Average Stack Gas Velocity (m/s)	3.1	9.3
Actual Gas Flow Volume (am^3/min)	13.1	110
Total Normal Gas Flow Volume (m^3/min)	11.4	99
Total Normal Gas Flow Volume (m^3/s)	0.190	1.645
Total Stack Pressure (kPa)	101.11	101.07
Moisture Content (% by volume)	3.30	2.56
Molecular Weight Dry Stack Gas (g/gmole)	29.6	31.2
Dry Gas Density (kg/m^3)	1.32	1.39
Oxygen (%)	0.5	0.1
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5410	5412
SEMA Number	728035	728037
Sample Start Time (hrs)	13:05	13:15
Sample Finish Time (hrs)	13:15	13:25
Odour Concentration (As Received) (ou)	10,300	17,500
Odour Concentration (Final) (ou)	**10,300**	**17,500**
Normal MOER (As Received) (ou m^3/s)	2,000	28,800
Normal MOER (Final) (ou m^3/s)	2,000	28,800
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

TABLE A- 5 EMISSION TEST RESULTS – INLET TO BIOFILTERS, DDG EVAPORATORS 1, 2, 3 & 4

Emission Test Results		
Project Number	**7095**	
Project Name	**Shoalhaven Starches**	
Test Location	**EPA ID 39 Biofilter Inlet DDG Evaporators 1, 2 & 3**	**EPA ID 39A Biofilter Inlet DDG Evaporator 4**
Date	8-Oct-20	8-Oct-20
	Dry	
Run	1	
Method	TM-1,TM-2 & TM-22	
Flow Start Time (hrs)	12:18	12:22
Flow Stop Time (hrs)	12:46	12:43
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	39.8	31.1
Stack Cross-Sectional area (m^2)	0.283	0.049
Average Stack Gas Velocity (m/s)	14.3	7.5
Actual Gas Flow Volume (am^3/min)	243	22
Total Normal Gas Flow Volume (m^3/min)	189	19
Total Normal Gas Flow Volume (m^3/s)	3.1	0.3
Total Stack Pressure (kPa)	96.25	101.06
Moisture Content (% by volume)	6.23	4.12
Molecular Weight Dry Stack Gas (g/gmole)	28.836	28.836
Dry Gas Density (kg/m^3)	1.287	1.287
Oxygen (%)	20.9	20.9
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5434	5435
SEMA Number	728098	728099
Sample Start Time (hrs)	12:32	13:09
Sample Finish Time (hrs)	12:46	13:19
Odour Concentration (As Received) (ou)	15,600	41,900
Odour Concentration (Final) (ou)	**15,600**	**41,900**
Normal MOER (As Received) (ou m^3/s)	49,100	13,200
Normal MOER (Final) (ou m^3/s)	49,100	13,200
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

TABLE A- 6 EMISSION TEST RESULTS DDG PELLET PLANT

Emission Test Results		
Project Number	**7095**	
Project Name	**Shoalhaven Starches**	
Test Location	**Part EPA ID 46* DDG Pellet Cooler East Stack**	**Part EPA ID 46* DDG Pellet Silo**
Date	28-Oct-20	28-Oct-20
	Dry	
Run	1	
Method	TM-1,TM-2 & TM-22	
Flow Start Time (hrs)	16:25	15:54
Flow Stop Time (hrs)	16:48	16:06
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	69.0	56.0
Stack Cross-Sectional area (m^2)	0.665	0.126
Average Stack Gas Velocity (m/s)	14	12
Actual Gas Flow Volume (am^3/min)	571	87
Total Normal Gas Flow Volume (m^3/min)	434	70
Total Normal Gas Flow Volume (m^3/s)	7.2	1.2
Total Stack Pressure (kPa)	99.70	102.11
Moisture Content (% by volume)	3.21	3.57
Molecular Weight Dry Stack Gas (g/gmole)	28.836	28.836
Dry Gas Density (kg/m^3)	1.29	1.29
Oxygen (%)	20.9	20.9
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5438	5437
SEMA Number	728112	728111
Sample Start Time (hrs)	16:38	16:08
Sample Finish Time (hrs)	16:48	16:18
Odour Concentration (As Received) (ou)	8,800	6,200
Odour Concentration (Final) (ou)	**8,800**	**6,200**
Normal MOER (As Received) (ou m^3/s)	63,600	7,300
Normal MOER (Final) (ou m^3/s)	63,600	7,300
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

Key:

Part 46* = partial contribution to EPA ID 46 stack which was not accessible

TABLE A- 7 EMISSION TEST RESULTS – BIOFILTER OUTLETS

Emission Test Results				
Project Number	**7095**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 40 Biofilter A East**	**EPA ID 40 Biofilter A West**	**EPA ID 41 Biofilter B East**	**EPA ID 41 Biofilter B West**
Date	8-Oct-20	8-Oct-20	8-Oct-20	8-Oct-20
Run	1			
Method	TM-2 & TM-22			
Sample & Flow Start Time (hrs)	13:10	13:41	13:06	13:32
Sample & Flow Stop Time (hrs)	13:20	13:51	13:16	13:43
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	37.6	38.4	30.6	27.8
Proportion of Inlet air flow (%)	**26**	**25**	**26**	**23**
Analysis	Odour	Odour	Odour	Odour
Method	AS4323.3	AS4323.3	AS4323.3	AS4323.3
ORLA Number	728094	728096	728095	728097
SEMA Number	5430	5432	5431	5433
Odour Concentration (As Received) (ou)	1,200	1,400	4,000	6,200
Odour Concentration (Final) (ou)	**1,200**	**1,400**	**4,000**	**6,200**
Normal MOER (As Received) (ou m^3/s)	1,100	1,200	3,700	4,900
Normal MOER (Final) (ou m^3/s)	1,100	1,200	3,700	4,900
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

APPENDIX B – CERTIFICATES OF ANALYSIS

Odour Research Laboratories Australia

A Division of Peter W. Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

52A Hampstead Road
Auburn NSW 2144 Australia
Tel: (02) 9737 9991
E-Mail: pstephenson@orla.com.au

Olfactometry Test Report

The measurement was commissioned by SEMA on behalf of:

Client	Organisation:	Shoalhaven Starches
	Address:	Bolong Road, Bomaderry NSW 2541
	Contact:	John Studdert
	Sampling Sites:	Starch Dryers 1, 3, 4 and 5 Gluten Dryers 1, 2, 3 and 4 Fermenter 13 CO_2 Scrubber inlet and outlet Boilers 2, 4 and 5&6
	Telephone:	02 4423 8254
	Email:	John.studdert@manildra.com.au
Project	ORLA Report Number:	7095/ORLA/01
	Project Manager:	Margot Kimber
	Testing operator:	Peter Stephenson
	ORLA Sample number(s):	5405 - 5420
	SEMA Sample number(s):	728031 - 728044
Order	Analysis Requested:	Odour Analysis
	Order requested by:	SEMA on behalf of Shoalhaven Starches
	Date of order:	31 July 2020
	Order number:	5147
	Telephone:	02 9737 9991
	Signed by:	Margot Kimber
	Order accepted by:	Peter Stephenson
Report	Date of issue:	14 August 2020

NATA accredited laboratory number 15043.

Accredited for Compliance with ISO/IEC 17025 - Testing

ODOUR CONCENTRATION MEASUREMENTS RESULTS 7095/ORLA/01

Investigated Item	Odour concentration in odour units 'ou' determined by Sensory odour concentration measurements, of an odour sample supplied in a sampling bag. All samples were received in good condition.
Analysis Method	The samples were analysed in accordance with AS/NZS4323.3:2001.
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 n-butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Instrument Used	The Olfactometer used during this testing session was: AC'SCENT International Olfactometer
Measuring Range	The measuring range of the AC'SCENT International olfactometer is $12 \leq \chi \leq 92{,}102$ ou. . If the measuring range was insufficient the odour samples will have been pre-diluted.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between ± 3°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.05$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $r = 0.0020$ (February 2020) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.20$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $A = 0.020$ (February 2020) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the AC'SCENT International Olfactometer has been determined to be 12 ou.
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 every session to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

14 August, 2020

Peter Stephenson
Managing Director

Odour Research Laboratories Australia

Odour Olfactometry Results – 7095/ORLA/01

Sample				Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ +
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Starch Dryer 1	728031	05.08.20 11:21	5406	06.08.20 10:50	4	8	Nil	250	250	Hessian, earthy, floral mould, flour, musty, yeasty-then plastic, paint (-1)^
Sample ID: Gluten Dryer 2	728032	05.08.20 10:35	5407	06.08.20 11:19	4	8	Nil	430	430	Musty, dirty feet, wheat, plastic, paint, hessian, bag of dirty potatoes, earthy, grains (-2)^
Sample ID: Gluten Dryer 3	728033	05.08.20 12:11	5408	06.08.20 11:49	4	8	Nil	850	850	Dirty feet, hessian, wet cardboard, fried vegetables, first sharp/sour vomit – then musty, wheat, plastic (-2)^
Sample ID: Gluten Dryer 4	728034	05.08.20 11:43	5409	06.08.20 12:18	4	8	Nil	720	720	Musty, hessian, earthy, wheat, plastic, dirty feet, metallic drain water (-2)^
Sample ID: Fermenter #13	728035	05.08.20 13:05	5410	06.08.20 12:47	4	8	Nil	10300	10300	Flowery, sweet, perfume, vinegar, ink, alcohol, caramel liqueur, fruit yoghurt (-1)^
Sample ID: CO2 scrubber Inlet	728036	05.08.20 13:16	5411	06.08.20 14:10	4	8	Nil	11300	11300	Ethanol, sickly sweet, alcohol, sweet vinegar, ink, caramel liqueur, syrup, mango yoghurt (0)^
Sample ID: CO2 scrubber Outlet	728037	05.08.20 13:15	5412	06.08.20 14:39	4	8	Nil	17500	17500	Perfume, citrus, sweet vinegar, ink, alcohol, caramel liqueur, syrup, fruit, sour – but not sharp (-2)^

Odour Research Laboratories Australia

Odour Olfactometry Results – 7095/ORLA/01

Sample				Analysis Date/Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^*
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Starch Dryer 5	728038	12.08.20 10:40	5413	13.08.20 10:46	4	8	Nil	250	250	Dirty feet, gas, musty, hessian, grain, wheat, fermentation (hops?), firstly earth & garbage/septic then plastic (-2)^
Sample ID: Starch Dryer 3	728039	12.08.20 11:33	5415	13.08.20 11:14	4	8	Nil	400	400	Yeasty, sweet, organic, hessian, wheat, grains, slight soapy, later plastic artificial fruit (0)^
Sample ID: Starch Dryer 4	728040	12.08.20 11:33	5416	13.08.20 11:43	4	8	Nil	140	140	Starch, musty, sweet, plastic toys, slight chlorine, dank pipe water (metallic), hessian, wheat, compost, dirty & earthy at end (-1)^
Sample ID: Gluten Dryer 1	728041	12.08.20 12:14	5417	13.08.20 12:12	4	8	Nil	660	660	Dirty feet, musty, rotting stone fruit, corn, garlic, potato, earth, vinyl, wood (-2)^
Sample ID: Boiler 5&6	728042	12.08.20 12:43	5418	13.08.20 12:42	4	8	Nil	2000	2000	Damp, musty, car exhaust, sweet coal/steam train exhaust, septic, earth, wood, grain, plastic (-2)^
Sample ID: Boiler 4	728043	12.08.20 13:24	5419	13.08.20 13:10	4	8	Nil	2180	2180	Car exhaust fumes, coke-not coal, slightly metallic, musty, acid, sweet, slight mild & sweet vinegar, plastic (-1)^
Sample ID: Boiler 2	728044	12.08.20 14:10	5420	13.08.20 13:39	4	8	Nil	1100	1100	Exhaust fumes, coke, musty, sulfur, solvent, plastic, sweet mild vinegar (-1)^

Odour Research Laboratories Australia

Odour Panel Calibration Results – 7095/ORLA/01

Reference Odorant	ORLA Sample No.	Date	Concentration of Reference Gas (ppm)	Reference Gas Measured Concentration (ou)	Panel Average Measured Concentration (ppb) [3]	Does panel calibration measurement comply with AS/NZS4323.3:P2001 (Yes/No) [4]
n-butanol	5405	06.08.20	62.0	1413	43.9	Yes
n-butanol	5414	13.08.20	62.0	1679	36.9	Yes

Comments: All samples were collected by Stephenson Environmental Management Australia and analysed by Odour Research Laboratories Australia at their Sydney Laboratory.

Notes from Odour Olfactometry Results:

[1] Sample Odour Concentration: as received in the bag

[2] Sample Odour Concentration: allowing for pre-dilution

[3] Panel Average Measured Concentration: indicates the sensitivity of the panel for the session completed

[4] Target Range for reference gas n-butanol is $20 \leq \chi \leq 80$ ppb and compliance with AS/NZ4323.3:2001 is based on the individuals rolling average and not on the panel average measured concentration.

Panellist Rolling Average:

06/08/2020: SR =46.9, PR = 61.3, TL = 32.2, JW= 42.4

13/08/2020: SR =46.9, PR = 61.3, TL = 31.1, JW= 42.4

^ denotes the Average Hedonic Tone: describes the pleasantness of the odour being presented where (+5) represents Very Pleasant, (0) represents Neutral and (-5) represents Very Unpleasant and has been derived from the panellist responses at the recognition threshold.

+ This value is not part of our NATA Scope of Accreditation and AS4323.3

--------------------------------END OF TEST REPORT--------------------------------

Odour Research Laboratories Australia

A Division of Peter W. Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

52A Hampstead Road
Auburn NSW 2144 Australia
Tel: (02) 9737 9991
E-Mail: pstephenson@orla.com.au

Olfactometry Test Report

The measurement was commissioned by SEMA on behalf of:

Client	Organisation:	Shoalhaven Starches
	Address:	Bolong Road, Bomaderry NSW 2541
	Contact:	John Studdert
	Sampling Sites:	Biofilter Outlets A & B East, Biofilter Outlets A & B West, Biofilter Inlet from DDG Evaporators 1, 2, 3 & 4, DDG Pellet Silo and DDG Pellet Cooler East Stack
	Telephone:	02 4423 8254
	Email:	John.studdert@manildra.com.au
Project	ORLA Report Number:	7095/ORLA/02
	Project Manager:	Margot Kimber
	Testing operator:	Peter Stephenson
	ORLA Sample number(s):	5429 - 5438
	SEMA Sample number(s):	728094 - 728099 and 728111 - 728112
Order	Analysis Requested:	Odour Analysis
	Order requested by:	SEMA on behalf of Shoalhaven Starches
	Date of order:	8-Oct-2020
	Order number:	5167
	Telephone:	02 9737 9991
	Signed by:	Margot Kimber
	Order accepted by:	Peter Stephenson
Report	Date of issue:	04 January, 2021

NATA accredited laboratory number 15043.

Accredited for Compliance with ISO/IEC 17025 - Testing

Investigated Item	Odour concentration in odour units 'ou' determined by Sensory odour concentration measurements, of an odour sample supplied in a sampling bag. All samples were received in good condition.
Analysis Method	The samples were analysed in accordance with AS/NZS4323.3:2001.
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 n-butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Instrument Used	The Olfactometer used during this testing session was: AC'SCENT International Olfactometer
Measuring Range	The measuring range of the AC'SCENT International olfactometer is $12 \leq \chi \leq 92{,}102$ ou. . If the measuring range was insufficient the odour samples will have been pre-diluted.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between ± 3°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.05$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $r = 0.0020$ (February 2020) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.20$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $A = 0.020$ (February 2020) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the AC'SCENT International Olfactometer has been determined to be 12 ou.
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 every session to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

04 January, 2021

Peter Stephenson
Managing Director

Odour Research Laboratories Australia

Odour Olfactometry Results – 7095/ORLA/02

Sample				Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour concentration		Odour Character & Hedonic Tone* +
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Bio outlet A East	728094	08.10.20 13:10	5430	09.10.20 09:54	4	8	Nil	1200	1200	Manure, caffeine, sour, fertiliser, bitter, mould, earth, yeast, cocoa, coffee (-3)*
Sample ID: Bio outlet B East	728095	08.10.20 13:06	5431	09.10.20 10:24	4	8	Nil	4000	4000	Vegemite, slight sewer, earth, grain, hessian, sweet, cocoa, fruit yoghurt, sour vegetables, chocolate (-2)*
Sample ID: Bio outlet A West	728096	08.10.20 13:41	5432	09.10.20 10:53	4	8	Nil	1400	1400	Manure, fertiliser, smoky, burnt, earth, sulfur, grain, vegemite, swamp, cocoa (-2)*
Sample ID: Bio outlet B West	728097	08.10.20 13:32	5433	09.10.20 11:22	4	8	Nil	6200	6200	Sour, sour vegetable soup, hessian, mould, peat, cocoa, chocolate, sweet (-1)*
Sample ID: Bio inlet DDG Evaporators 1,2 & 3	728098	08.10.20 12:32	5434	09.10.20 12:55	4	8	Nil	15600	15600	Hessian, vegemite, grain, cocoa, sweet, dusty vacuum cleaner, plastic (-1)*
Sample ID: Bio inlet DDG Evaporator 4	728099	08.10.20 13:09	5435	09.10.20 13:27	4	8	Nil	42000	42000	Almond oil, sickly oil, cooking potatoes, tar, molasses, grain, sweet, chocolate, caramel liqueur (-3)*
Sample ID: DDG Pellet Silo	728111	28.10.20 16:08	5437	29.10.20 17:22	4	8	Nil	6200	6200	Malt, milkshake, wheat, cereal, slight yoghurt odour, old cooking oil, bitter (+1)*
Sample ID: DDG Pellet Cooler East	728112	28.10.20 16:38	5438	29.10.20 17:50	4	8	Nil	8800	8800	Sweet, sugar, malt, milkshake, cereal, wheat, dirty (+1)*

Odour Research Laboratories Australia

Odour Panel Calibration Results – 7095/ORLA/02

Reference Odorant	ORLA Sample No.	Date	Concentration of Reference Gas (ppm)	Reference Gas Measured Concentration (ou)	Panel Average Measured Concentration (ppb) [3]	Does panel calibration measurement comply with AS/NZS4323.3:P2001 (Yes/No) [4]
n-butanol	5429	09.10.20	62.0	1413	43.8	Yes
n-butanol	5436	29.10.20	62.0	1421	43.6	Yes

Comments: All samples were collected by Stephenson Environmental Management Australia and analysed by Odour Research Laboratories Australia at their Sydney Laboratory.

Notes from Odour Olfactometry Results:

1 Sample Odour Concentration: as received in the bag
2 Sample Odour Concentration: allowing for pre-dilution
3 Panel Average Measured Concentration: indicates the sensitivity of the panel for the session completed
4 Target Range for reference gas n-butanol is $20 \leq \chi \leq 80$ ppb and compliance with AS/NZ4323.3:2001 is based on the individuals rolling average and not on the panel average measured concentration.

Panellist Rolling Average:
09/10/2020: SR = 48.5, PR = 57.3, TL = 32.2, JW= 45.3
29/10/2020: SR = 46.9, PR = 61.3, TL = 31.1, PRP= 39.5

^ denotes the Average Hedonic Tone: describes the pleasantness of the odour being presented where (+5) represents Very Pleasant, (0) represents Neutral and (-5) represents Very Unpleasant and has been derived from the panellist responses at the recognition threshold.

+ This value is not part of our NATA Scope of Accreditation and AS4323.3

--END OF TEST REPORT--

APPENDIX C – DETAILS OF INSTRUMENT CALIBRATION

TABLE C- 1 INSTRUMENT CALIBRATION DETAILS DAY 1

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	07-May-20	07-Nov-20
775	Thermocouple	07-May-20	07-Nov-20
893	Thermocouple	07-May-20	07-Nov-20
815	Digital Manometer	06-Dec-19	06-Dec-20
726	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	Combustion Analyzer	16-Mar-20	16-Sep-20
675	Personal Sampler	12-Mar-20	12-Mar-21
832	Personal Sampler	26-Feb-20	26-Feb-21
678	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	05-Dec-19	05-Dec-20
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C- 2 INSTRUMENT CALIBRATION DETAILS DAY 2

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	07-May-20	07-Nov-20
920	Thermocouple	07-May-20	07-Nov-20
769	Thermocouple	07-May-20	07-Nov-20
815	Digital Manometer	06-Dec-19	06-Dec-20
726	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	Combustion Analyzer	16-Mar-20	16-Sep-20
675	Personal Sampler	12-Mar-20	12-Mar-21
832	Personal Sampler	26-Feb-20	26-Feb-21
678	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	05-Dec-19	05-Dec-20
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C- 3 INSTRUMENT CALIBRATION DETAILS DAY 3

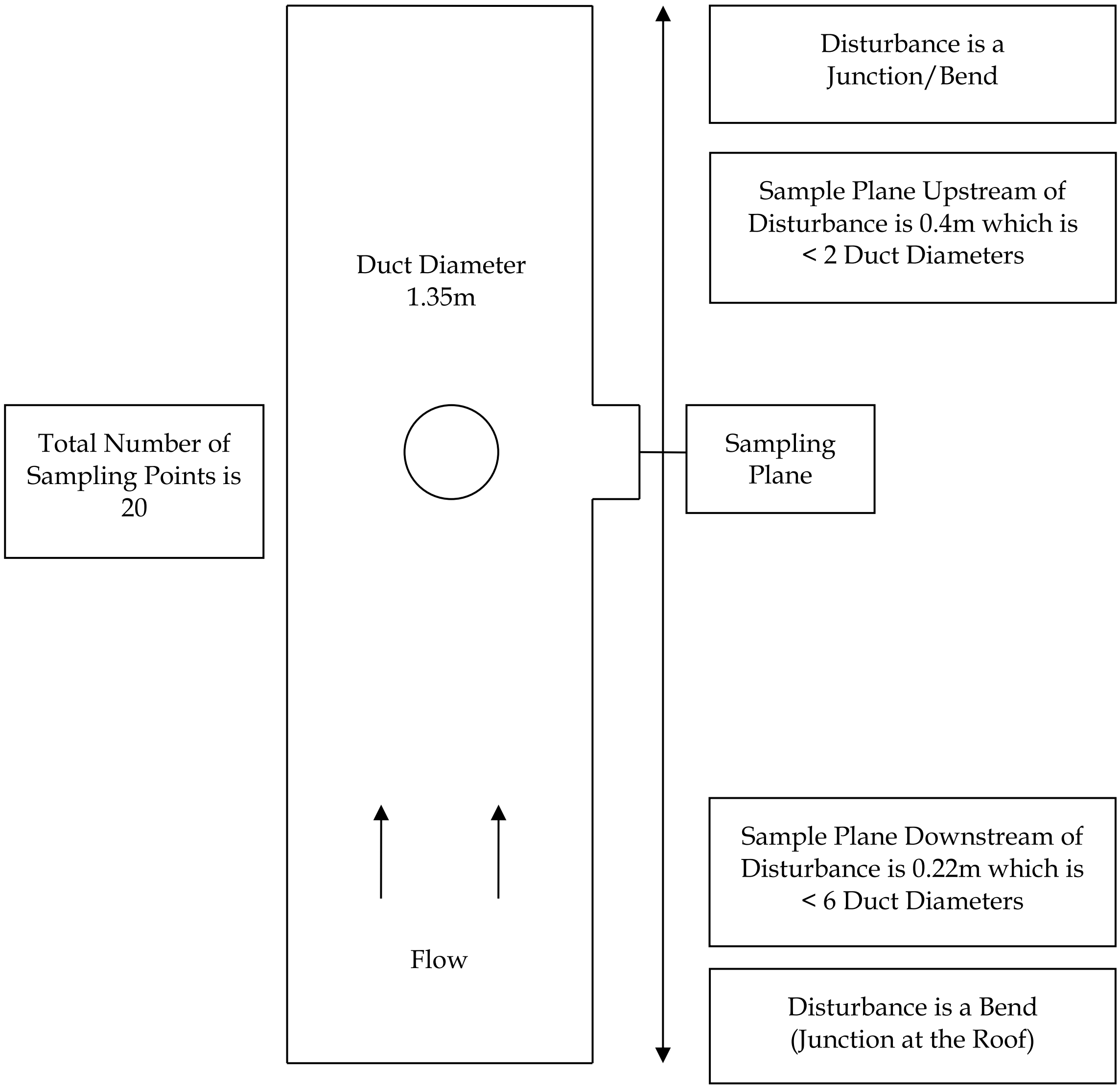
SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	07-May-20	07-Nov-20
919	Thermocouple	07-May-20	07-Nov-20
775	Thermocouple	07-May-20	07-Nov-20
815	Digital Manometer	06-Dec-19	06-Dec-20
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	Combustion Analyzer	02-Sep-20	02-Mar-21
832	Personal Sampler	26-Feb-20	26-Feb-21
753	Personal Sampler	12-Mar-20	12-Mar-21
678	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	05-Dec-19	05-Dec-20
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C-4 INSTRUMENT CALIBRATION DETAILS DAY 4

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	19-Oct-20	19-Apr-21
920	Thermocouple	19-Oct-20	19-Apr-21
805	Thermocouple	19-Oct-20	19-Apr-21
815	Digital Manometer	06-Dec-19	06-Dec-20
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	Combustion Analyzer	02-Sep-20	02-Mar-21
676	Personal Sampler	26-Feb-20	26-Feb-21
613	Barometer	05-Dec-19	05-Dec-20
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

APPENDIX D – SAMPLE LOCATIONS

FIGURE D-1 GLUTEN DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC



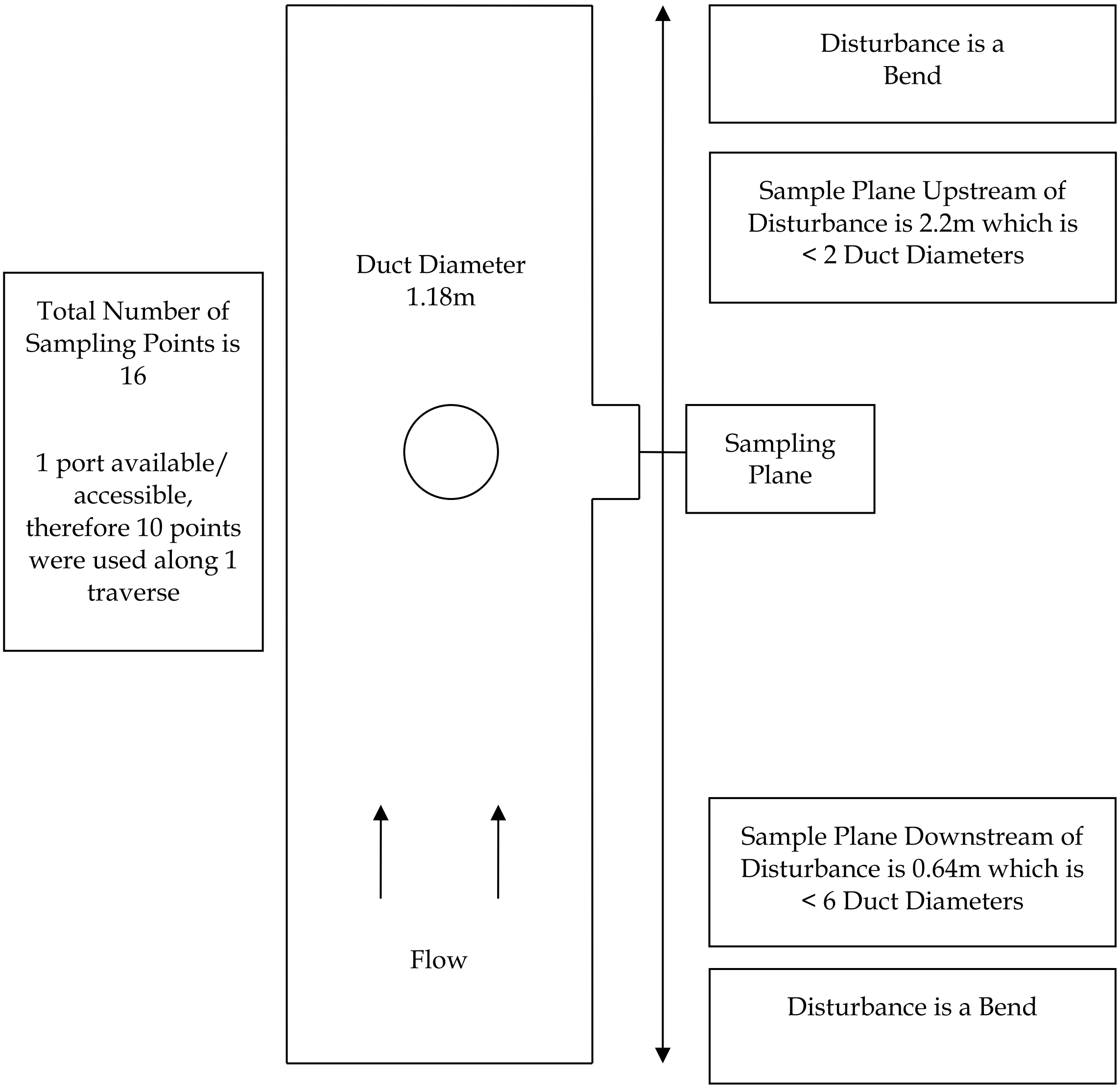
In the absence of cyclonic flow activity ideal sampling plane positions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-2 GLUTEN DRYER NO. 1 – SAMPLE LOCATION

FIGURE D-3 GLUTEN DRYER NO. 2 –SAMPLE LOCATION SCHEMATIC



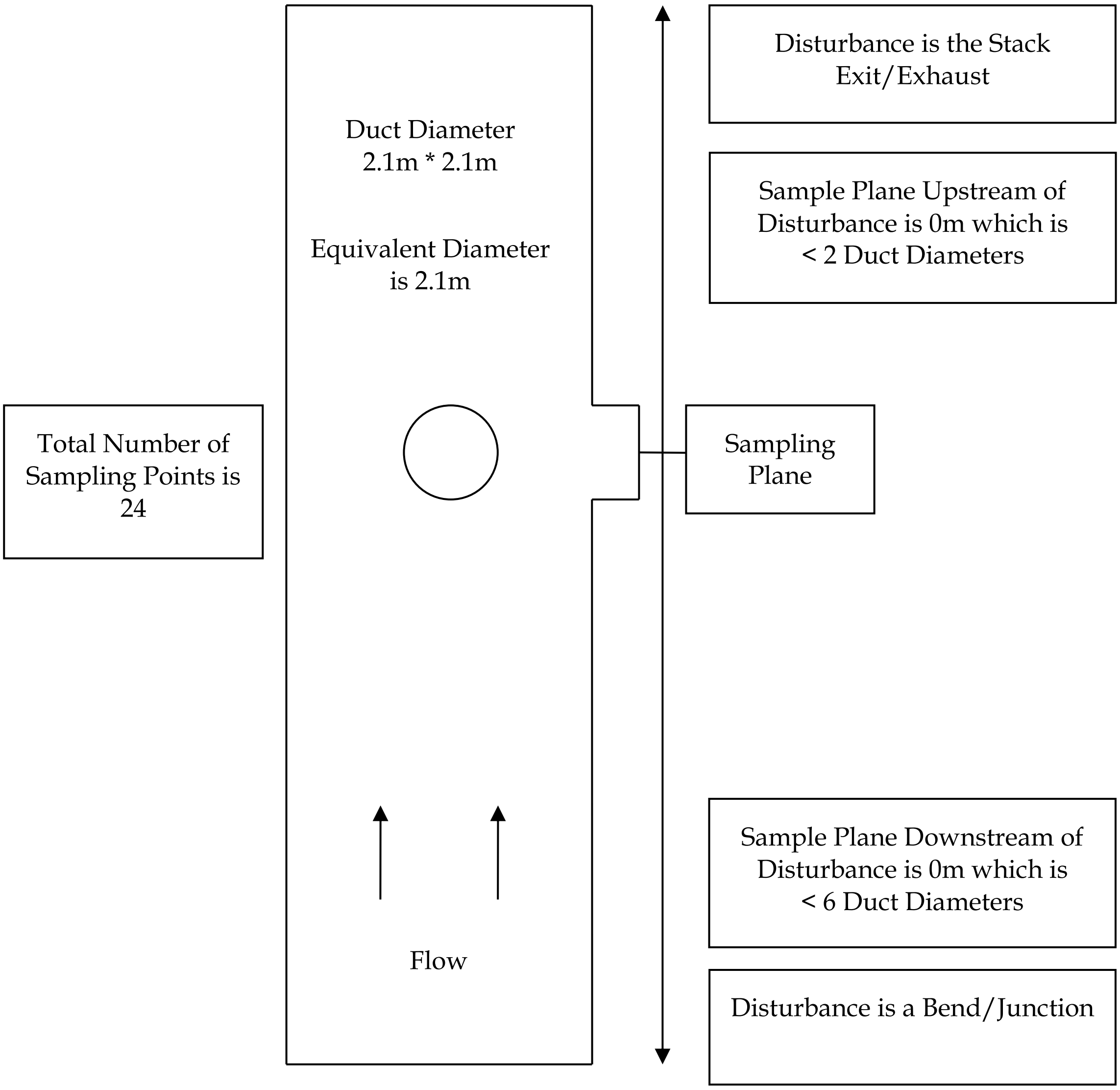
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the interim exit sampling plane complies with AS4323.1 temperature and AS4323.3 odour criteria for sampling.

FIGURE D-4 GLUTEN DRYER NO. 2 – ODOUR SAMPLE LOCATION AT DUCT EXIT

FIGURE D-5 GLUTEN DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC



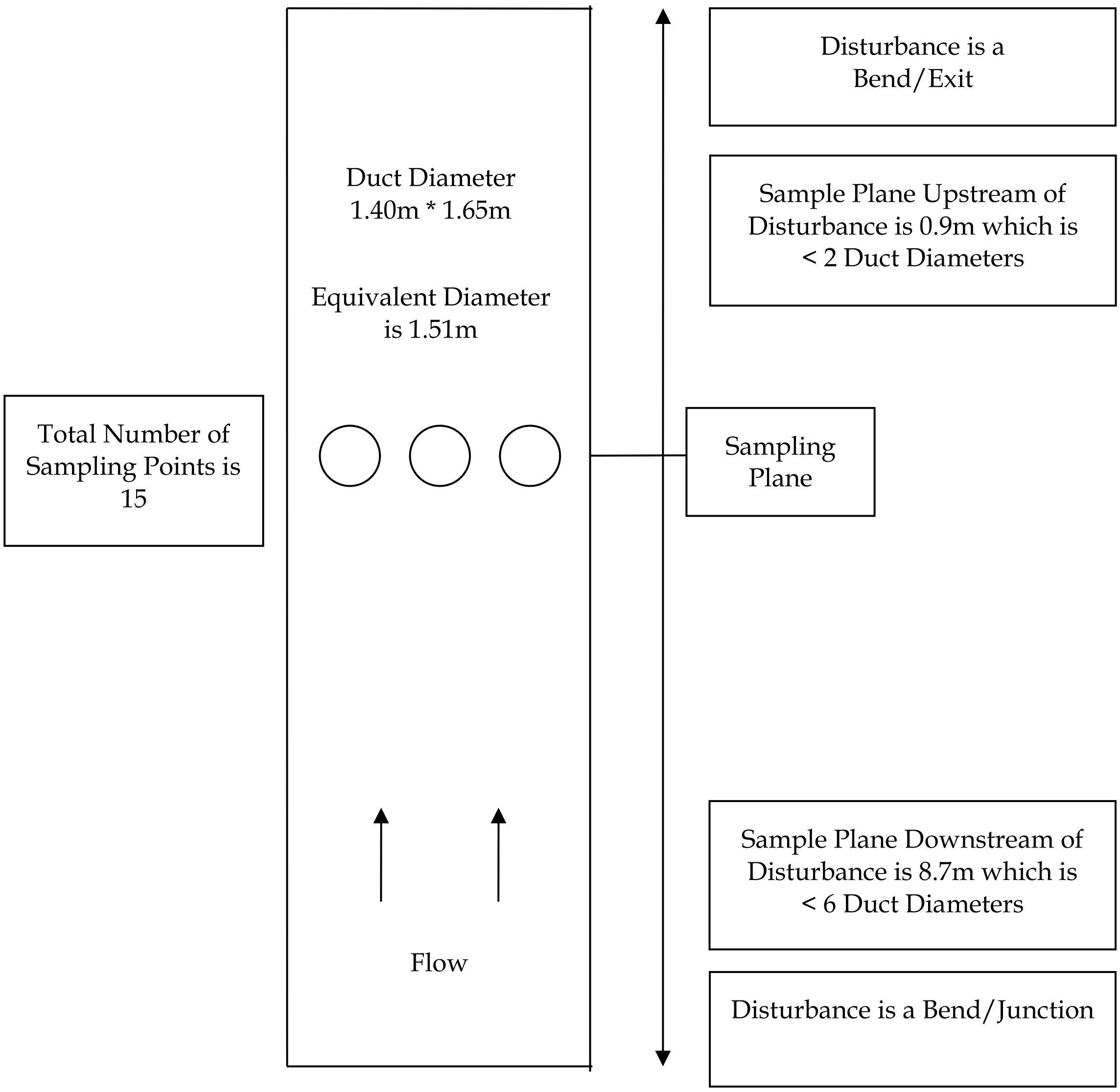
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of minimum velocity profile not meeting the minimum 3 metres per second (m/s) at every sampling point. Previous Minimum (0.8 m/s), Current Minimum (0 m/s).

FIGURE D-6 GLUTEN DRYER NO. 3 – SAMPLE LOCATION

FIGURE D-7 GLUTEN DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC



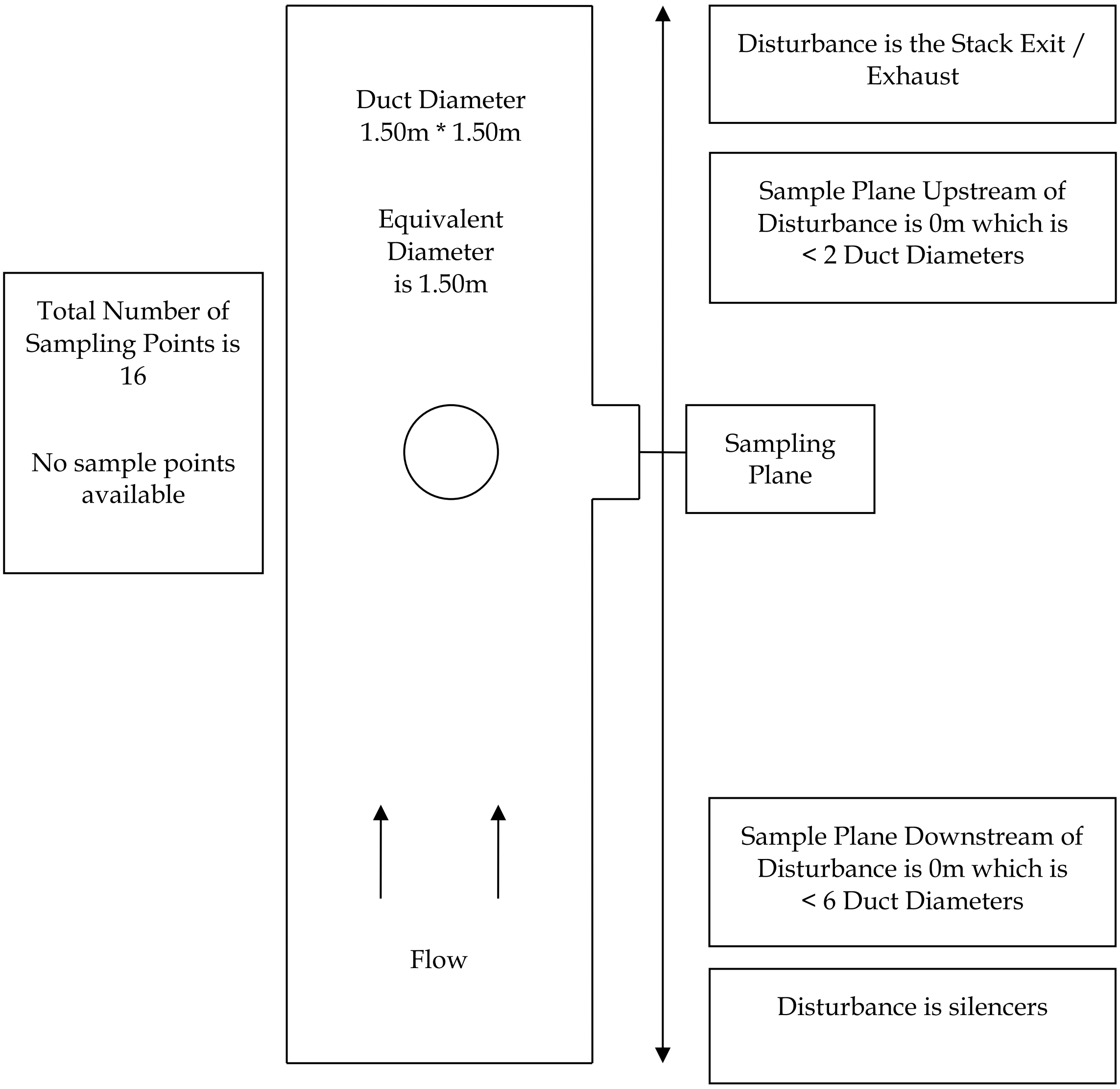
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane does meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-8 GLUTEN DRYER NO. 4 – SAMPLE LOCATION

FIGURE D-9 STARCH DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC



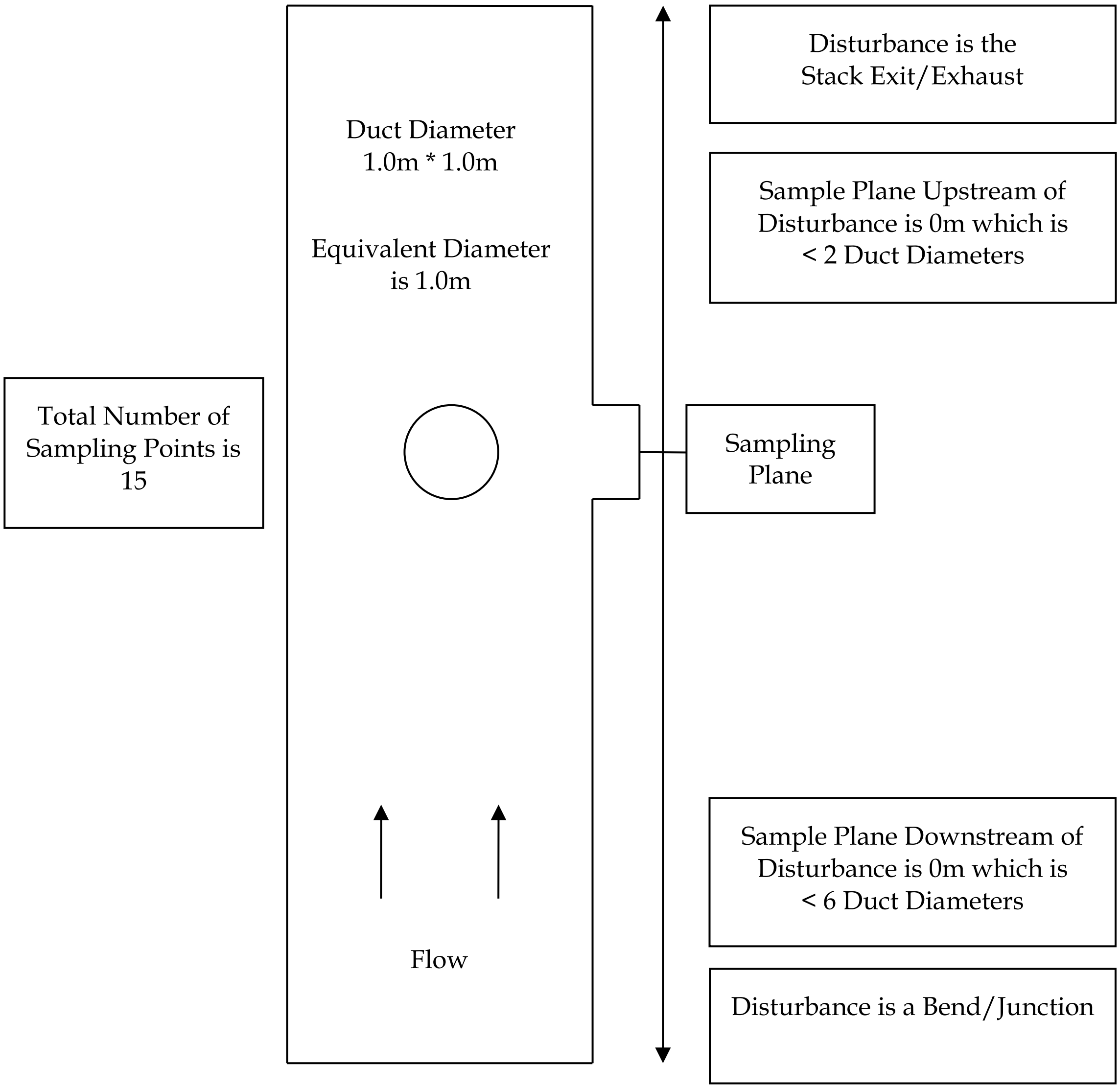
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-10 STARCH DRYER NO. 1 – SAMPLE LOCATION

FIGURE D-11 STARCH DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC



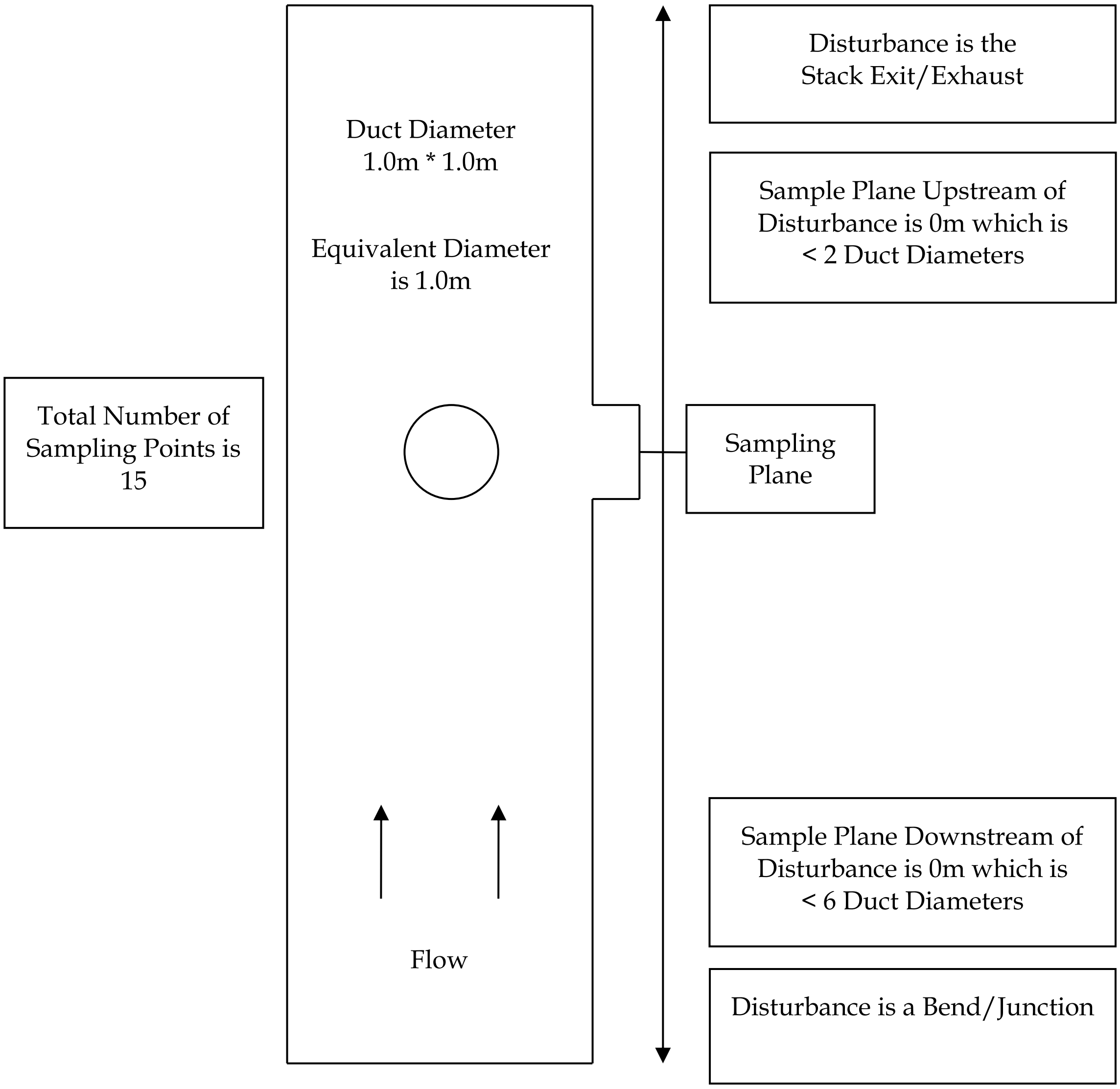
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-12 STARCH DRYER NO. 3 – SAMPLE LOCATION

FIGURE D-13 STARCH DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC



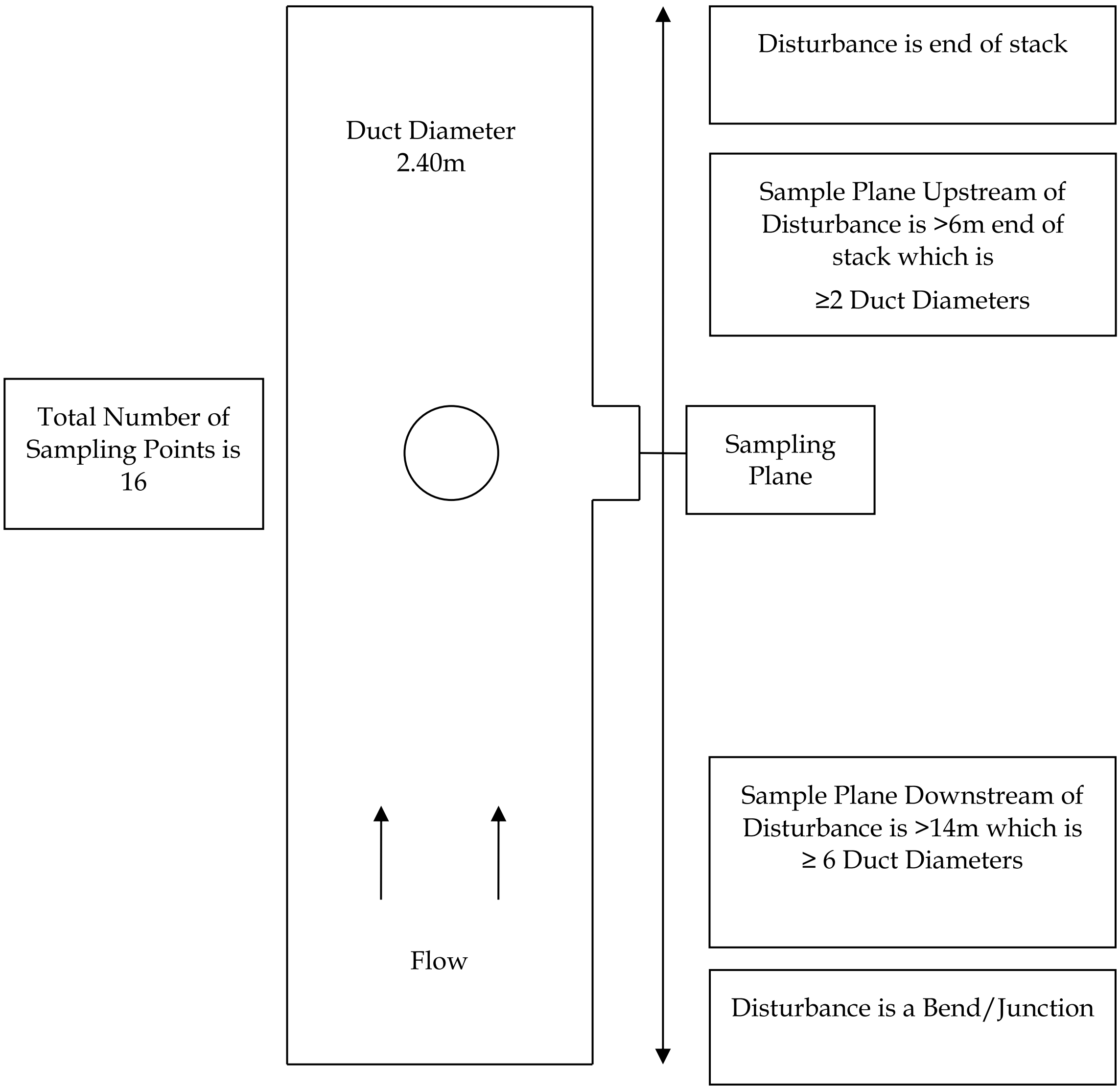
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-14 STARCH DRYER NO. 4 – SAMPLE LOCATION

FIGURE D-15 STARCH DRYER NO. 5 – SAMPLE LOCATION SCHEMATIC

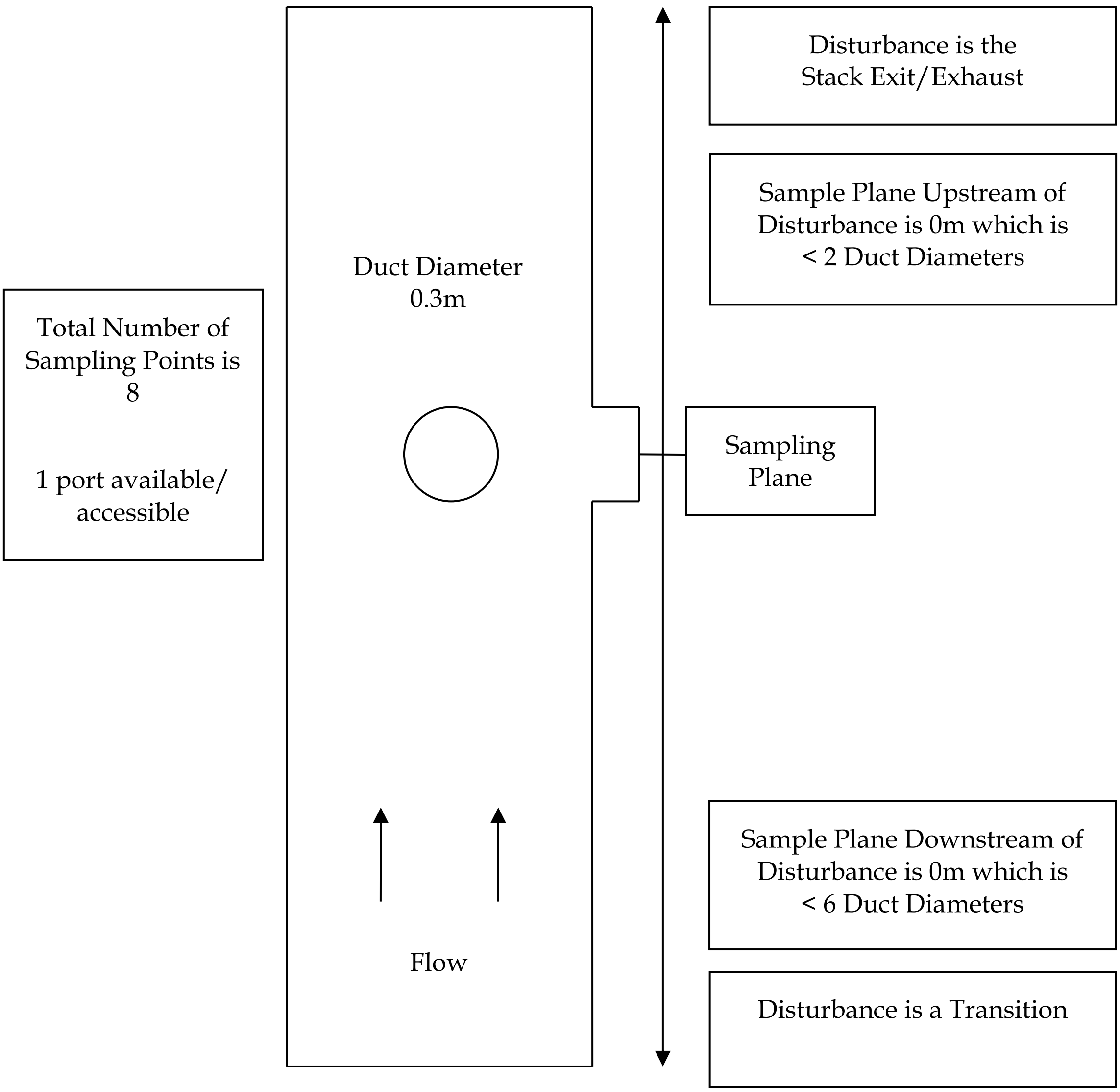


In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does meet this criterion. .

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-16 STARCH DRYER NO. 5 – SAMPLE LOCATION

FIGURE D-17 FERMENTERS – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

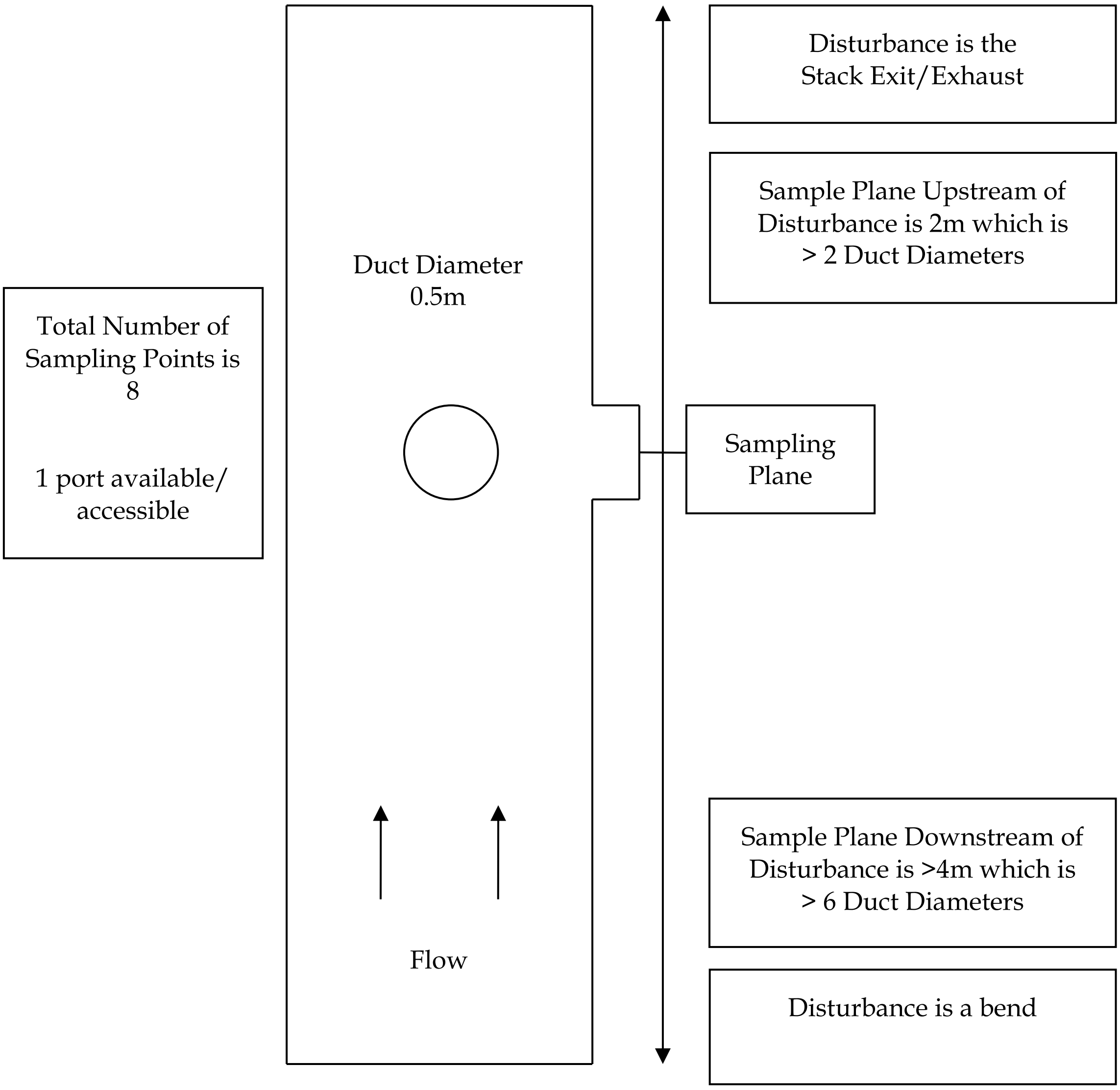
However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The sample location also does not meet the minimum number of access holes available.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of the velocity profile not meeting the minimum 3 metres per second (m/s) at any sampling point. Previous measurements were Average (0.9 m/s), maximum (1.1 m/s) and minimum (0.8 m/s) velocity profile. Current measurements are Average (1.7 m/s), maximum (3.5 m/s) and minimum (0 m/s) velocity profile.

FIGURE D-18 FERMENTERS – SAMPLE LOCATION

FIGURE D-19 CO_2 SCRUBBER OUTLET – SAMPLE LOCATION SCHEMATIC

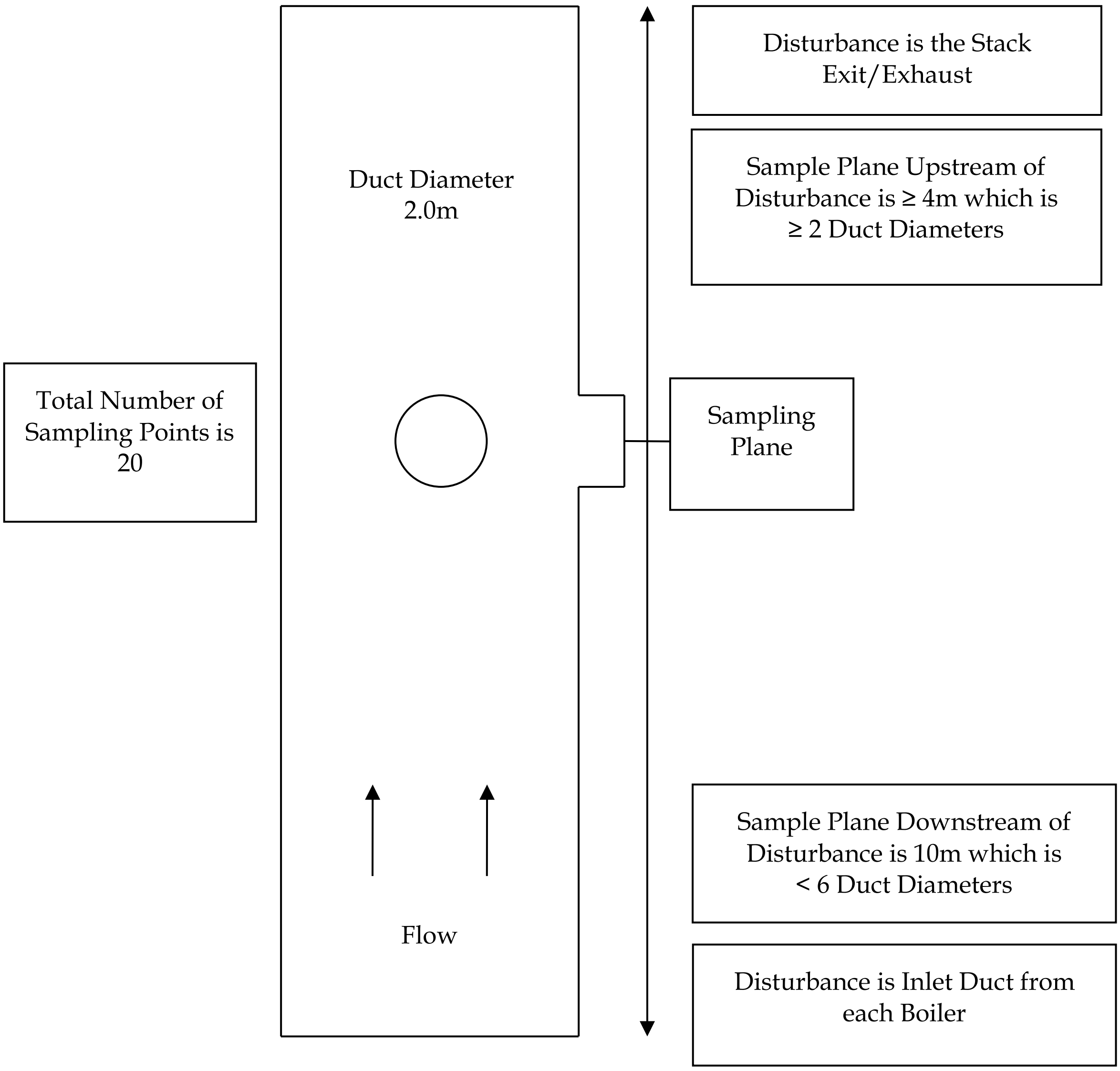


In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does meet this criterion.

The sample location does not meet the minimum number of access holes available.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-20 BOILER NOS. 5 & 6 – SAMPLE LOCATION SCHEMATIC



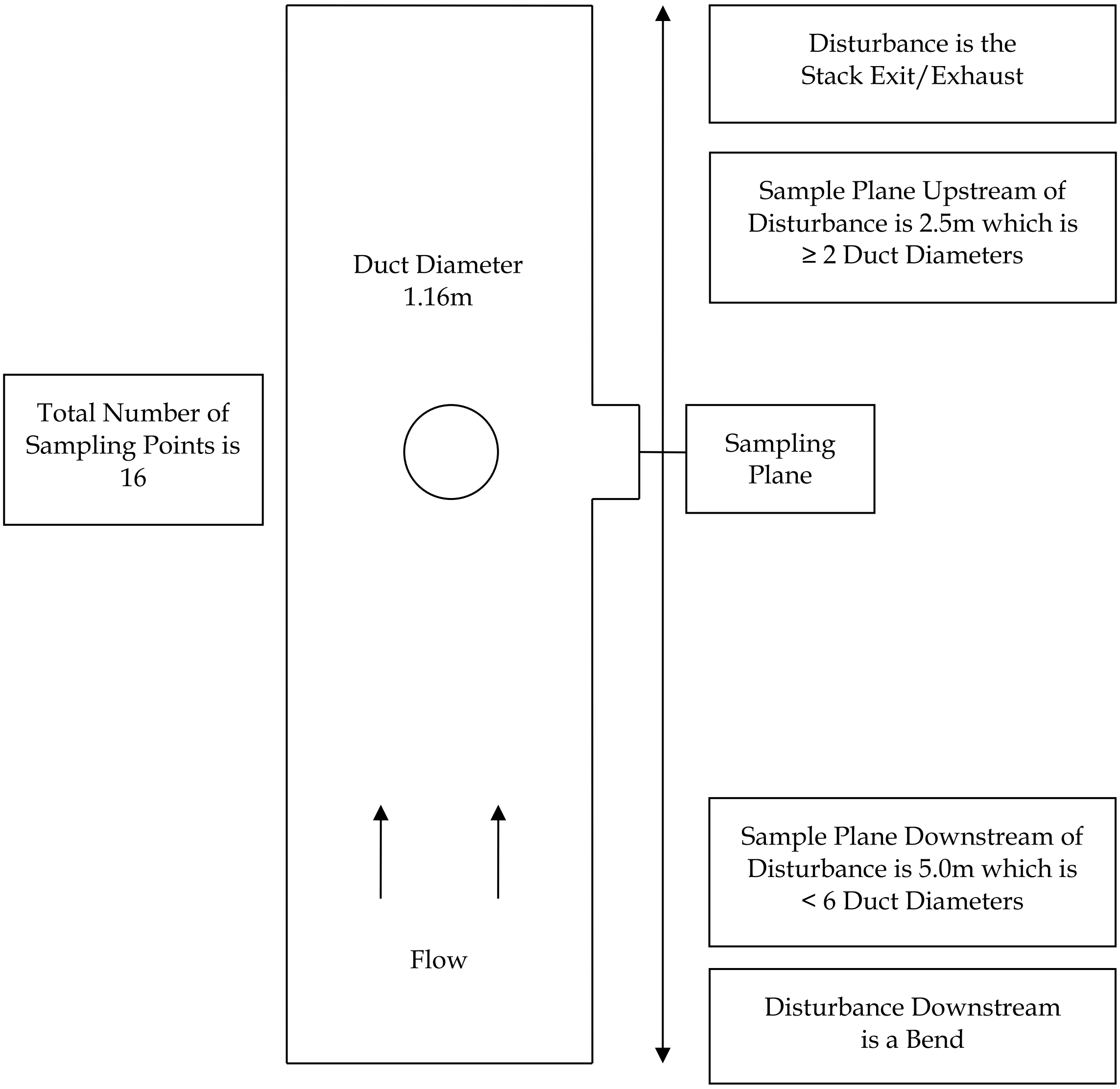
In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-21 BOILER NOS. 5 & 6 – SAMPLE LOCATION

FIGURE D-22 BOILER NO. 4– SAMPLE LOCATION SCHEMATIC



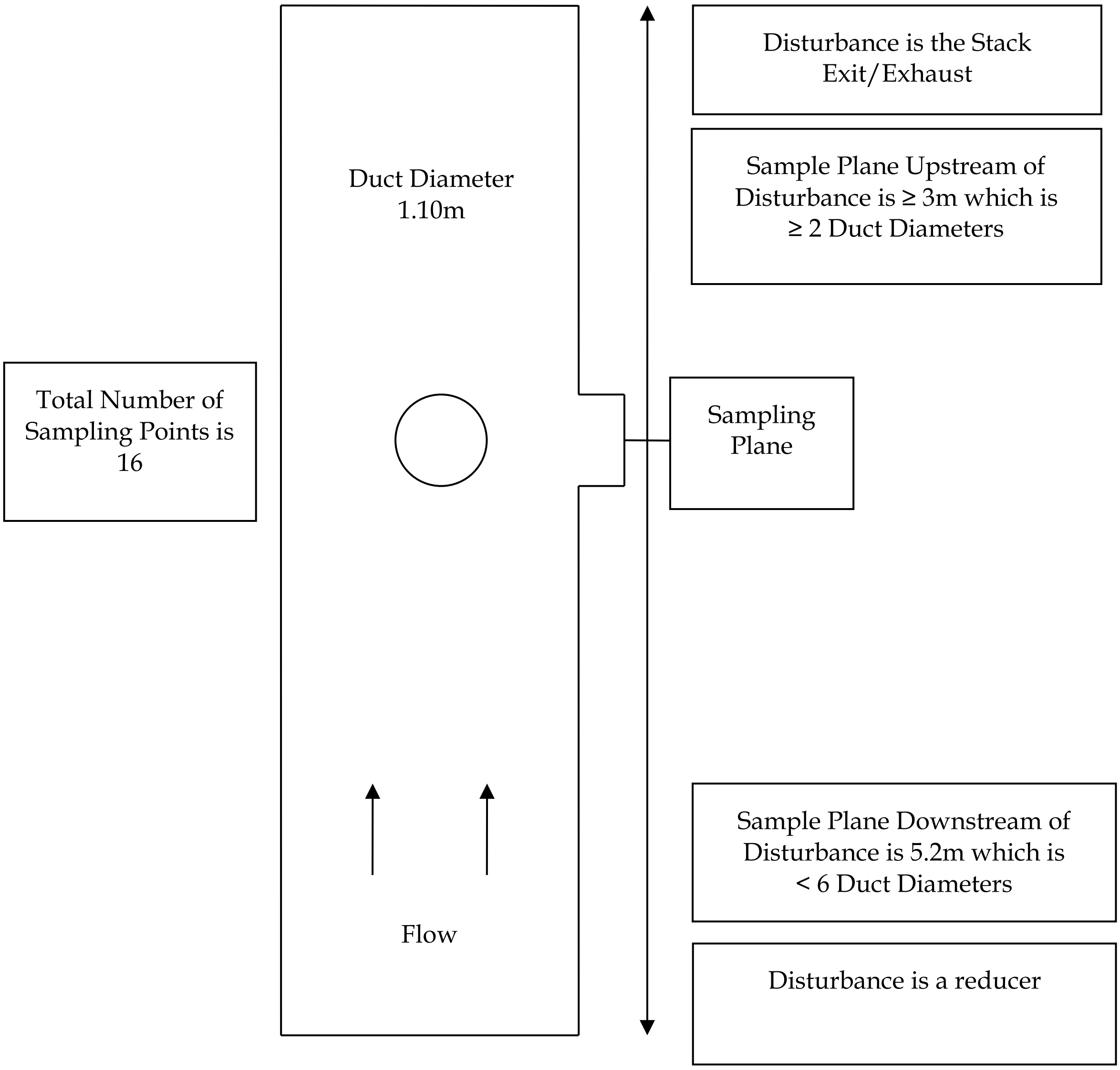
In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-23 BOILER NO 4 – SAMPLE LOCATION

FIGURE D-24 BOILER NO 2 – SAMPLE LOCATION SCHEMATIC

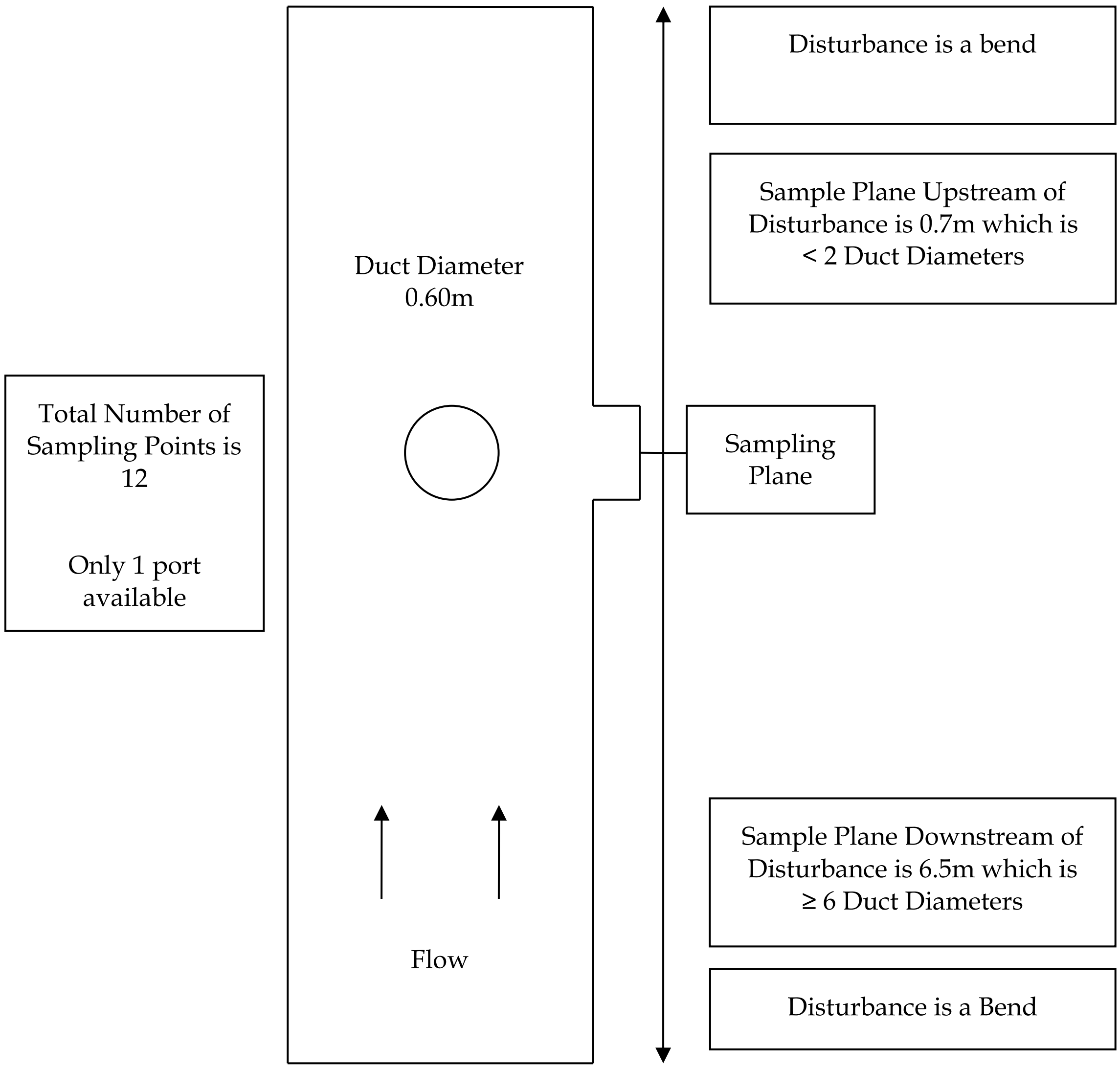


In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-25 BIOFILTER INLET – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

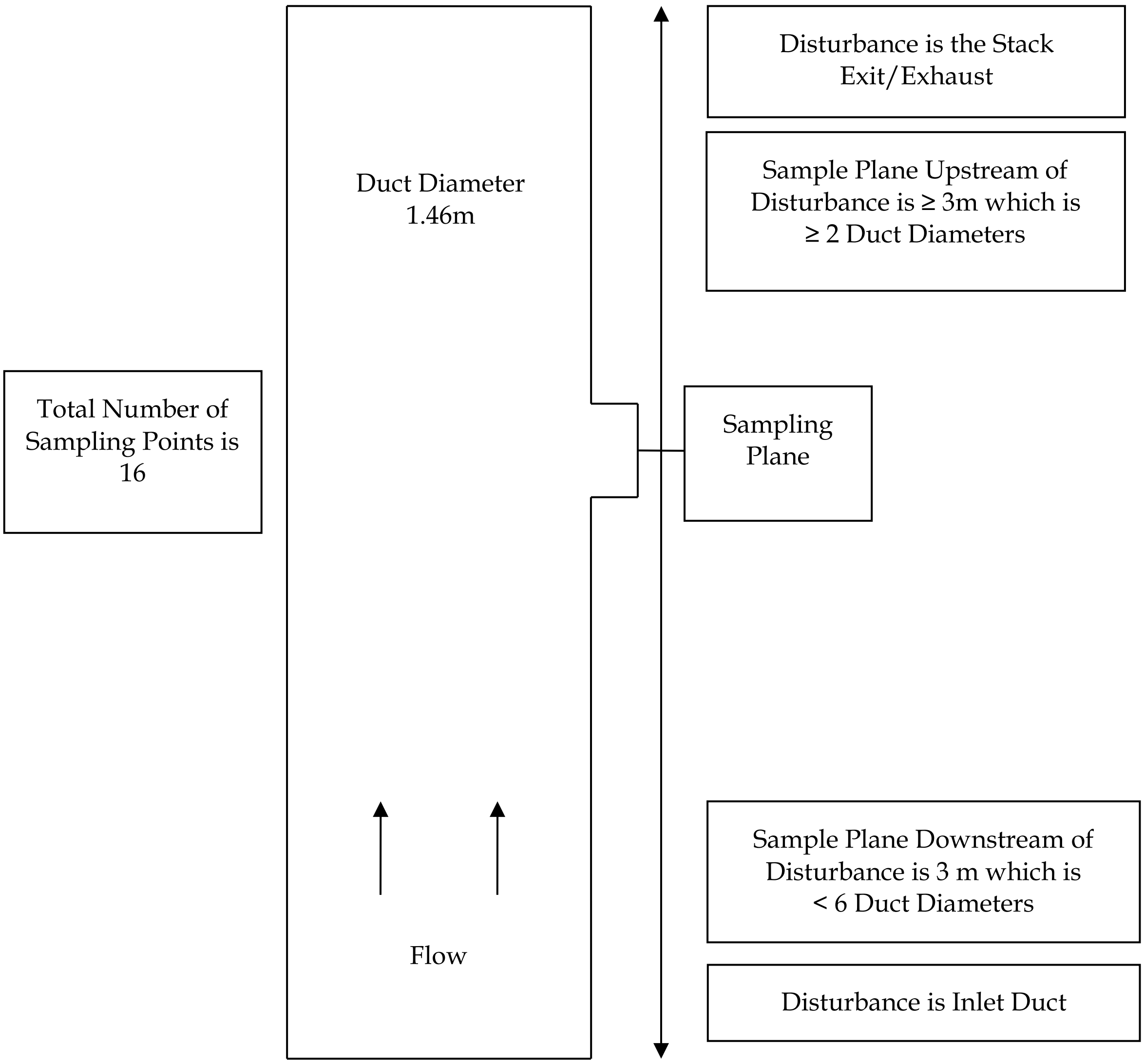
The sample plane also does not meet the minimum number of access points required. Additional sample points were used in compliance with AS4323.1.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of velocity meeting the minimum velocity of 3m/s at every sampling point. Maximum = 5.2 m/s, Average = 2.4 m/s, Minimum = 1.0 m/s.

FIGURE D-26 BIOFILTER OUTLET EAST EPL ID 40 & 41 – SAMPLE LOCATION

FIGURE D-27 BIOFILTER OUTLET WEST EPL ID 41 – SAMPLE LOCATION

FIGURE D-28 DDG PELLET PLANT STACK – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-29 DDG PELLET PLANT STACK – SAMPLE LOCATION PHOTOGRAPH

Stephenson
Environmental Management Australia

EPL ODOUR EMISSION SURVEY ANNUAL & QUARTER 3, 2020-2021

SHOALHAVEN STARCHES PTY LTD

BOMADERRY, NSW

PROJECT NO.: 7116/S25548B/20

DATES OF SURVEY: 18 & 24 NOVEMBER, AND 7 DECEMBER 2020

DATE OF REPORT ISSUE: 21 DECEMBER, 2020

Stephenson
Environmental Management Australia

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EPL ODOUR EMISSION SURVEY ANNUAL & QUARTER 3, 2020-2021

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DATE OF REPORT ISSUE: 21 DECEMBER, 2020

P W STEPHENSON

J WEBER

M KIMBER

TABLE OF CONTENTS

1 INTRODUCTION 4

2 MONITORING REQUIREMENTS 5

2.1 ENVIRONMENT PROTECTION LICENCE 883 (ISSUED 18 DECEMBER 2015) 5

2.1.1 CONDITION P1 LOCATION OF MONITORING/DISCHARGE POINTS AND AREAS 5

2.1.2 CONDITION M2 – MONITORING CONCENTRATION OF DISCHARGED POLLUTANTS 6

3 PRODUCTION CONDITIONS 8

4 ODOUR EMISSION TEST RESULTS 9

5 CONCLUSIONS 11

6 TEST METHODS 27

6.1 ODOUR MEASUREMENT/DYNAMIC OLFACTOMETRY 27

6.1.1 ODOUR PANEL SELECTION 28

6.1.2 ODOUR TERMINOLOGY 28

6.2 EXHAUST GAS VELOCITY 28

6.3 EXHAUST GAS TEMPERATURE 29

6.4 OXYGEN (O_2) 29

6.5 MOISTURE 29

6.6 ACCURACY 29

APPENDIX A – EMISSION TEST RESULTS I

APPENDIX B – CERTIFICATES OF ANALYSIS I

APPENDIX C – DETAILS OF INSTRUMENT CALIBRATION I

APPENDIX D – SAMPLE LOCATIONS I

TABLE OF TABLES

TABLE 2-1 LOCATION OF ODOUR MONITORING/DISCHARGE POINTS AND AREAS 5

TABLE 2-2 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 8, 9, 10, 11, 12, 13, 14, 16 & 47) 6

TABLE 2-3 SAMPLING AND ANALYSIS OF DIFFUSE SOURCES (POINTS 19, 20, 21 & 23, 24 & 25) 6

TABLE 2-4 SAMPLING AND ANALYSIS OF SOURCES (POINTS 39, 40, 41, 44 & 46) 6

TABLE 2-5 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 35, 42 & 45) 7

TABLE 4-1 MEASURED EMISSION CONCENTRATION TEST RESULTS POINT SOURCES, QUARTER 3, 2020 9

TABLE 4-2 MEASURED EMISSION CONCENTRATION TEST RESULTS DIFFUSE SOURCES, ANNUAL & Q3, 2020 10

TABLE 6-1 ESTIMATION OF MEASUREMENT UNCERTAINTY 29

TABLE OF FIGURES

FIGURE 5-1 ODOUR EMISSION CONCENTRATIONS, GLUTEN DRYERS NO.1, 2, 3 & 4 (EPA 8, 9, 10 & 11) . 12

FIGURE 5-2 ODOUR EMISSION CONCENTRATIONS, STARCH DRYERS NO.1, 3 & 4 (EPA 12, 13 &14) 13

FIGURE 5-3 ODOUR EMISSION CONCENTRATIONS, STARCH DRYER 5 (EPA 47) 14

FIGURE 5-4 ODOUR EMISSION CONCENTRATIONS, FERMENTERS (EPA 44) 15

FIGURE 5-5 ODOUR EMISSION CONCENTRATIONS, CARBON DIOXIDE SCRUBBER OUTLET (EPA 16) 16

FIGURE 5-6 ODOUR EMISSION CONCENTRATIONS, COMBINED BOILER 5 & 6 STACK (EPA 35) 17

FIGURE 5-7 ODOUR EMISSION CONCENTRATIONS, BOILER 4 STACK (EPA 42) 18

FIGURE 5-8 ODOUR EMISSION CONCENTRATIONS, BOILER 2 STACK (EPA 45) 19

FIGURE 5-9 ODOUR EMISSION CONCENTRATIONS, BIOFILTERS (EPA 39, 40, 41) 20
FIGURE 5-10 ODOUR EMISSION CONCENTRATIONS, DDG PELLET PLANT (EPA 46) 21
FIGURE 5-11 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 1 22
FIGURE 5-12 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 3 23
FIGURE 5-13 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 5 24
FIGURE 5-14 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 6 25
FIGURE 5-15 ODOUR EMISSION CONCENTRATIONS, SULPHUR OXIDATION POND 26

TABLE OF TABLES – APPENDICES

TABLE A-1 EMISSION TEST RESULTS – GLUTEN DRYERS NO. 1, 2, 3 & 4 II
TABLE A-2 EMISSION TEST RESULTS – STARCH DRYERS NO.1, 3, 4 & 5 III
TABLE A- 3 EMISSION TEST RESULTS – BOILERS NO. 5&6, 4 & 2 IV
TABLE A-4 EMISSION TEST RESULTS – FERMENTER 16 & CO_2 SCRUBBER OUTLET V
TABLE A- 5 EMISSION TEST RESULTS –INLET TO BIOFILTERS, DDG DRYERS 1,2,3 & 4 VI
TABLE A- 6 EMISSION TEST RESULTS DDG PELLET PLANT VII
TABLE A- 7 EMISSION TEST RESULTS – BIOFILTER OUTLETS VIII

TABLE C- 1 INSTRUMENT CALIBRATION DETAILS DAY 1 II
TABLE C- 2 INSTRUMENT CALIBRATION DETAILS DAY 2 III
TABLE C- 3 INSTRUMENT CALIBRATION DETAILS DAY 3 IV

TABLE OF FIGURES – APPENDICES

FIGURE D-1 GLUTEN DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC II
FIGURE D-2 GLUTEN DRYER NO. 1 – SAMPLE LOCATION III
FIGURE D-3 GLUTEN DRYER NO. 2 –SAMPLE LOCATION SCHEMATIC IV
FIGURE D-4 GLUTEN DRYER NO. 2 – ODOUR SAMPLE LOCATION AT DUCT EXIT V
FIGURE D-5 GLUTEN DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC VI
FIGURE D-6 GLUTEN DRYER NO. 3 – SAMPLE LOCATION VII
FIGURE D-7 GLUTEN DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC VIII
FIGURE D-8 GLUTEN DRYER NO. 4 – SAMPLE LOCATION IX
FIGURE D-9 STARCH DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC X
FIGURE D-10 STARCH DRYER NO. 1 – SAMPLE LOCATION XI
FIGURE D-11 STARCH DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC XII
FIGURE D-12 STARCH DRYER NO. 3 – SAMPLE LOCATION XIII
FIGURE D-13 STARCH DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC XIV
FIGURE D-14 STARCH DRYER NO. 4 – SAMPLE LOCATION XV
FIGURE D-15 STARCH DRYER NO. 5 – SAMPLE LOCATION SCHEMATIC XVI
FIGURE D-16 STARCH DRYER NO. 5 – SAMPLE LOCATION XVII
FIGURE D-17 FERMENTERS – SAMPLE LOCATION SCHEMATIC XVIII
FIGURE D-18 FERMENTERS – SAMPLE LOCATION XIX
FIGURE D-19 CO_2 SCRUBBER OUTLET – SAMPLE LOCATION SCHEMATIC XX
FIGURE D-20 BOILER NOS. 5 & 6 – SAMPLE LOCATION SCHEMATIC XXI
FIGURE D-21 BOILER NOS. 5 & 6 – SAMPLE LOCATION XXII
FIGURE D-22 BOILER NO. 4– SAMPLE LOCATION SCHEMATIC XXIII
FIGURE D-23 BOILER NO 4 – SAMPLE LOCATION XXIV
FIGURE D-24 BOILER NO 2 – SAMPLE LOCATION SCHEMATIC XXV
FIGURE D-25 BIOFILTER INLET – SAMPLE LOCATION SCHEMATIC XXVI
FIGURE D-26 BIOFILTER OUTLET EAST EPL ID 40 & 41 – SAMPLE LOCATION XXVII

FIGURE D-27 BIOFILTER OUTLET WEST EPL ID 41 – SAMPLE LOCATION XXVII
FIGURE D-28 DDG PELLET PLANT STACK – SAMPLE LOCATION SCHEMATIC.. XXVIII
FIGURE D-29 DDG PELLET PLANT STACK – SAMPLE LOCATION PHOTOGRAPH.. XXIX

1 INTRODUCTION

Stephenson Environmental Management Australia (SEMA) was requested by Shoalhaven Starches Pty Limited to conduct an odour emission survey at their manufacturing complex in Bomaderry, New South Wales (NSW).

The objective of the survey is to comply with Condition M2.1 of the Environment Protection Licence (EPL) No. 883 issued by the Environment Protection Authority (EPA). The EPA is now part of the Office of Environment and Heritage (OEH).

Section 2 of this report outlines Conditions P1 and M2 which identify the potential point and diffuse odour sources and the sampling and analysis methods respectively required by the OEH. This survey monitored the quarterly and annual odour concentrations as required in section M2.2 of EPL 883.

In addition, the Carbon Dioxide (CO_2) Scrubber Inlet sampling point, which currently is not listed in EPL 883 and therefore does not an have EPA Identification No., was also sampled.

The quarters are defined as below:

- Quarter 1 May to July inclusive
- Quarter 2 August to October inclusive
- Quarter 3 November to January inclusive
- Quarter 4 February to April inclusive

The annual and Quarter 3, 2020-2021 odour test results are presented in this report. These tests were conducted on the 18th and 24th November, and the 7th December 2020.

2 MONITORING REQUIREMENTS

2.1 ENVIRONMENT PROTECTION LICENCE 883 (ISSUED 18 DECEMBER 2015)

2.1.1 CONDITION P1 LOCATION OF MONITORING/DISCHARGE POINTS AND AREAS

Table 2-1 identifies the point and diffuse sources as defined by the OEH that relate to this survey as per most recent version of EPL No. 883 dated 20 June 2018.

TABLE 2-1 LOCATION OF ODOUR MONITORING/DISCHARGE POINTS AND AREAS

EPL ID. No.	Location	Odour Samples TM OM-7/8	Frequency as per M2.2 EPL 883
8	No. 1 Gluten Dryer	1	Quarterly
9	No. 2 Gluten/Starch Dryer*	1	Quarterly
10	No. 3 Gluten Dryer	1	Quarterly
11	No. 4 Gluten Dryer	1	Quarterly
12	No. 1 Starch Dryer	1	Quarterly
13	No. 3 Starch Dryer	1	Quarterly
14	No. 4 Starch Dryer	1	Quarterly
16	CO_2 Scrubber outlet	1	Quarterly
Not specified	CO_2 Scrubber inlet	1	--
19	Effluent Storage Dam 1	1	Yearly
20	Effluent Storage Dam 2	1	Yearly
21	Effluent Storage Dam 3	1	Yearly
23	Effluent Storage Dam 5	1	Yearly
24	Effluent Storage Dam 6	1	Yearly
25	Sulphur Oxidisation Pond	1	Yearly
35	Combined Stack Boilers No.5 & 6	1	Quarterly
39	Inlet Pipe to Biofilters A & B (DDG Evap #1,2&3)	1	Quarterly
39A	Inlet Pipe to Biofilters A & B (DDG Evap #4)	1	Quarterly
40	Outlet of Biofilter A	2	Quarterly
41	Outlet of Biofilter B	2	Quarterly
42	Boiler No.4	1	Quarterly
44	Fermenter	1	Quarterly
45	Boiler No.2	1	Quarterly
46	DDG Pellet Plant Stack	1	Quarterly
47	No. 5 Starch Dryer	1	Quarterly

2.1.2 CONDITION M2 – MONITORING CONCENTRATION OF DISCHARGED POLLUTANTS

Condition M2.1 states: *For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency specified in the opposite columns.*

Key to Tables 2.2 to 2.5:

%	=	percent
°C	=	degrees Celsius
g/g.mole	=	grams per gram mole
kg/m³	=	kilograms per cubic metre
m/s	=	metres per second
m³/s	=	cubic metres per second
mg/m³	=	milligrams per cubic metre
OM	=	Other Method
ou	=	odour units
TM	=	Test Method

TABLE 2-2 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 8, 9, 10, 11, 12, 13, 14, 16 & 47)

Pollutant	Units	Frequency	Approved Method
Dry Gas Density	kg/m³	Quarterly	TM-23
Flow	m³/s	Quarterly	TM-2
Moisture	%	Quarterly	TM-22
Molecular Weight of stack gases	g/g-mole	Quarterly	TM-23
Odour	ou	Quarterly	OM-7
Oxygen	%	Quarterly	TM-25
Temperature	°C	Quarterly	TM-2
Velocity	m/s	Quarterly	TM-2

TABLE 2-3 SAMPLING AND ANALYSIS OF DIFFUSE SOURCES (POINTS 19, 20, 21 & 23, 24 & 25)

Pollutant	Units	Frequency	Approved Method
Odour	ou	Annual	OM-7

TABLE 2-4 SAMPLING AND ANALYSIS OF SOURCES (POINTS 39, 40, 41, 44 & 46)

Pollutant	Units	Frequency	Approved Method
Odour	ou	Quarterly	OM-7

TABLE 2-5 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 35, 42 & 45)

Pollutant	Units	Frequency	Approved Method
Cadmium	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Mercury	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Moisture	%	Quarterly	TM-22
Molecular weight of stack gases	g/g.mole	Quarterly	TM-23
Nitrogen Oxides	mg/m^3	Quarterly	TM-11
Odour	ou	Quarterly	OM-7
Opacity	%	Quarterly	CEM-1
Oxygen	%	Quarterly	TM-25
Sulphur Dioxide	mg/m^3	Annual	TM-4
Temperature	^oC	Quarterly	TM-2
Total Solid Particles	mg/m^3	Quarterly	TM-15
Type 1 & Type 2 substances in aggregate	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Velocity	m/s	Quarterly	TM-2
Volatile Organic Compounds as n-propane equivalent	mg/m^3	Quarterly	TM-34
Volumetric Flowrate	m^3/s	Quarterly	TM-2

3 PRODUCTION CONDITIONS

Shoalhaven Starches personnel considered the factory and the ethanol distillery were operating under typical conditions on the days of testing.

One exception is that Gluten Dryer No.1 (EPA ID 8) has had a new silencer and supporting ductwork installed to replace the previous unit. However, the sampling ports have not been re-installed in this new ductwork. Therefore, access to the inside of the duct is no longer available. Thus, exhaust gas flow measurements were unable to be taken.

However, odour measurements were taken from the duct outlet to atmosphere. To enable calculation of the Mass Odour Emission Rate (MOER), exhaust gas flow measurements have been based on the most recent previous quarterly monitoring results; that is, Quarter 1, 2020 results.

4 ODOUR EMISSION TEST RESULTS

SEMA performed the sampling, and the odour analysis was performed by Odour Research Laboratories Australia (ORLA). SEMA and ORLA are both NATA accredited (No.15043) facilities to ISO 17025 for this.

The NATA accredited ORLA Olfactometry Test Report 7116/ORLA is presented in Appendix B.

Exhaust gas flow and emission tests results from measured sources are detailed in Tables A-1 to A-7, Appendix A.

Appendix C details calibration of instruments used to take measurements.

Appendix D shows sample locations.

Tables 4-1 summarises the odour emission concentrations for the point sources measured in Quarter 3, 2020. Table 4-2 summarises the odour emission concentrations of the diffuse sources.

TABLE 4-1 MEASURED EMISSION CONCENTRATION TEST RESULTS POINT SOURCES, QUARTER 3, 2020

EPA ID No.	Description	Date	Odour Concentration (ou)
8	No.1 Gluten Dryer	18/11/2020	470
9	No.2 Gluten Dryer	18/11/2020	250
10	No.3 Gluten Dryer	18/11/2020	300
11	No.4 Gluten Dryer	18/11/2020	360
12	No.1 Starch Dryer	18/11/2020	470
13	No.3 Starch Dryer	18/11/2020	120
14	No.4 Starch Dryer	18/11/2020	110
16	Carbon Dioxide Scrubber Outlet	18/11/2020	8,000
--	Carbon Dioxide Scrubber Inlet	18/11/2020	10,600
35	Combined Stack No.5 & 6 Boilers	24/11/2020	2,200
42	Boiler No.4 Stack	24/11/2020	1,700
44	Fermenter (No. 16)	24/11/2020	7,500
45	Boiler No.2 Stack	24/11/2020	1,200
46	DDG Pellet Plant Stack	24/11/2020	2,300
47	No.5 Starch Dryer	24/11/2020	390

Key: ou = odour units

TABLE 4-2 MEASURED EMISSION CONCENTRATION TEST RESULTS DIFFUSE SOURCES, ANNUAL & Q3, 2020

EPA ID No.	Description	Date	Odour Concentration (ou)
39	Inlet to Biofilters A & B	24/11/2020	9,500
39A	Inlet to Biofilters A & B	24/11/2020	70,400
40	Outlet of Biofilter A (east)	24/11/2020	1,200
40	Outlet of Biofilter A (west)	24/11/2020	2,000
41	Outlet of Biofilter B (east)	24/11/2020	1,680
41	Outlet of Biofilter B (west)	24/11/2020	1,830
19	Effluent Storage Dam 1	7/12/2020	360
20	Effluent Storage Dam 2	Unsafe for sampling	---
21	Effluent Storage Dam 3	7/12/2020	280
23	Effluent Storage Dam 5	7/12/2020	63
24	Effluent Storage Dam 6	7/12/2020	38
25	Sulphur Oxidation Pond	7/12/2020	63

Key: ou = odour units

5 CONCLUSIONS

The comparative results of the odour sampling and analysis, over time, that have been undertaken by SEMA at Shoalhaven Starches manufacturing facility at Bomaderry are graphically presented in Figures 5-1 to 5-16.

Figure 5-1 presents graphical representations of odour concentrations recorded for Gluten Dryers No.1, 2, 3 and 4 since autumn 2005.

Figure 5-2 presents graphical representations of odour concentrations recorded for Starch Dryers No.1, 3 and 4 since autumn 2005.

Figure 5-3 graphically shows the Starch Dryer No. 5 emission concentrations since spring 2017.

Figure 5-4 graphically shows the Fermenter emission concentrations since summer 2007-2008.

Figure 5-5 illustrates odour emission concentrations from the Carbon Dioxide Scrubber since autumn 2013.

Figures 5-6 and 5-7 graphically show the Combined Boiler 5 and 6 stack and the Boiler No.4 stack emission concentrations since summer 2013-2014 respectively.

Figure 5-8 shows the Boiler 2 stack emission concentrations since winter 2019.

Figure 5-9 graphically shows the Bio-filter inlet (EPA ID#39) and outlet emission concentrations since autumn 2010.

Figure 5-10 graphically shows the DDG Pellet plant Stack emission concentrations since spring 2016.

Figures 5-11 to 5-15 show the Effluent Ponds 1, 3, 5 and 6 odour emission concentrations since summer 2003-2004.

Figure 5-16 shows Sulphur Oxidation Pond odour emission concentrations since winter 2010.

FIGURE 5-1 ODOUR EMISSION CONCENTRATIONS, GLUTEN DRYERS NO.1, 2, 3 & 4 (EPA 8, 9, 10 & 11)

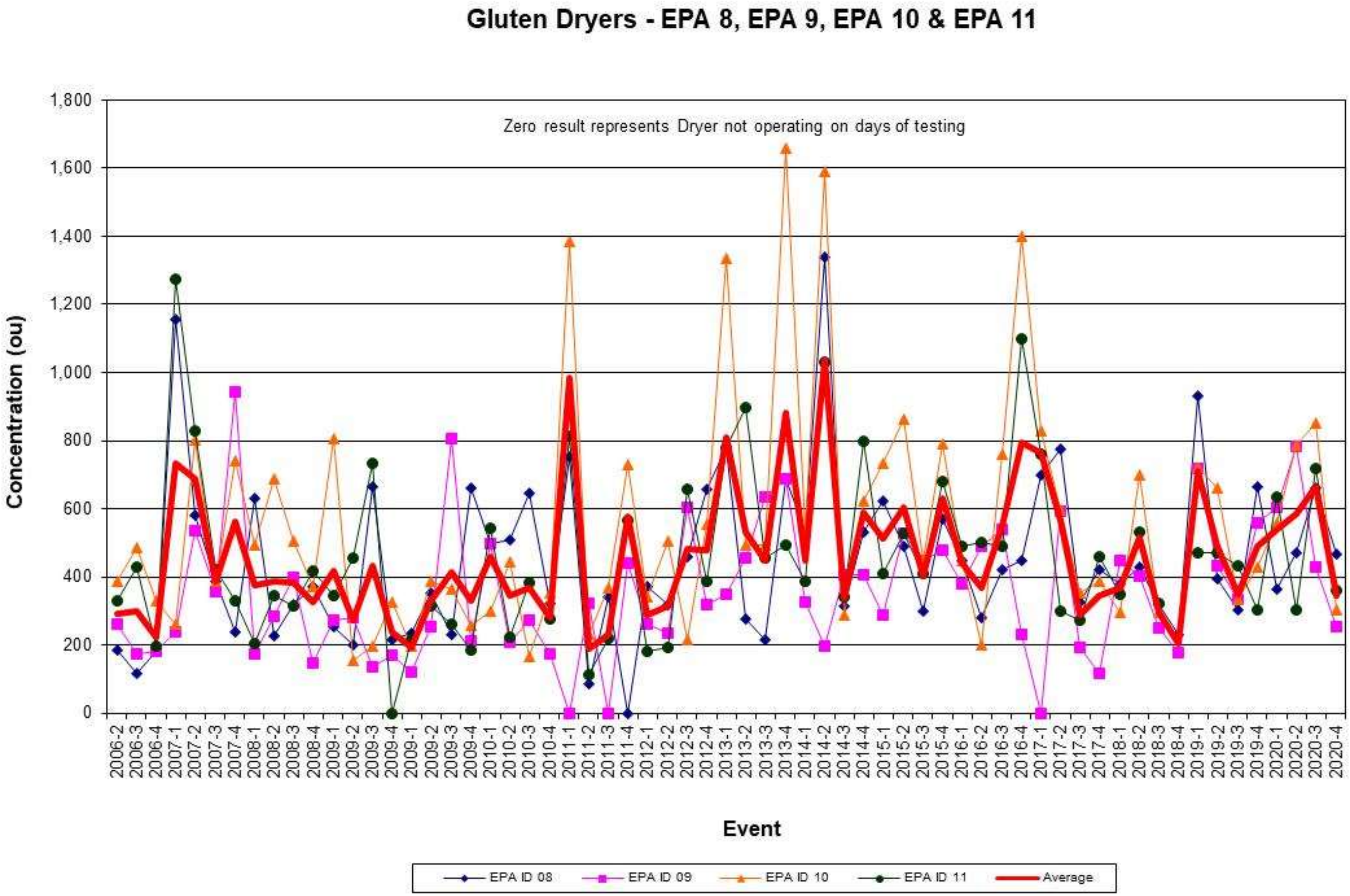


FIGURE 5-2 ODOUR EMISSION CONCENTRATIONS, STARCH DRYERS NO.1, 3 & 4 (EPA 12, 13 &14)

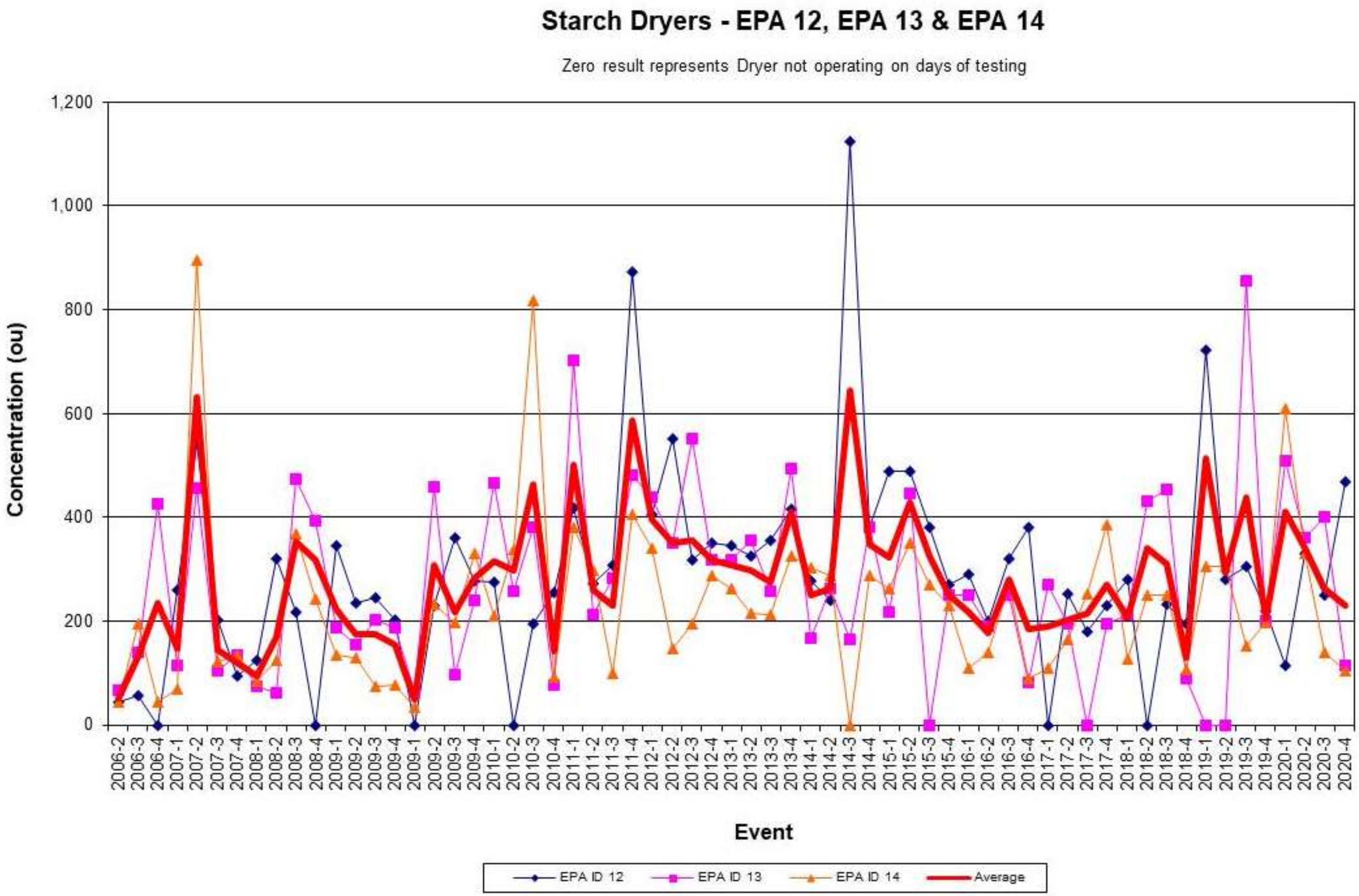


FIGURE 5-3 ODOUR EMISSION CONCENTRATIONS, STARCH DRYER 5 (EPA 47)

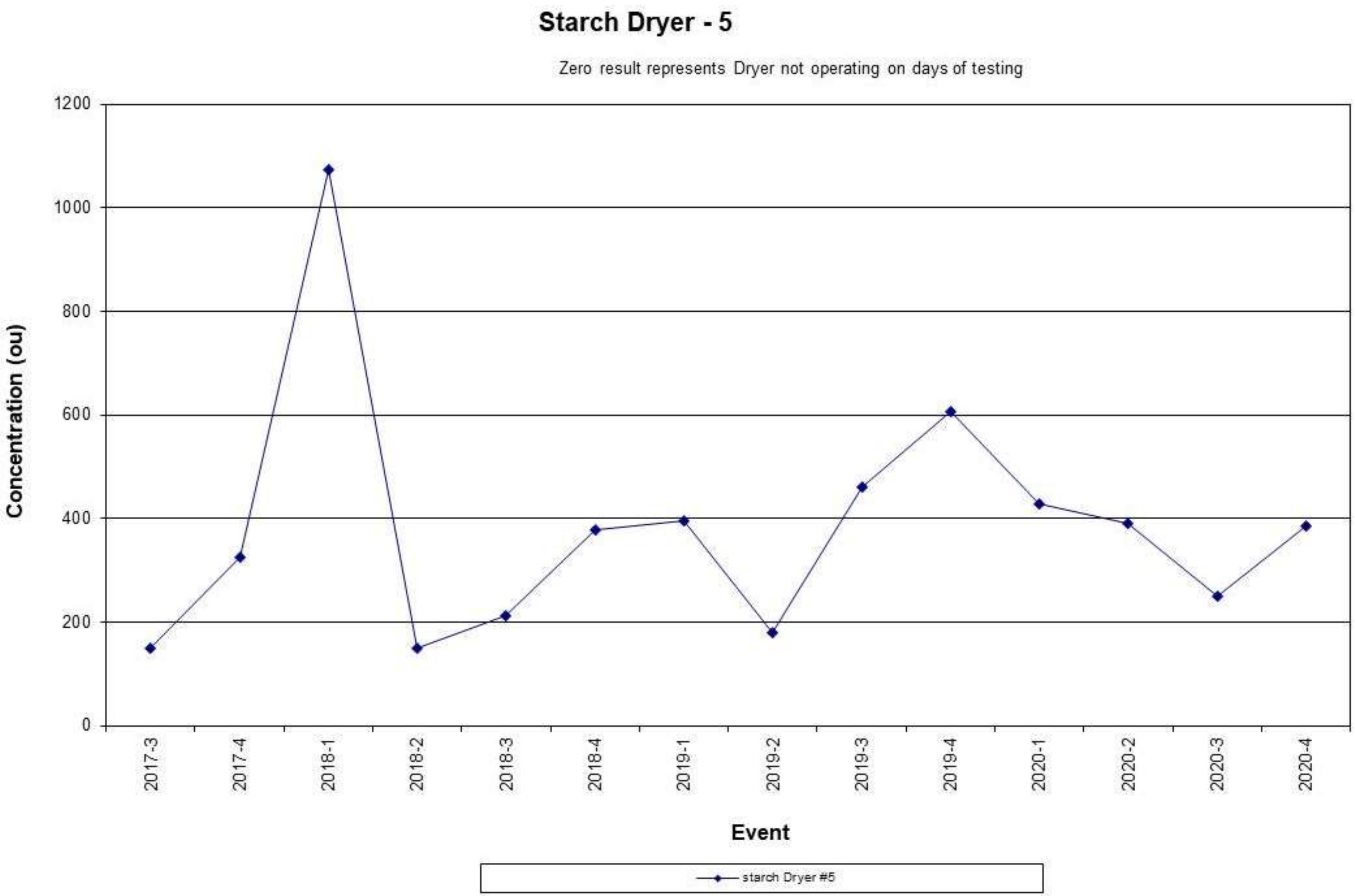


FIGURE 5-4 ODOUR EMISSION CONCENTRATIONS, FERMENTERS (EPA 44)

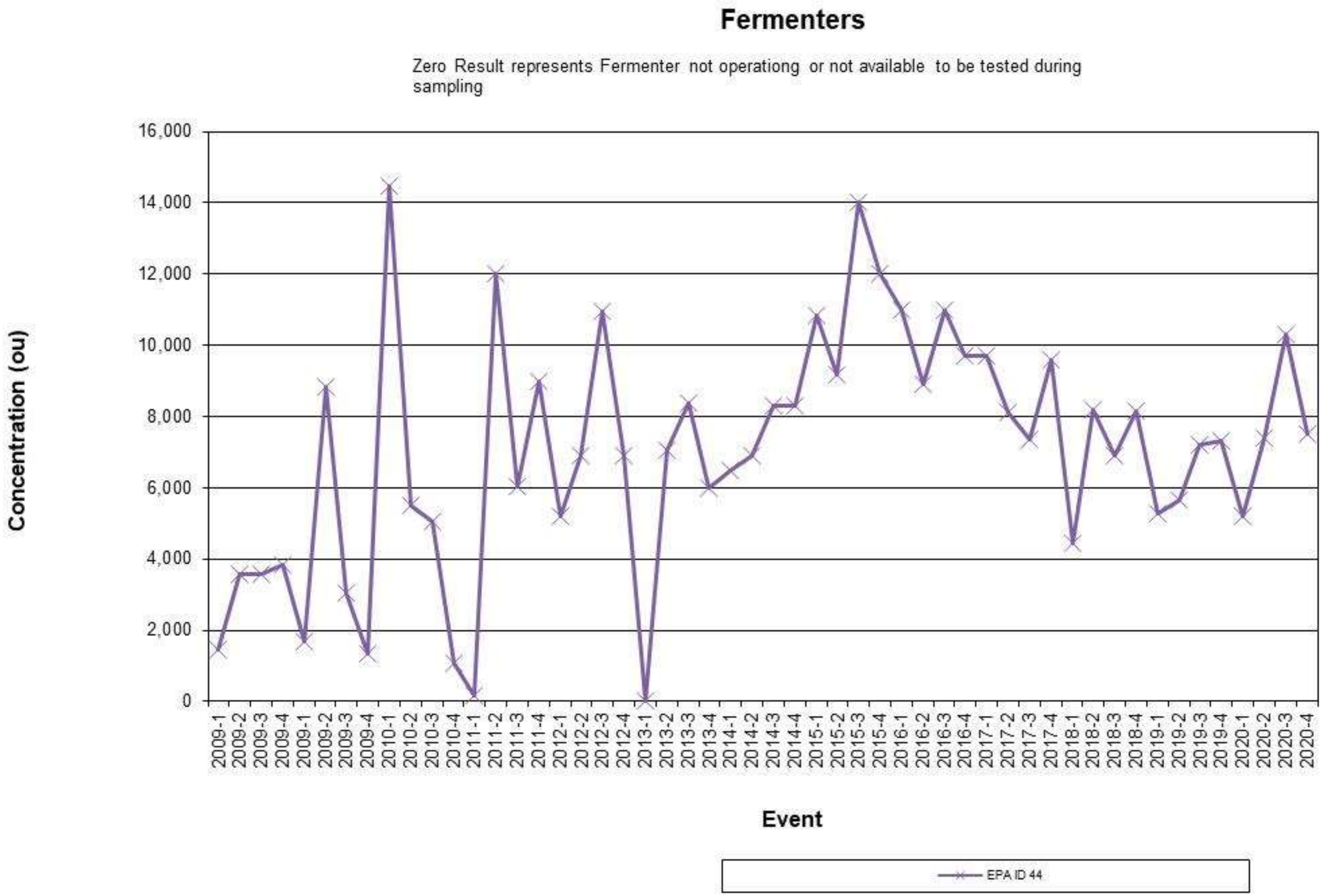


FIGURE 5-5 ODOUR EMISSION CONCENTRATIONS, CARBON DIOXIDE SCRUBBER OUTLET (EPA 16)

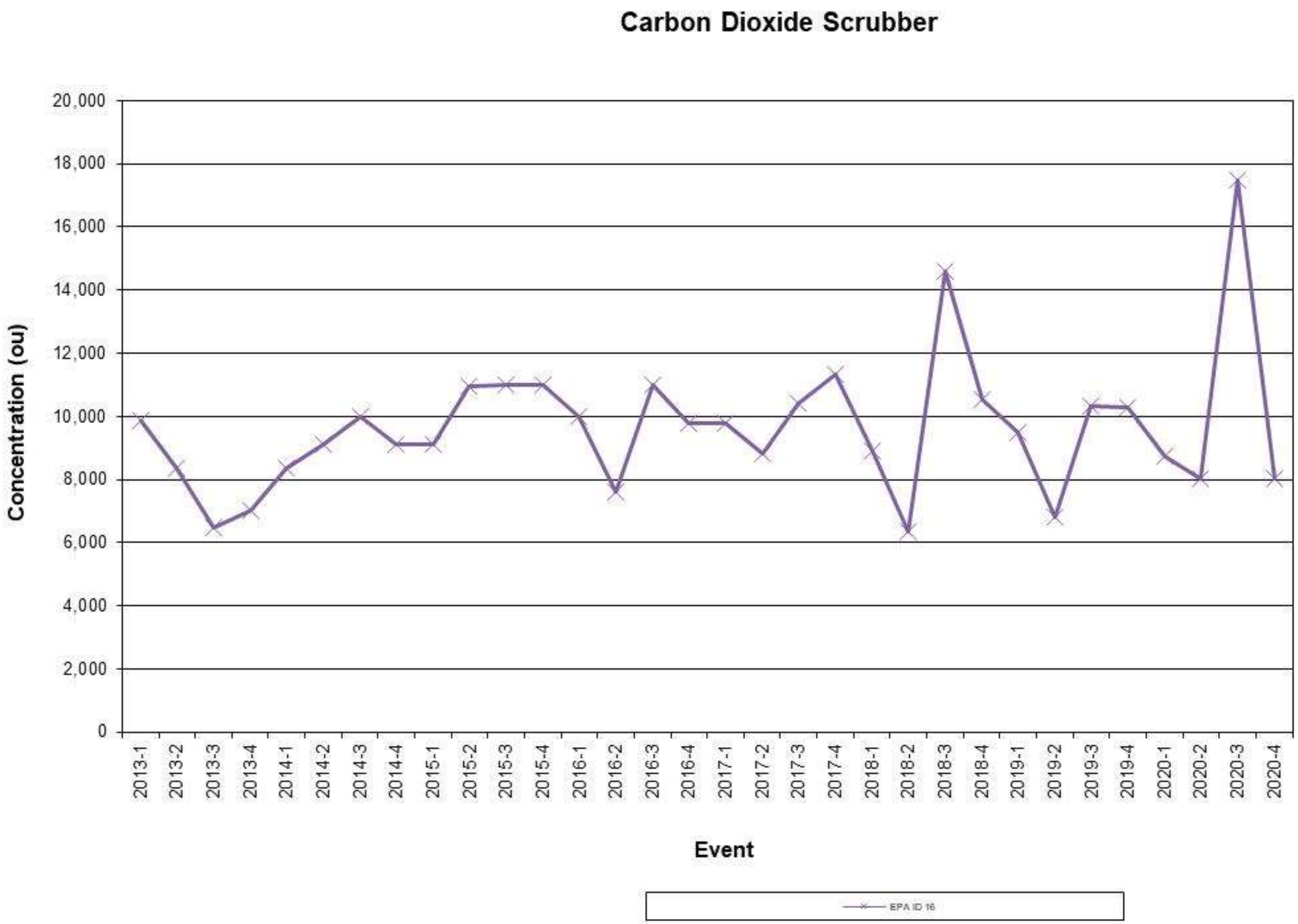


FIGURE 5-6 ODOUR EMISSION CONCENTRATIONS, COMBINED BOILER 5 & 6 STACK (EPA 35)

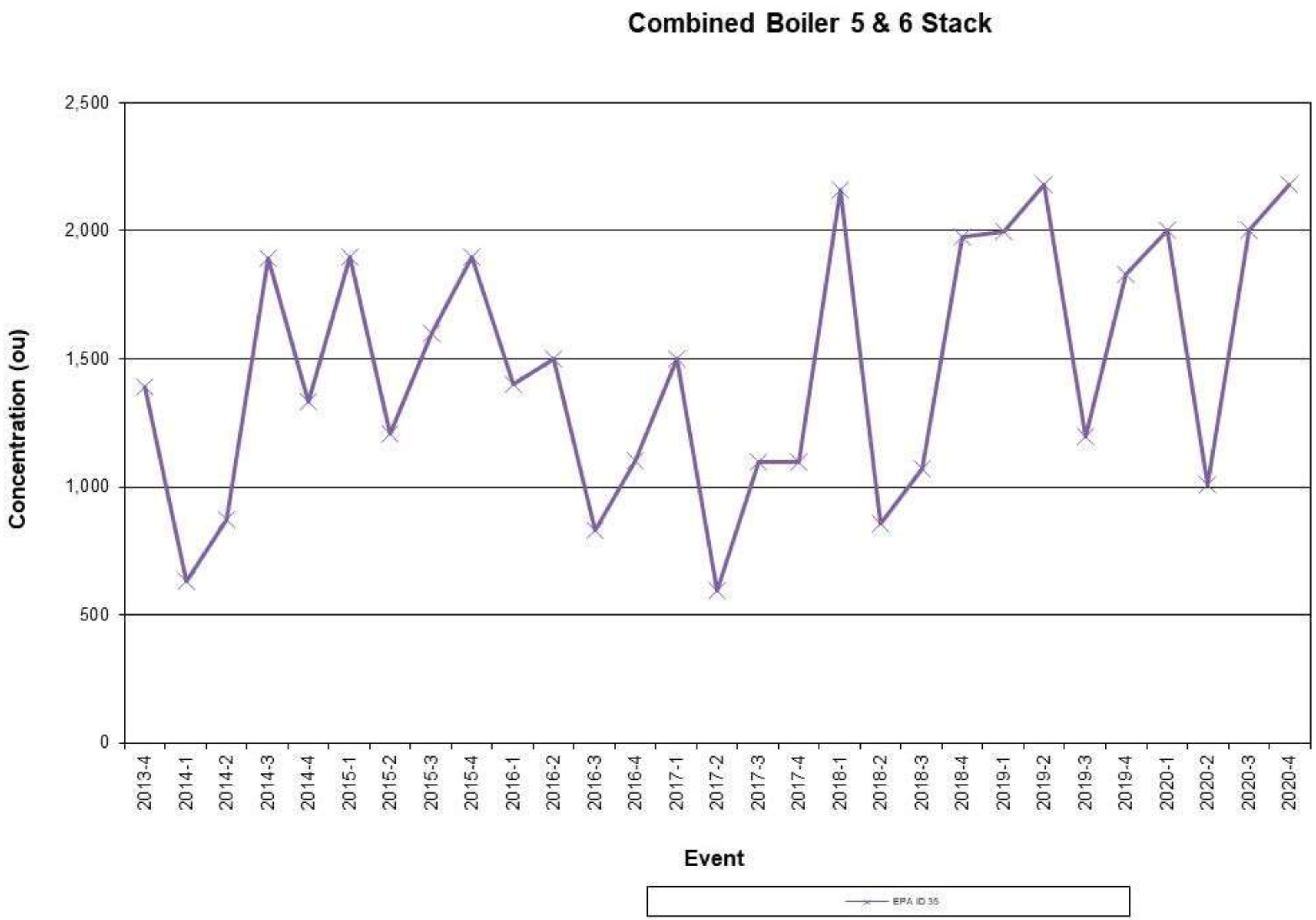


FIGURE 5-7 ODOUR EMISSION CONCENTRATIONS, BOILER 4 STACK (EPA 42)

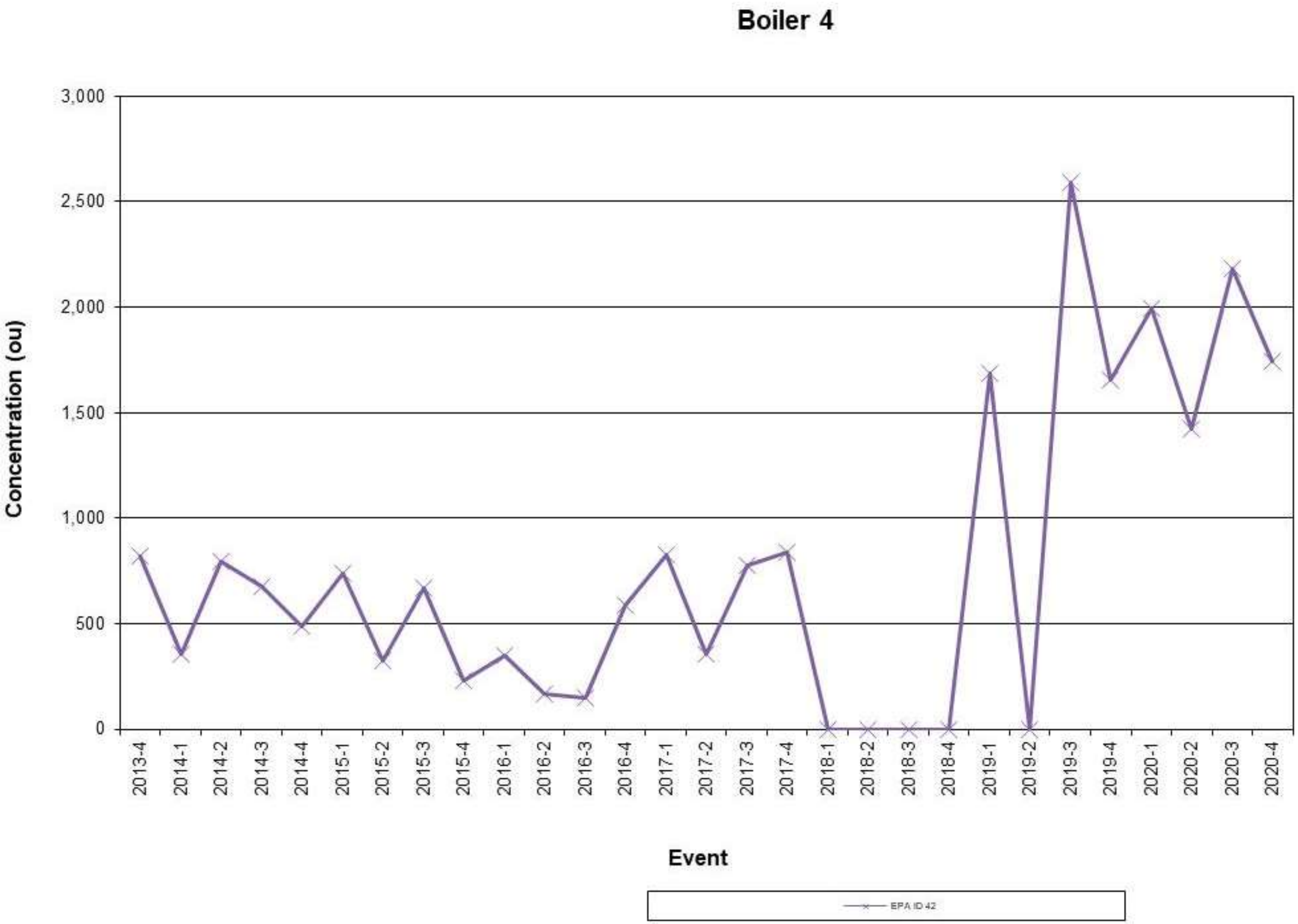


FIGURE 5-8 ODOUR EMISSION CONCENTRATIONS, BOILER 2 STACK (EPA 45)

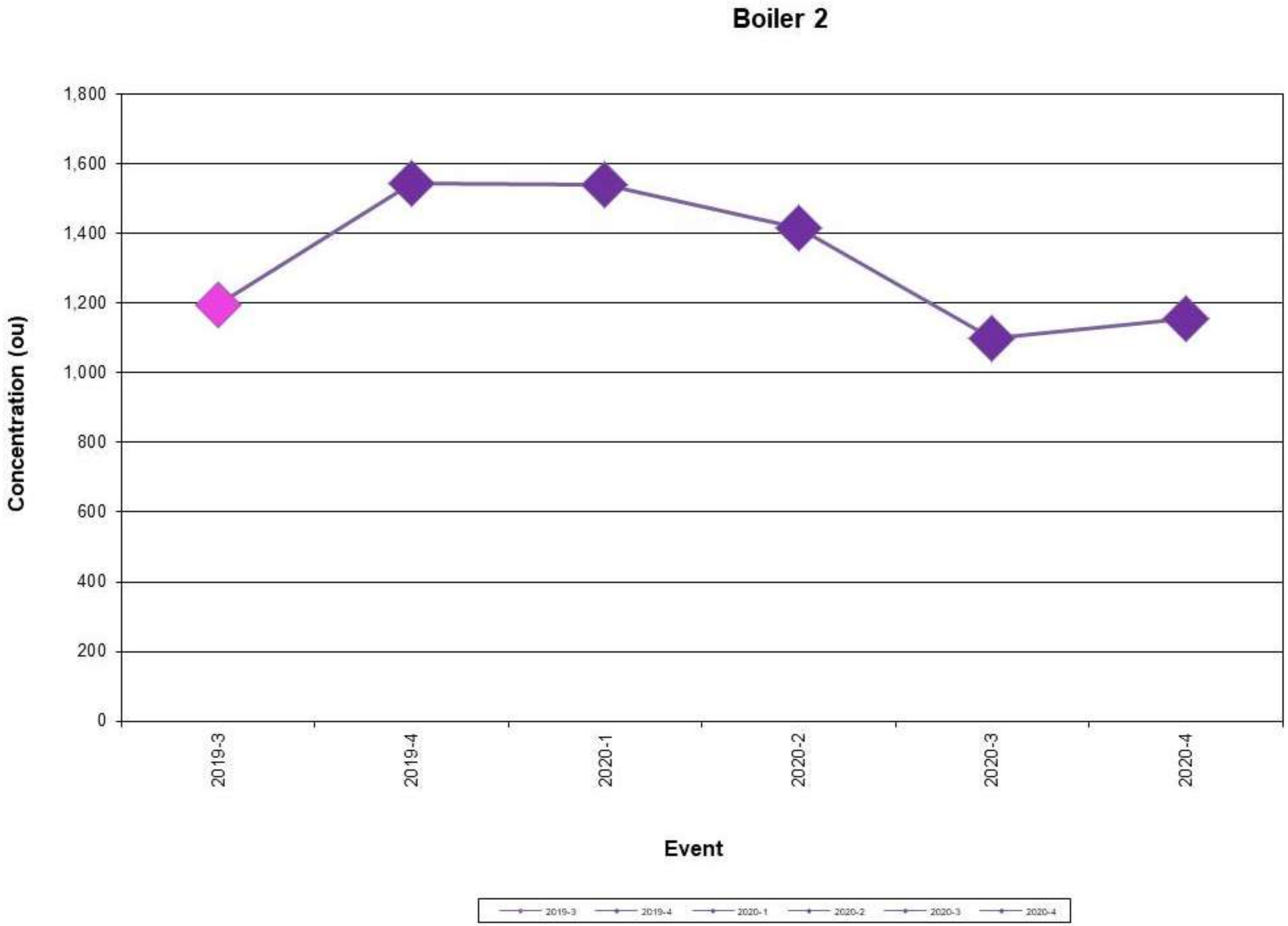


FIGURE 5-9 ODOUR EMISSION CONCENTRATIONS, BIOFILTERS (EPA 39, 40, 41)

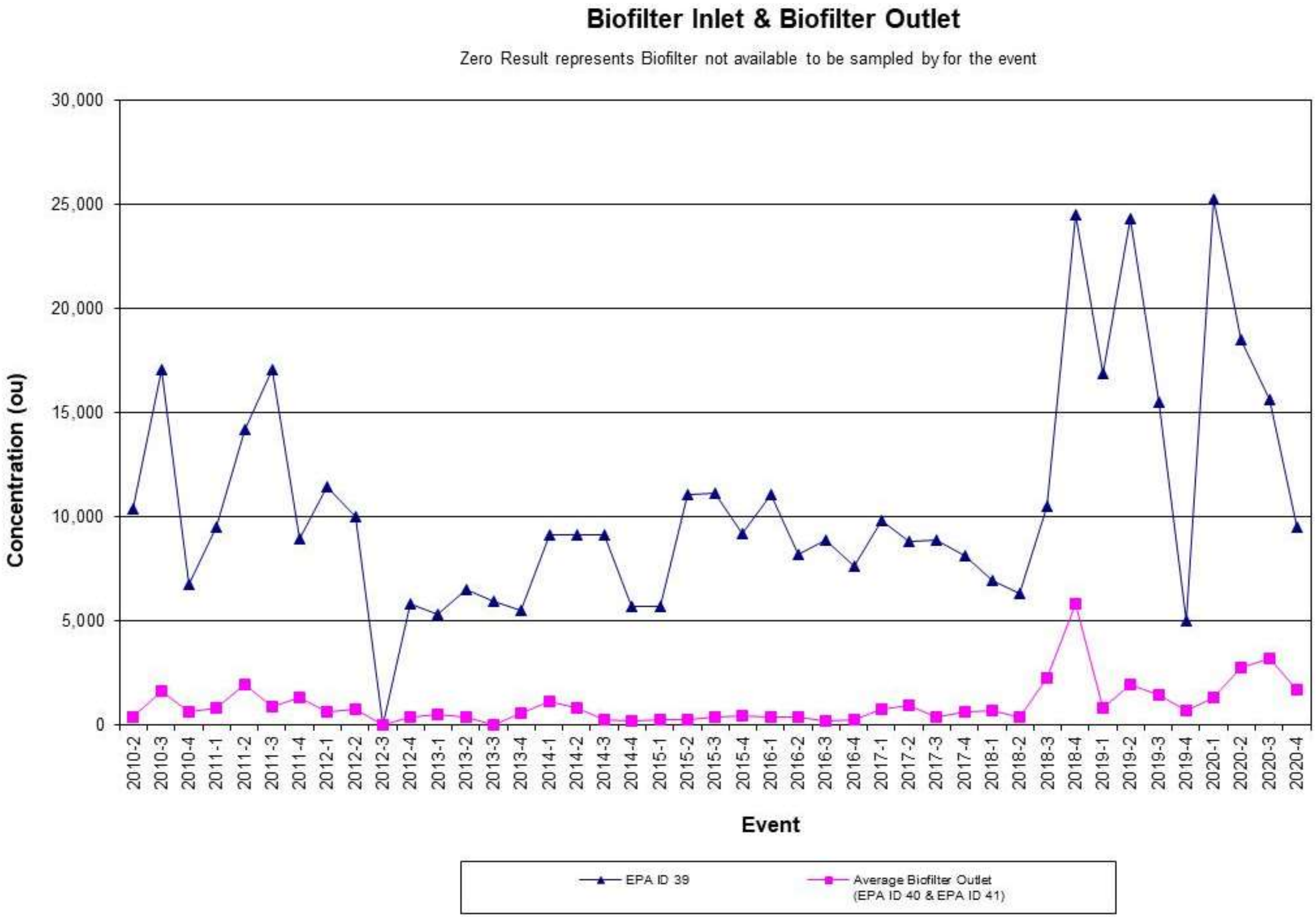


FIGURE 5-10 ODOUR EMISSION CONCENTRATIONS, DDG PELLET PLANT (EPA 46)

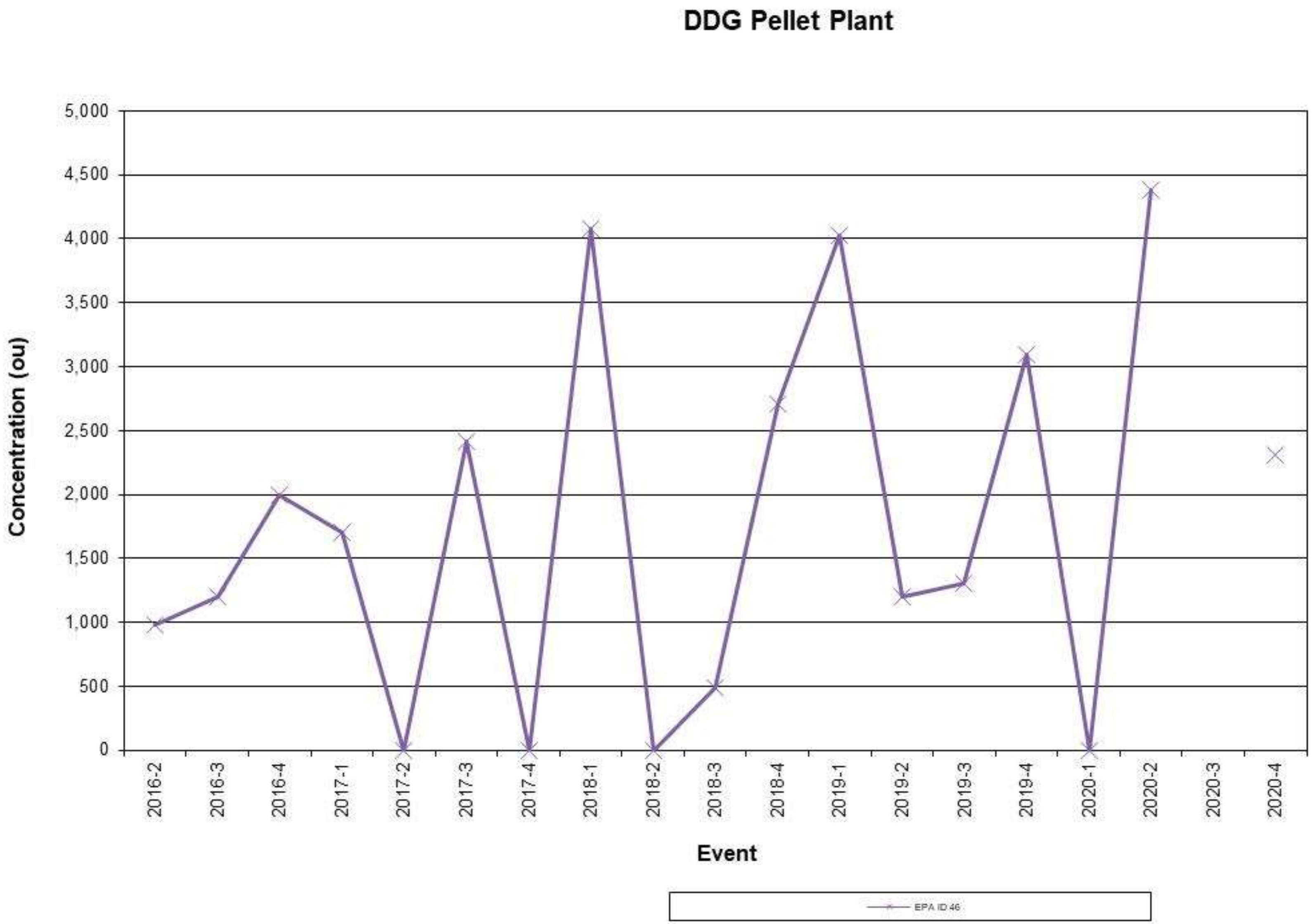


FIGURE 5-11 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 1

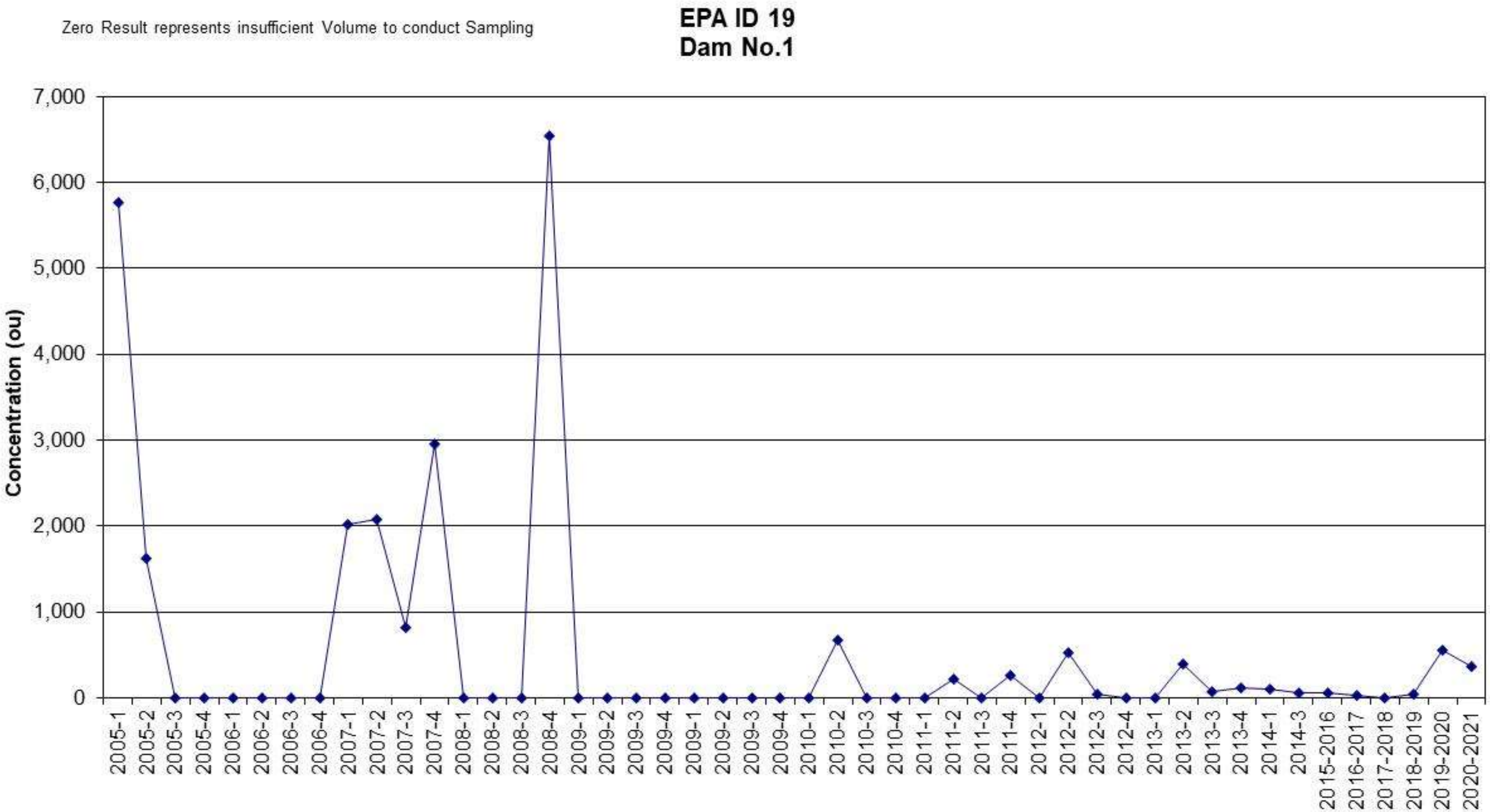


FIGURE 5-12 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 3

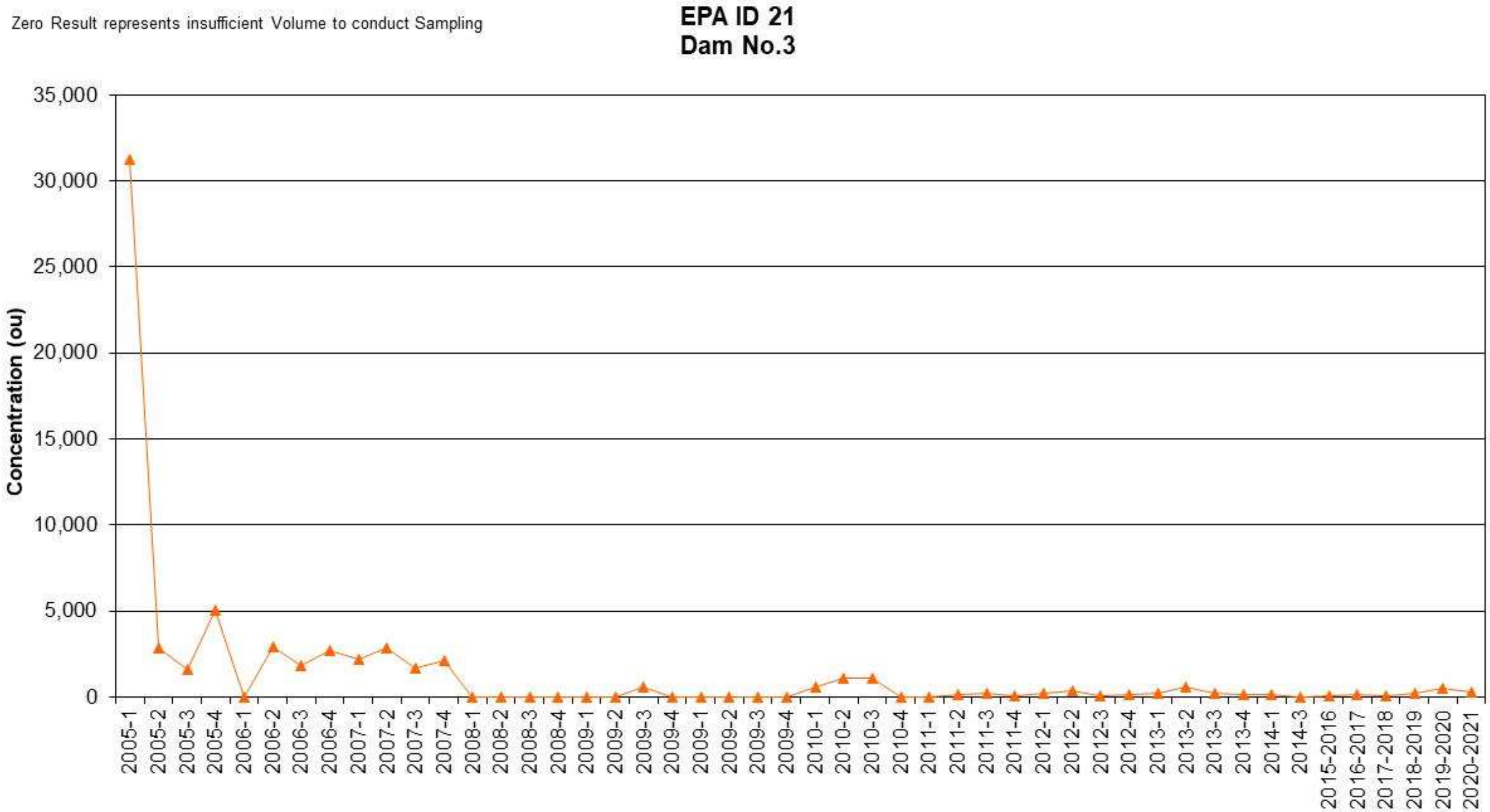


FIGURE 5-13 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 5

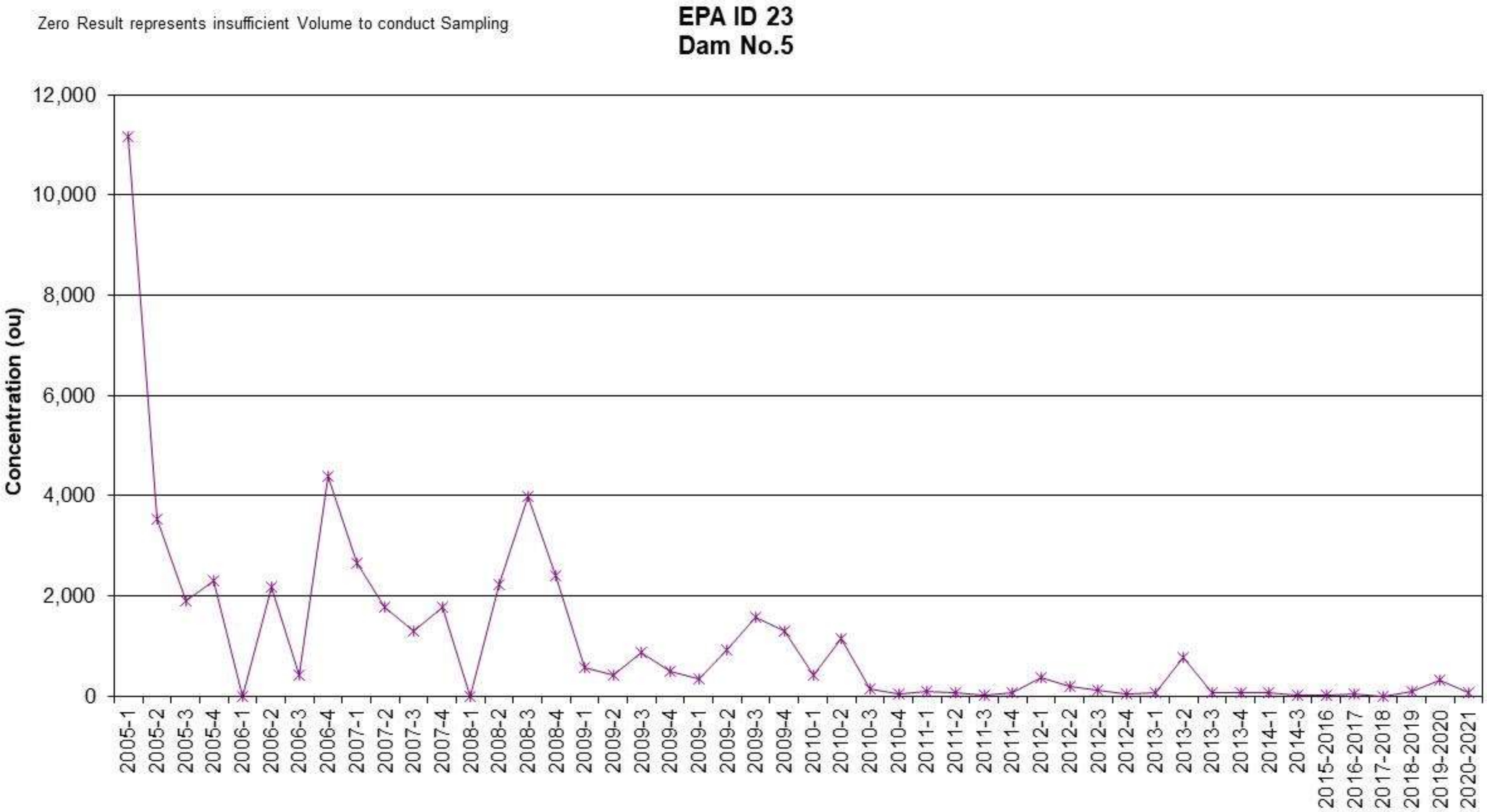


FIGURE 5-14 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 6

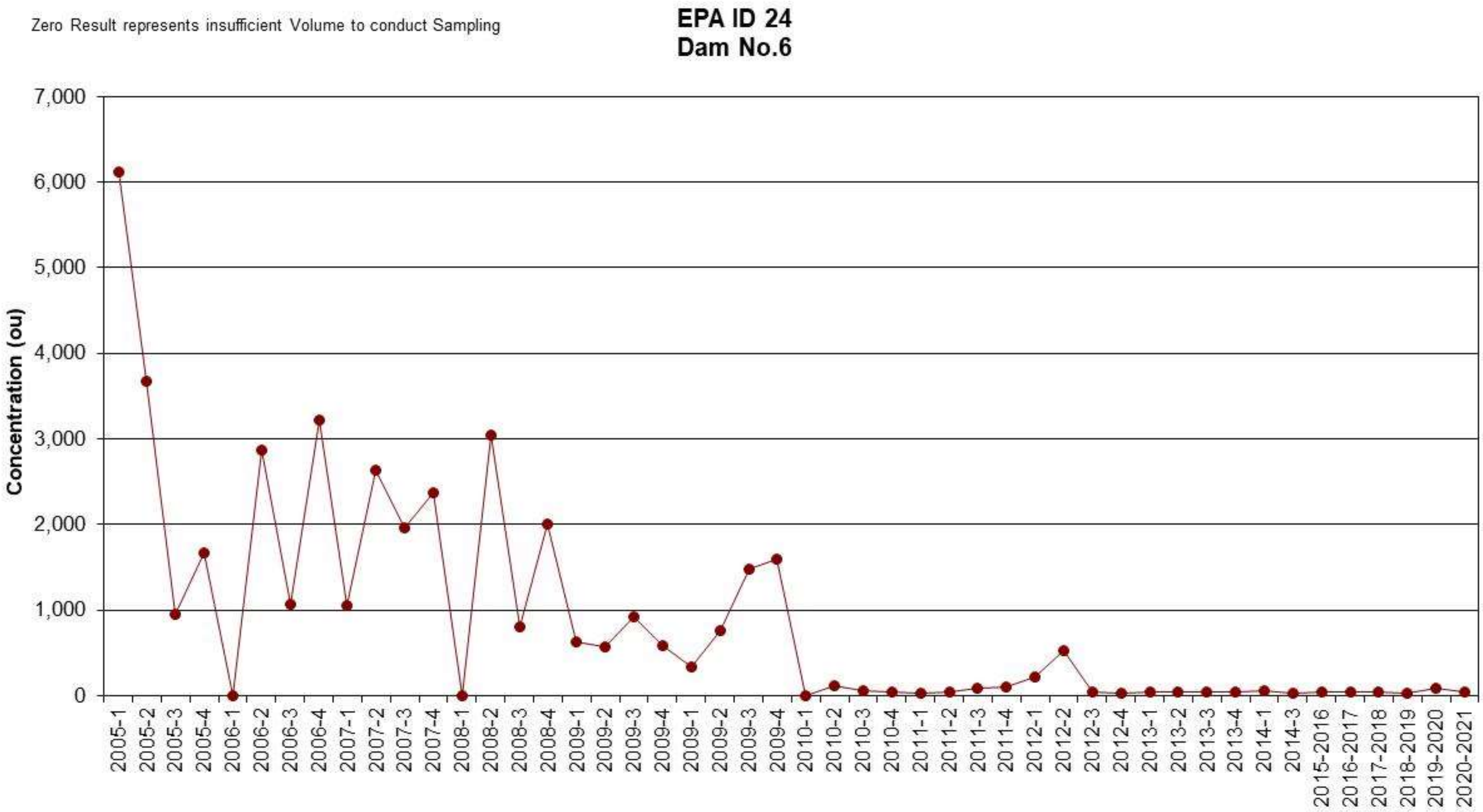
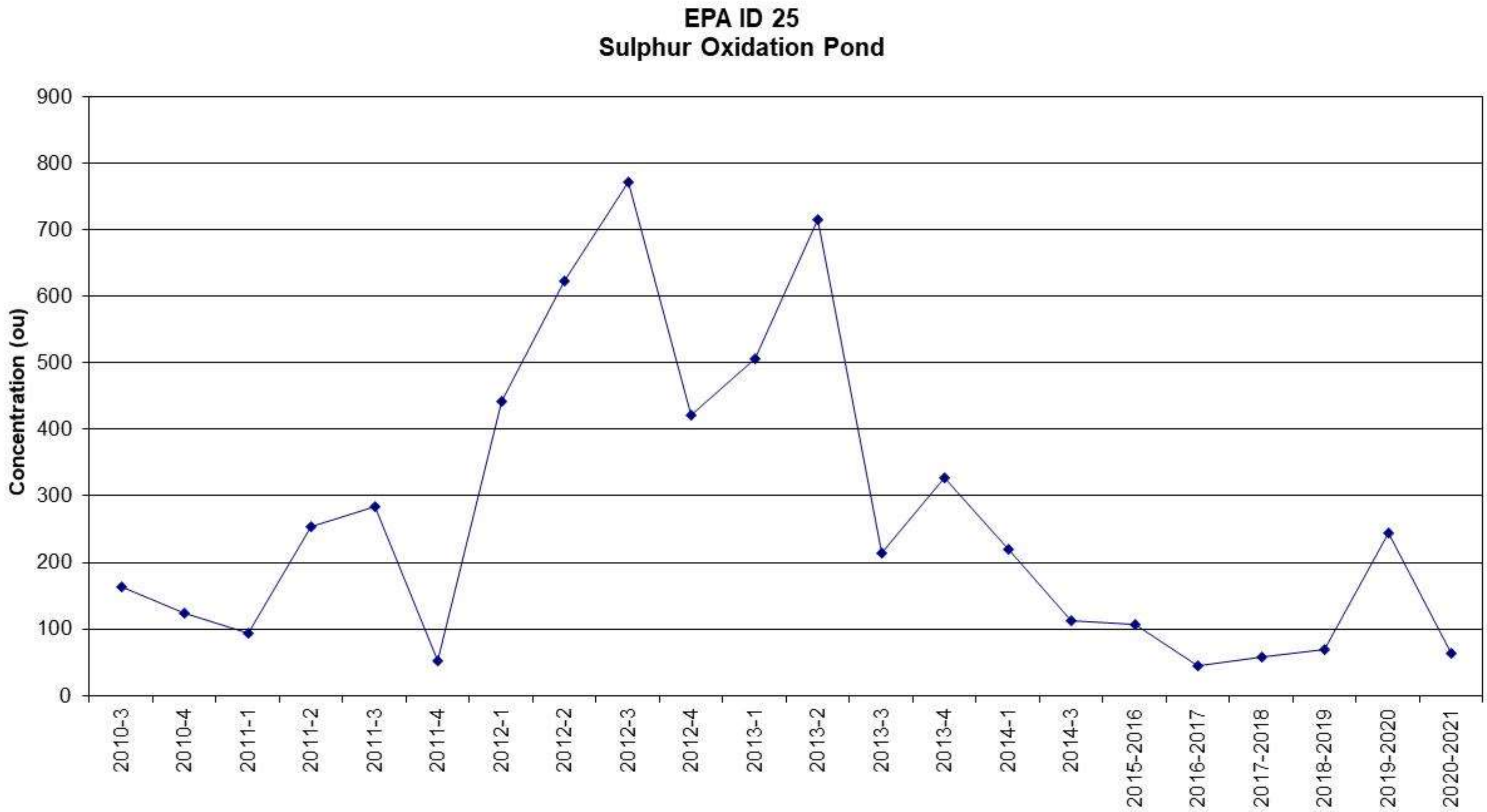


FIGURE 5-15 ODOUR EMISSION CONCENTRATIONS, SULPHUR OXIDATION POND



6 TEST METHODS

6.1 ODOUR MEASUREMENT/DYNAMIC OLFACTOMETRY

(AS 4323.3 & AS 4323.4 and OM-7 and OM-8)

Samples were collected in 30L Nalophane sampling bags which are enclosed in airtight plastic containers. Surface samples were collected utilising an equilibrium flux hood or witches hat flux hood.

Odorous gas for analysis was drawn through a Teflon (PTFE) sample probe. The gas then passes through a Teflon (PTFE) tube connected to the Nalophane sampling bag. The sampling pump is connected to the airtight plastic container to provide a sample gas flow-rate of approximately 0.5 – 1.5 litres per minute. After the required volume has been sampled, the pump is stopped and the bag sealed with a stainless steel valve. Two samples were collected from each site.

Using a triangular forced choice olfactometer, the Nalophane bag of odour sample was dynamically diluted to various concentrations with dry odour free air.

The diluted sample was then presented to a panel of screened panellists as one of these airflows. The panellists then recorded if they could detect any odour and from which flow. The other two flows were discharging odour free air.

The odour is always presented to the panellists in ascending concentration; that is, from lower to higher concentration. The panellists are required at each dilution level to give a response as to what they are smelling from the flows (forced choice methodology). The response options for the panellists are:

'Guess'	Unable to determine which air flow contains the diluted odours
'Inkle'	Thinks that one of the flows could be different from the other two flows
'Detect' or 'Certain'	Is confident that one of the airflows smells different from the other two flows. Not necessarily able to say what the smell is.
'Recognise'	Thinks that one of the flows could be different from the other two flows and is able to: ▪ Assign a 'hedonic tone' (pleasantness scale number) to the odour ranging from –10 to 10 and/or ▪ Able to assign a character to the colour, as in 'it smells like …' *Note: that the Recognise level concentration and Hedonic Tone and Odour descriptors are obtained with the diluted odour, panellists are not exposed to the full strength odour.*

The percentage panel response and dilution levels used were then entered into a computer programme to determine the 50% panel response. This dilution level corresponds to the odour concentration of the sample.

Sampling and dilution lines are constructed from teflon, stainless or glass to prevent contamination of the sample.

The sampling and the dilution procedures used were in accordance with OEH NSW Method OM-7 and OM-8, which are based on Standards Association of Australia, AS4323.3 and AS4323.4.

6.1.1 ODOUR PANEL SELECTION

Odour panellists must meet certain criteria to qualify as and remain panellists. Their average sensitivity to n-Butanol must be between 20 and 80 parts per billion (ppb) and their variability in response to n-Butanol must be within a certain range.

Panellists are screened against n-Butanol before every panel session to ensure they are in compliance.

Panellists should not suffer from respiratory complaints, nor should they eat or smoke or drink anything but water during the half hour preceding or during the test period and their person and clothing should be odour free and have not been exposed to an odorous environment before testing.

6.1.2 ODOUR TERMINOLOGY

The odour level is expressed in odour units and for mixed odours is analogous to concentration expressed in parts per billion. The odour detection level is defined as the ratio of *the volume that a sample of odorous gas would occupy when diluted to the threshold of detection of that odour* to *the volume of the sample*. In simpler terms, the ratio indicated the number of dilutions necessary to reduce the odour to its threshold of detection or odour detection threshold. This ratio is expressed in odour units or number of dilutions to detection threshold. For example, a value of 2,000 odour units would mean the volume of the initial sample of odorous gas would need to be diluted 2,000 times before the odour would just be detectable to the average human nose, that is, at the odour detection threshold.

6.2 EXHAUST GAS VELOCITY

(OEH NSW TM-2 and USEPA Method 12)

Velocity profiles were obtained across the stack utilising an Airflow Developments Ltd. S-type pitot tube and digital manometer.

6.3 EXHAUST GAS TEMPERATURE

(OEH NSW TM- 2, 3 & 4 and USEPA Methods 2, 3 & 4)

The exhaust gas temperature was measured using a Digital thermometer (0-1200°C) connected to a chromel/alumel (K-type) thermocouple probe.

6.4 OXYGEN (O_2)

(OEH NSW TM-24 and USEPA Method 3A)

O_2 was analysed by a Testo 350 analyser.

6.5 MOISTURE

(OEH NSW TM-22 and USEPA Method 4)

Moisture from the stack was determined in accordance with OEH NSW TM-22 and USEPA Method 4. In particular, M4 Section 2.2.1 which nominates a moisture approximation method used to enable calculation of isokinetic sampling rates and where isokinetic sampling is not required such as odour sampling.

6.6 ACCURACY

All results are quoted on a dry basis. SEMA has adopted the following (Table 6-1) uncertainties for various stack testing methods.

TABLE 6-1 ESTIMATION OF MEASUREMENT UNCERTAINTY

Pollutant	Methods	Uncertainty
Moisture	AS4323.2, TM-22, USEPA 4	25%
Odour	AS4323.3, AS4323.4	3 times
Oxygen and Carbon Dioxide	TM-24, TM-25, USEPA 3A	1% actual
Velocity	AS4323.1, TM-2, USEPA 2A & 2C	5%

Key:

Unless otherwise indicated the uncertainties quoted have been determined @ 95% level of Confidence level (i.e. by multiplying the repeatability standard deviation by a co-efficient equal to 1.96) (Source – Measurement Uncertainty)

Sources: *Measurement Uncertainty – implications for the enforcement of emission limits by Maciek Lewandowski (Environment Agency) & Michael Woodfield (AEAT) UK*

Technical Guidance Note (Monitoring) M2 Monitoring of stack emissions to air Environment Agency Version 3.1 June 2005.

APPENDIX A – EMISSION TEST RESULTS

Glossary:

%	=	percent
^oC	=	Degrees Celsius
am^3/min	=	cubic metre of gas at actual conditions per minute
Normal Volume (m^3)	=	cubic metre at 0°C and 760 mm pressure and 1 atmosphere
am^3	=	cubic metre of gas at actual conditions
g/g mole	=	grams per gram mole
g/s	=	grams per second
hrs	=	hours
kg/m^3	=	kilograms per cubic metre
kPa	=	kilo Pascals
m^2	=	square metre
m/s	=	metre per second
m^3/sec	=	cubic metre per second at 0^0C and 1 atmosphere
mg	=	milligrams
mg/ m^3	=	milligrams per cubic metre at 0^oC and 1 atmosphere
O_2	=	Oxygen

Abbreviations for names of SEMA staff who completed either Sampling or Analysis or QA Checking

PWS	=	Peter W Stephenson
JW	=	Jay Weber

TABLE A-1 EMISSION TEST RESULTS – GLUTEN DRYERS NO. 1, 2, 3 & 4

Emission Test Results				
Project Number	**7116**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 8 Gluten Dryer 1***	**EPA ID 9 Gluten Dryer 2**	**EPA ID 10 Gluten Dryer 3**	**EPA ID 11 Gluten Dryer 4**
Date	18-Nov-20	18-Nov-20	18-Nov-20	18-Nov-20
	Dry			
Run	1			
Method	TM-1, TM-2 & TM-22			
Flow Start Time (hrs)	12:07	13:48	14:46	14:26
Flow Stop Time (hrs)	12:24	14:06	15:57	14:48
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	65.3	63.0	73.5	74.3
Stack Cross-Sectional area (m^2)	1.431	1.094	4.410	2.310
Average Stack Gas Velocity (m/s)	13.7	17.0	11.5	15.7
Actual Gas Flow Volume (am^3/min)	1,179	1,114	3,040	2,173
Total Normal Gas Flow Volume (m^3/min)	915	794	2,293	1,633
Total Normal Gas Flow Volume (m^3/s)	15.2	13.2	38.2	27.2
Total Stack Pressure (kPa)	102.5	93.4	102.8	102.5
Moisture Content (% by volume)	5.01	4.77	5.69	5.57
Molecular Weight Dry Stack Gas (g/gmole)	28.8	28.8	28.8	28.8
Dry Gas Density (kg/m^3)	1.29	1.29	1.29	1.29
Oxygen (%)	20.9	20.9	20.9	20.9
Analysis	**Odour**	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5446	5447	5448	5449
SEMA Number	728138	728139	728140	728141
Sample Start Time (hrs)	12:58	13:53	14:57	14:38
Sample Finish Time (hrs)	13:08	14:06	15:07	14:48
Odour Concentration (As Received) (ou)	468	254	302	359
Odour Concentration (Final) (ou)	**470**	**250**	**300**	**360**
Normal MOER (As Received) (ou m^3/s)	7,136	3,362	11,540	9,768
Normal MOER (Final) (ou m^3/s)	7,136	3,362	11,540	9,768
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit	No Limit
Sample storage prior to disposal	2 days	2 days	2 days	2 days
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

* Re. Gluten Dryer No.1 (EPA ID 8), odour measurements were taken. However, new silencer and ductwork no longer enable access to the duct. Thus, flow measurements were unable to be taken. To enable calculation of the MOER, flow measurements have been based on previous Quarter 1, 2020 results.

TABLE A-2 EMISSION TEST RESULTS – STARCH DRYERS NO.1, 3, 4 & 5

Emission Test Results				
Project Number	**7116**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 12 Starch Dryer 1**	**EPA ID 13 Starch Dryer 3**	**EPA ID 14 Starch Dryer 4**	**EPA ID 47 Starch Dryer 5**
Date	18-Nov-20	18-Nov-20	18-Nov-20	24-Nov-20
	Dry			
Run	1			
Method	TM-1, TM-2 & TM-22			
Flow Start Time (hrs)	12:47	15:26	15:25	13:19
Flow Stop Time (hrs)	13:09	15:48	16:47	13:40
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	41.4	40.1	39.5	64.4
Stack Cross-Sectional area (m^2)	2.250	1.000	1.000	4.524
Average Stack Gas Velocity (m/s)	7.3	20.2	21.0	14.9
Actual Gas Flow Volume (am^3/min)	980	1,214	1,258	4,047
Total Normal Gas Flow Volume (m^3/min)	812	1,004	1,046	3,020
Total Normal Gas Flow Volume (m^3/s)	13.5	16.7	17.4	50.3
Total Stack Pressure (kPa)	102.47	102.53	102.54	101.11
Moisture Content (% by volume)	5.75	6.22	5.99	7.61
Molecular Weight Dry Stack Gas (g/gmole)	28.8	28.8	28.8	28.8
Dry Gas Density (kg/m^3)	1.29	1.29	1.29	1.29
Oxygen (%)	20.9	20.9	20.9	20.9
Analysis	**Odour**	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5445	5450	5451	5457
SEMA Number	728137	728142	728143	728148
Sample Start Time (hrs)	12:59	15:38	16:37	13:30
Sample Finish Time (hrs)	13:09	15:48	16:47	13:40
Odour Concentration (As Received) (ou)	470	116	106	386
Odour Concentration (Final) (ou)	**470**	**120**	**110**	**390**
Normal MOER (As Received) (ou m^3/s)	6,358	1,942	1,848	19,428
Normal MOER (Final) (ou m^3/s)	6,358	1,942	1,848	19,428
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit	No Limit
Sample storage prior to disposal	2 days	2 days	2 days	2 days
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

TABLE A-3 EMISSION TEST RESULTS – BOILERS NO. 5 & 6, 4 & 2

Emission Test Results			
Project Number	**7116**		
Project Name	**Shoalhaven Starches**		
Test Location	**EPA ID 35 Boilers 5&6**	**EPA ID 42 Boiler 4**	**EPA ID 45 Boiler 2**
Date	24-Nov-20	24-Nov-20	24-Nov-20
	Dry		
Run	1		
Method	TM-1, TM-2 & TM-22		
Flow Start Time (hrs)	11:38	10:43	10:00
Flow Stop Time (hrs)	12:00	11:05	10:20
Inlet/Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	135.2	164.6	214.0
Stack Cross-Sectional area (m^2)	3.142	1.057	0.950
Average Stack Gas Velocity (m/s)	16.5	18.7	8.3
Actual Gas Flow Volume (am^3/min)	3,117.3	1,187.5	475.9
Total Normal Gas Flow Volume (m^3/min)	1,973.7	702.2	254.5
Total Normal Gas Flow Volume (m^3/s)	32.895	11.704	4.242
Total Stack Pressure (kPa)	101.11	101.23	101.23
Moisture Content (% by volume)	5.15	5.15	4.54
Molecular Weight Dry Stack Gas (g/gmole)	30.080	29.840	30.080
Dry Gas Density (kg/m^3)	1.34	1.33	1.34
Oxygen (%)	8.4	10.0	8.4
Analysis	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5455	5454	5453
SEMA Number	728146	728145	728144
Sample Start Time (hrs)	11:50	10:55	10:10
Sample Finish Time (hrs)	12:00	11:05	10:20
Odour Concentration (As Received) (ou)	2,181	1,742	1,156
Odour Concentration (Final) (ou)	**2,200**	**1,700**	**1,200**
Normal MOER (As Received) (ou m^3/s)	71,745	20,388	4,904
Normal MOER (Final) (ou m^3/s)	71,745	20,388	4,904
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit
Sample storage prior to disposal	2 days	2 days	2 days
Calculations entered by	JW	JW	JW
Calculations checked by	PWS	PWS	PWS

TABLE A-4 EMISSION TEST RESULTS – FERMENTER 16 & CO_2 SCRUBBER OUTLET

Emission Test Results		
Project Number	**7116**	
Project Name	**Shoalhaven Starches**	
Test Location	**EPA ID 44 Fermenter 16**	**EPA ID 16 CO_2 Scrubber outlet**
Date	18-Nov-20	18-Nov-20
	Dry	
Run	1	
Method	TM-1,TM-2 & TM-22	
Flow Start Time (hrs)	10:36	11:02
Flow Stop Time (hrs)	10:57	11:22
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	32.2	28.4
Stack Cross-Sectional area (m^2)	0.071	0.196
Average Stack Gas Velocity (m/s)	6.1	7.6
Actual Gas Flow Volume (am^3/min)	25.7	90
Total Normal Gas Flow Volume (m^3/min)	22.4	79
Total Normal Gas Flow Volume (m^3/s)	0.373	1.320
Total Stack Pressure (kPa)	102.51	102.51
Moisture Content (% by volume)	3.80	3.45
Molecular Weight Dry Stack Gas (g/gmole)	29.620	31.204
Dry Gas Density (kg/m^3)	1.32	1.39
Oxygen (%)	0.5	0.1
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5442	5443
SEMA Number	728134	728135
Sample Start Time (hrs)	10:47	11:12
Sample Finish Time (hrs)	10:57	11:22
Odour Concentration (As Received) (ou)	7,516	8,035
Odour Concentration (Final) (ou)	**7,500**	**8,000**
Normal MOER (As Received) (ou m^3/s)	2,804	10,609
Normal MOER (Final) (ou m^3/s)	2,804	10,609
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample storage prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

TABLE A-5 EMISSION TEST RESULTS – INLET TO BIOFILTERS, DDG DRYERS 1, 2, 3 & 4

Emission Test Results		
Project Number	**7116**	
Project Name	**Shoalhaven Starches**	
Test Location	**EPA ID 39 Biofilter Inlet DDG Dryers 1, 2 & 3**	**EPA ID 39A Biofilter Inlet DDG Dryer 4**
Date	24-Nov-20	24-Nov-20
	Dry	Dry
Run	1	1
Method	TM-1,TM-2 & TM-22	TM-1,TM-2 & TM-22
Flow Start Time (hrs)	14:50	14:50
Flow Stop Time (hrs)	14:50	15:12
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	41.8	30.1
Stack Cross-Sectional area (m^2)	0.283	0.049
Average Stack Gas Velocity (m/s)	13.6	8.5
Actual Gas Flow Volume (am^3/min)	231	25
Total Normal Gas Flow Volume (m^3/min)	178	22
Total Normal Gas Flow Volume (m^3/s)	3.0	0.4
Total Stack Pressure (kPa)	96.42	101.39
Moisture Content (% by volume)	6.90	3.93
Molecular Weight Dry Stack Gas (g/gmole)	28.836	28.836
Dry Gas Density (kg/m^3)	1.287	1.287
Oxygen (%)	20.9	20.9
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5462	5463
SEMA Number	728153	728154
Sample Start Time (hrs)	14:16	15:02
Sample Finish Time (hrs)	14:26	15:12
Odour Concentration (As Received) (ou)	9,495	70,388
Odour Concentration (Final) (ou)	**9,500**	**70,400**
Normal MOER (As Received) (ou m^3/s)	28,146	25,522
Normal MOER (Final) (ou m^3/s)	28,146	25,522
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample Storage prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

TABLE A-6 EMISSION TEST RESULTS DDG PELLET PLANT

Emission Test Results	
Project Number	**7116**
Project Name	**Shoalhaven Starches**
Test Location	**EPA ID 46 DDG Pellet Plant Stack**
Date	24-Nov-20
	Dry
Run	1
Method	TM-1,TM-2 & TM-22
Flow Start Time (hrs)	11:24
Flow Stop Time (hrs)	11:47
Inlet/Exhaust	Exhaust
Stack Temperature (^oC)	45.0
Stack Cross-Sectional area (m^2)	1.674
Average Stack Gas Velocity (m/s)	12.5
Actual Gas Flow Volume (am^3/min)	1,255.6
Total Normal Gas Flow Volume (m^3/min)	1,051.8
Total Normal Gas Flow Volume (m^3/s)	17.530
Total Stack Pressure (kPa)	101.07
Moisture Content (% by volume)	2.20
Molecular Weight Dry Stack Gas (g/gmole)	28.836
Dry Gas Density (kg/m^3)	1.29
Oxygen (%)	20.9
Analysis	**Odour**
Method	**AS4323.3**
ORLA Number	5456
SEMA Number	728147
Sample Start Time (hrs)	11:24
Sample Finish Time (hrs)	11:47
Odour Concentration (As Received) (ou)	2,307
Odour Concentration (Final) (ou)	**2,300**
Normal MOER (As Received) (ou m^3/s)	40,442
Normal MOER (Final) (ou m^3/s)	40,442
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit
Sample Storage prior to disposal	2 days
Calculations entered by	JW
Calculations checked by	PWS

TABLE A- 7 EMISSION TEST RESULTS – BIOFILTER OUTLETS

Emission Test Results				
Project Number	7116			
Project Name	Shoalhaven Starches			
Test Location	**EPL ID 40 Biofilter A East**	**EPL ID 40 Biofilter A West**	**EPL ID 41 Biofilter B East**	**EPL ID 41 Biofilter B West**
Date	24-Nov-20	24-Nov-20	24-Nov-20	24-Nov-20
	Dry	Dry	Dry	Dry
Run	1	1	1	1
Method	TM-2 & TM-22			
Sample Start Time (hrs)	15:37	16:32	15:32	16:15
Sample Stop Time (hrs)	15:47	16:42	15:42	16:25
Inlet/Exhaust	Exhaust			
Stack Temperature (^oC)	39.1	37.8	39.5	36.4
Proportion of Inlet air flow	**0.26**	**0.24**	**0.24**	**0.26**
Calculated from inlet flow Actual Gas Flow Volume (am^3/min)	65.4	62.2	62.2	66.8
Calculated from inlet flow Total Normal Gas Flow Volume (m^3/min)	50.90	48.36	48.36	52.0
Analysis	Odour			
Method	AS4323.3			
ORLA Number	5458	5460	5459	5461
SEMA Number	728149	728151	728150	728152
Sample Start Time (hrs)	15:37	16:32	15:32	16:15
Sample Stop Time (hrs)	15:47	16:42	15:42	16:25
Odour Concentration (As Received) (ou)	1,242	1,679	2,004	1,830
Odour Concentration (Final) (ou)	1,200	1,680	2,000	1,830
Normal MOER (As Received) (ou m^3/s)	1054	1353	1615	1586
Normal MOER (Final) (ou m^3/s)	1054	1353	1615	1586
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

APPENDIX B – CERTIFICATES OF ANALYSIS

Odour Research Laboratories Australia

A Division of Peter W. Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

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Auburn NSW 2144 Australia
Tel: (02) 9737 9991
E-Mail: pstephenson@orla.com.au

Olfactometry Test Report

The measurement was commissioned by SEMA on behalf of:

Client	Organisation:	Shoalhaven Starches
	Address:	Bolong Road, Bomaderry NSW 2541
	Contact:	John Studdert
	Sampling Site:	Ponds 1, 3, 5 & 6, SO Basin Pond, Starch Dryers 1, 3, 4 & 5, Gluten Dryers 1, 2, 3 & 4, Boiler 2, Boiler 4, Boilers 5&6, Biofilter A outlets, Biofilter B outlets, Biofilter inlet from DDG Evaporators No. 1, 2, 3,& 4, CO_2 Scrubber inlet & outlet, Fermenter 16, DDG Pellet Plant stack
	Telephone:	02 4423 8254
	Email:	John.studdert@manildra.com.au
Project	ORLA Report Number:	7116/ORLA/01
	Project Manager:	Margot Kimber
	Testing operator:	Peter Stephenson
	ORLA Sample number(s):	5441 to 5469
	SEMA Sample number(s):	728134 to 728159
Order	Analysis Requested:	Odour Analysis
	Order requested by:	SEMA on behalf of Shoalhaven Starches
	Date of order:	18 November 2020
	Order number:	5175
	Telephone:	02 9737 9991
	Signed by:	Margot Kimber
	Order accepted by:	Peter Stephenson
Report	Date of issue:	18 December 2020

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Accredited for Compliance with ISO/IEC 17025 - Testing

ODOUR CONCENTRATION MEASUREMENTS RESULTS 7116/ORLA/01

Investigated Item	Odour concentration in odour units 'ou' determined by Sensory odour concentration measurements, of an odour sample supplied in a sampling bag. All samples were received in good condition.
Analysis Method	The samples were analysed in accordance with AS/NZS4323.3:2001.
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 n-butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Instrument Used	The Olfactometer used during this testing session was: AC'SCENT International Olfactometer
Measuring Range	The measuring range of the AC'SCENT International olfactometer is $12 \leq \chi \leq 92{,}102$ ou. . If the measuring range was insufficient the odour samples will have been pre-diluted.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between ± 3°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.05$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $r = 0.0020$ (February 2020) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.20$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $A = 0.020$ (February 2020) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the AC'SCENT International Olfactometer has been determined to be 12 ou.
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 every session to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

18 December, 2020

Peter Stephenson
Managing Director

Odour Research Laboratories Australia

Odour Olfactometry Results – 7116/ORLA/01

Sample				Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Fermenter No.16	728134	18/11/2020 10:50	5442	19/11/2020 10:55	4	8	Nil	7500	7500	Strawberry Yoplait, oily, vinegar, sharp, alcohol, sweet, veggie oil, glue, gas, ink pen (-1)^
Sample ID: CO_2 scrubber outlet	728135	18/11/2020 11:12	5443	19/11/2020 11:26	4	8	Nil	8000	8000	Vinegar, sharp, sweet, glue, oily, veggie oil, strawberry, slight decay, decomposing fruit, alcohol (-1)
Sample ID: CO_2 scrubber inlet	728136	18/11/2020 11:14	5444	19/11/2020 11:54	4	8	Nil	10600	10600	Fruity, faint strawberry, oily, sweet, sharp, alcohol, veggie oil, vinegar (-1)^
Sample ID: Starch Dryer 1	728137	18/11/2020 12:59	5445	19/11/2020 12:25	4	8	Nil	470	470	Swampy, woody, earth, weet-bix, yeast, fresh bread, starchy, banana, vinegar (-0)^
Sample ID: Gluten Dryer 1	728138	18/11/2020 12:58	5446	19/11/2020 13:40	4	8	Nil	470	470	Earth, natural gas, wheat, grain, fresh bread, starchy vegetables, yoghurt (0)^
Sample ID: Gluten Dryer 2	728139	18/11/2020 13:53	5447	19/11/2020 14:09	4	8	Nil	250	250	Fermenting yoghurt, Yoplait , banana, fresh bread, plastic, vacuum cleaner dust (-1)^
Sample ID: Gluten Dryer 3	728140	18/11/2020 14:57	5448	19/11/2020 15:07	4	8	Nil	300	300	Plastic, yeast, slight sour, strawberry, yoghurt, cereal, plastic taste, fast food potato and gravy (0)^

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Odour Olfactometry Results – 7116/ORLA/01

Sample				Analysis Date/Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Gluten Dryer 4	728141	18/11/2020 14:38	5449	19/11/2020 14:38	4	8	Nil	360	360	Nestle Quik, caramel, vanilla, earth, chocolate, slight coffee, cocoa (2)^
Sample ID: Starch Dryer 3	728142	18/11/2020 15:38	5450	19/11/2020 15:38	4	8	Nil	120	120	Musty, dust, earth, mushroom, gas, peat, cereal, hops (-1)^
Sample ID: Starch Dryer 4	728143	18/11/2020 16:37	5451	19/11/2020 15:41	4	8	Nil	110	110	Hops, cereal, earth, peat, plastic, musty, potato (-1)^
Sample ID: Boiler 2	728144	24/11/2020 10:10	5453	25/11/2020 10:55	4	8	Nil	1200	1200	Acid, chalk, ammonia, earthy, moss exhaust, household gas, swamp gas, dirty, mould, dusty, fireplace heater, (-2)^
Sample ID: Boiler 4	728145	24/11/2020 10:55	5454	25/11/2020 11:25	4	8	Nil	1700	1700	Acid, lime, citrus, gas, burnt jet fuel, swamp gas, earth, mushroom, chlorine, bleach (-1)^
Sample ID: Boiler 5&6	728146	24/11/2020 11:50	5455	25/11/2020 11:54	4	8	Nil	2200	2200	Chlorine, acid, oil, burnt kerosene or jet fuel exhaust gas, swampy, natural gas (-2)^
Sample ID: DDG Pellet	728147	24/11/2020 11:37	5456	25/11/2020 12:24	4	8	Nil	2300	2300	Yeast, baking bread, herbs, powdered cheese, vegemite, bitter (1)^

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Odour Olfactometry Results – 7116/ORLA/01

Sample				Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Starch Dryer 5	728148	24/11/2020 13:30	5457	25/11/2020 13:55	4	8	Nil	390	390	Wet towel, musty, mould, mushroom, yeast, baking bread, dirty socks, coal, oil, plastic, paint (-1)^
Sample ID: Biofilter A East outlet	728149	24/11/2020 13:37	5458	25/11/2020 14:25	4	8	Nil	1200	1200	Smelly sandshoes, smelly socks, garbage, septic, dirt, soil, plastic paint, vinegar, sour, tannin from decayed vegetable matter and mangroves (-3)^
Sample ID: Biofilter B East outlet	728150	24/11/2020 15:32	5459	25/11/2020 14:53	4	8	Nil	2000	2000	Garbage, smelly socks, sewerage, methylated spirits, rotten vegetables, faeces, decomposed matter, tyres (-3)^
Sample ID: Biofilter A West outlet	728151	24/11/2020 16:32	5460	25/11/2020 15:22	4	8	Nil	1680	1680	Decomposing starch, garbage, yeast, rotten vegetables, faeces, coal, tar, roadworks (-3)^
Sample ID: Biofilter B West outlet	728152	24/11/2020 16:15	5461	25/11/2020 15:51	4	8	Nil	1830	1830	Decomposing vegetation, ammonia,faeces, garbage, stinky socks, rubber, coal, tar (-3)^
Sample ID: Bio inlet DDG Evap. 1,2,3	728153	24/11/2020 14:16	5462	25/11/2020 17:23	4	8	Nil	9500	9500	Cocoa, chocolate, coffee, cereal, wheat, green wheat, corn bread, squishy rubber toys (1)^

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Odour Olfactometry Results – 7116/ORLA/01

Sample				Analysis Date/Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1 *	(ou) 2 *	
Sample ID: Bio inlet DDG Evap. 4	728154	24/11/2020 15:02	5463	25/11/2020 17:27	4	8	Nil	70400	70400	Compost, wheat, plastic playdough (-2)^
Sample ID: Pond 1	728155	07/12/2020 15:00	5465	08/12/2020 10:25	4	8	Nil	360	360	Earthy, mushrooms, yoghurt, yeast, vegemite, dirty, floral, creek, chicken salt, 2-minute noodles, slight motor oil (-1)^
Sample ID: Pond 3	728156	07/12/2020 16:13	5466	08/12/2020 11:13	4	8	Nil	280	280	Earthy, grass, mushrooms, corn, very faint sharp musty odour, styrofoam, 2-minute noodles, plastic (-1)^
Sample ID: Pond 5	728157	07/12/2020 17:38	5467	08/12/2020 11:49	4	8	Nil	63	63	Grain, tobacco leaf, earthy, coffee, mushroom, powered beef stock, decomposing logs, wood, wet forest, air from rubber tube, slight plastic (-2)^
Sample ID: Pond 6	728158	07/12/2020 18:19	5468	08/12/2020 12:22	4	8	Nil	38	38	Dry grass, reeds, dirt, decaying wet wood, earthy, mushrooms, bark, drain water with unperfumed soap (-2)^
Sample ID: SO Basin	728159	07/12/2020 20:00	5469	08/12/2020 14:17	4	8	Nil	63	63	Musty, stale, sports shoes, vinegar, peppermint, sweet dried tobacco, menthol cigarettes, dirt, pen ink (1)^

Odour Research Laboratories Australia

Odour Panel Calibration Results – 7116/ORLA/01

Reference Odorant	ORLA Sample No.	Date	Concentration of Reference Gas (ppm)	Reference Gas Measured Concentration (ou)	Panel Average Measured Concentration (ppb) [3]	Does panel calibration measurement comply with AS/NZS4323.3:P2001 (Yes/No) [4]
n-butanol	5441	19/11/2020	62.0	1236	50.2	Yes
n-butanol	5452	25/11/2020	62.0	1264	49.1	Yes
n-butanol	5464	08/12/2020	62.0	1269	48.9	Yes

Comments: All samples were collected by Stephenson Environmental Management Australia and analysed by Odour Research Laboratories Australia at their Sydney Laboratory.

Notes from Odour Olfactometry Results:

[1] Sample Odour Concentration: as received in the bag

[2] Sample Odour Concentration: allowing for pre-dilution

[3] Panel Average Measured Concentration: indicates the sensitivity of the panel for the session completed

[4] Target Range for reference gas n-butanol is $20 \leq \chi \leq 80$ ppb and compliance with AS/NZ4323.3:2001 is based on the individuals rolling average and not on the panel average measured concentration.

Panellist Rolling Average:

19/11/2020: SR = 46.9, PR = 61.3, MB = 54.1, JW= 42.4

25/11/2020: SR = 46.9, PR = 59.3, TL = 31.1, JW = 43.8, MB = 52.4

08/12/2020: SR = 48.5, PR = 57.3, TL = 31.1, JW = 45.3, MB = 51.8

^ denotes the Average Hedonic Tone: describes the pleasantness of the odour being presented where (+5) represents Very Pleasant, (0) represents Neutral and (-5) represents Very Unpleasant and has been derived from the panellist responses at the recognition threshold.

+ This value is not part of our NATA Scope of Accreditation and AS4323.3

--END OF TEST REPORT--

APPENDIX C – DETAILS OF INSTRUMENT CALIBRATION

TABLE C- 1 INSTRUMENT CALIBRATION DETAILS DAY 1

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	19-Oct-20	19-Apr-21
920	Thermocouple	19-Oct-20	19-Apr-21
805	Thermocouple	19-Oct-20	19-Apr-21
815	Digital Manometer	13-Nov-20	13-Nov-21
726	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	combustion analyzer	02-Sep-20	02-Mar-21
835	Personal Sampler	26-Feb-20	26-Feb-21
832	Personal Sampler	26-Feb-20	26-Feb-21
753	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	16-Nov-20	16-Nov-21
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C- 2 INSTRUMENT CALIBRATION DETAILS DAY 2

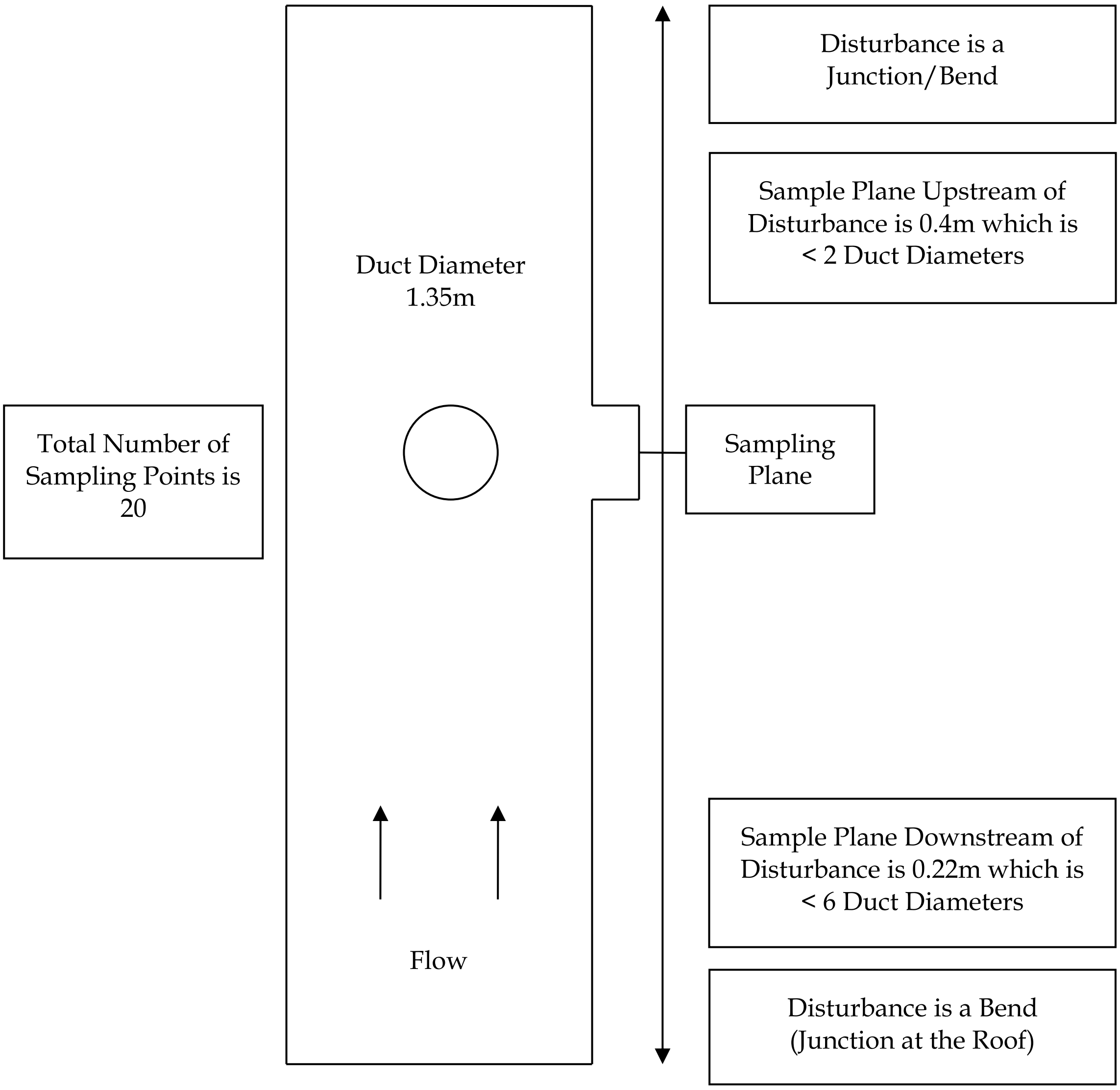
SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	19-Oct-20	19-Apr-21
920	Thermocouple	19-Oct-20	19-Apr-21
805	Thermocouple	19-Oct-20	19-Apr-21
815	Digital Manometer	13-Nov-20	13-Nov-21
726	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	combustion analyzer	02-Sep-20	02-Mar-21
835	Personal Sampler	26-Feb-20	26-Feb-21
832	Personal Sampler	26-Feb-20	26-Feb-21
753	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	16-Nov-20	16-Nov-21
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C- 3 INSTRUMENT CALIBRATION DETAILS DAY 3

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	19-Oct-20	19-Apr-21
605	Thermocouple	19-Oct-20	19-Apr-21
607	Thermocouple	19-Oct-20	19-Apr-21
753	Personal Sampler	12-Mar-20	12-Mar-21
835	Personal Sampler	26-Feb-20	26-Feb-21
613	Barometer	16-Nov-20	16-Nov-21

APPENDIX D – SAMPLE LOCATIONS

FIGURE D-1 GLUTEN DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC



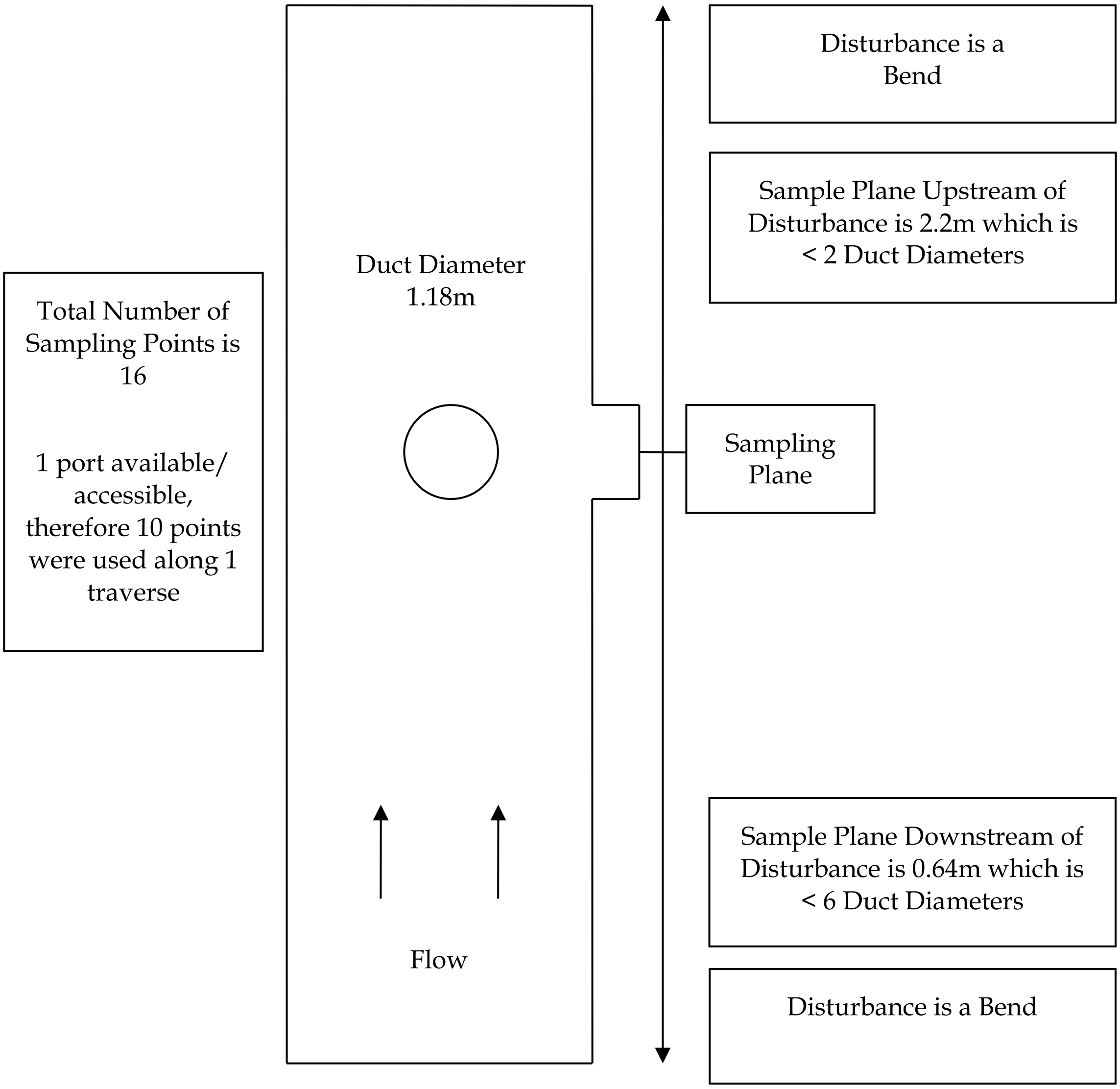
In the absence of cyclonic flow activity ideal sampling plane positions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane would most likely comply with AS4323.1 temperature, velocity and gas flow profile criteria for sampling; once the sampling ports are replaced in the new duct work.

FIGURE D-2 GLUTEN DRYER NO. 1 – SAMPLE LOCATION

FIGURE D-3 GLUTEN DRYER NO. 2 –SAMPLE LOCATION SCHEMATIC



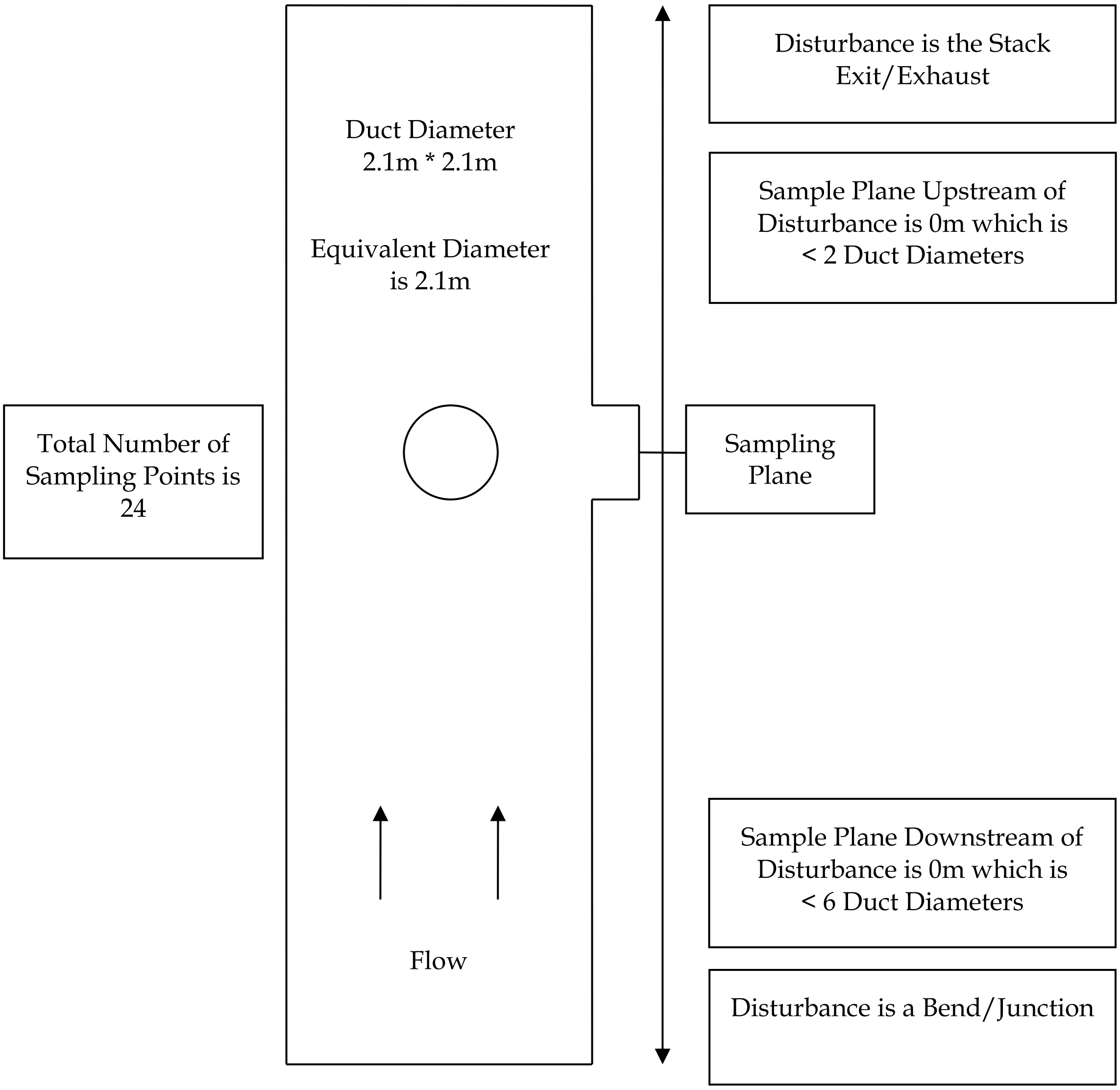
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the interim exit sampling plane complies with AS4323.1 temperature and AS4323.3 odour criteria for sampling.

FIGURE D-4 GLUTEN DRYER NO. 2 – ODOUR SAMPLE LOCATION AT DUCT EXIT

FIGURE D-5 GLUTEN DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC



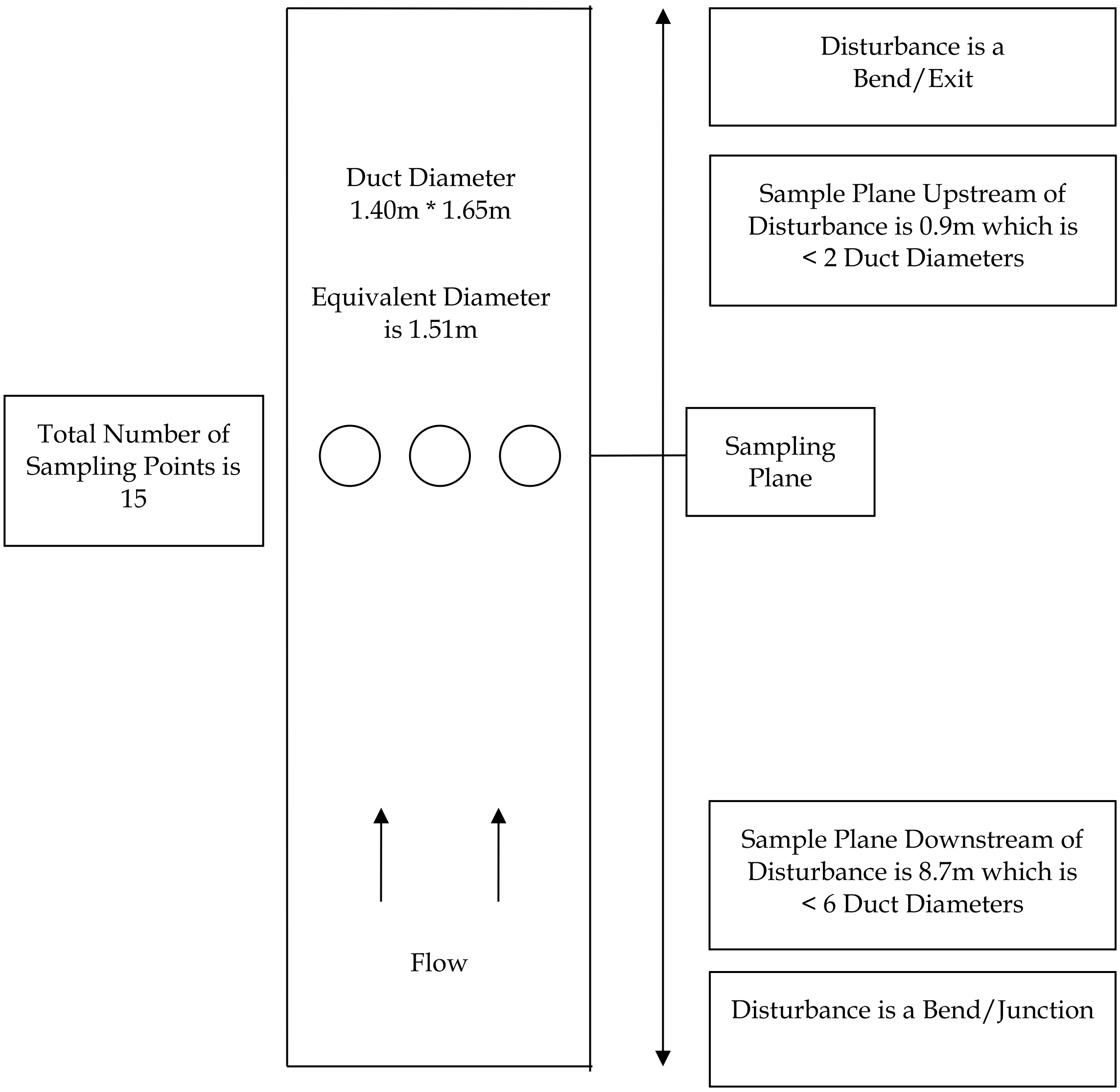
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of minimum velocity profile not meeting the minimum 3 metres per second (m/s) at every sampling point. Previous Minimum (0.8 m/s), Current Minimum (0 m/s).

FIGURE D-6 GLUTEN DRYER NO. 3 – SAMPLE LOCATION

FIGURE D-7 GLUTEN DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC



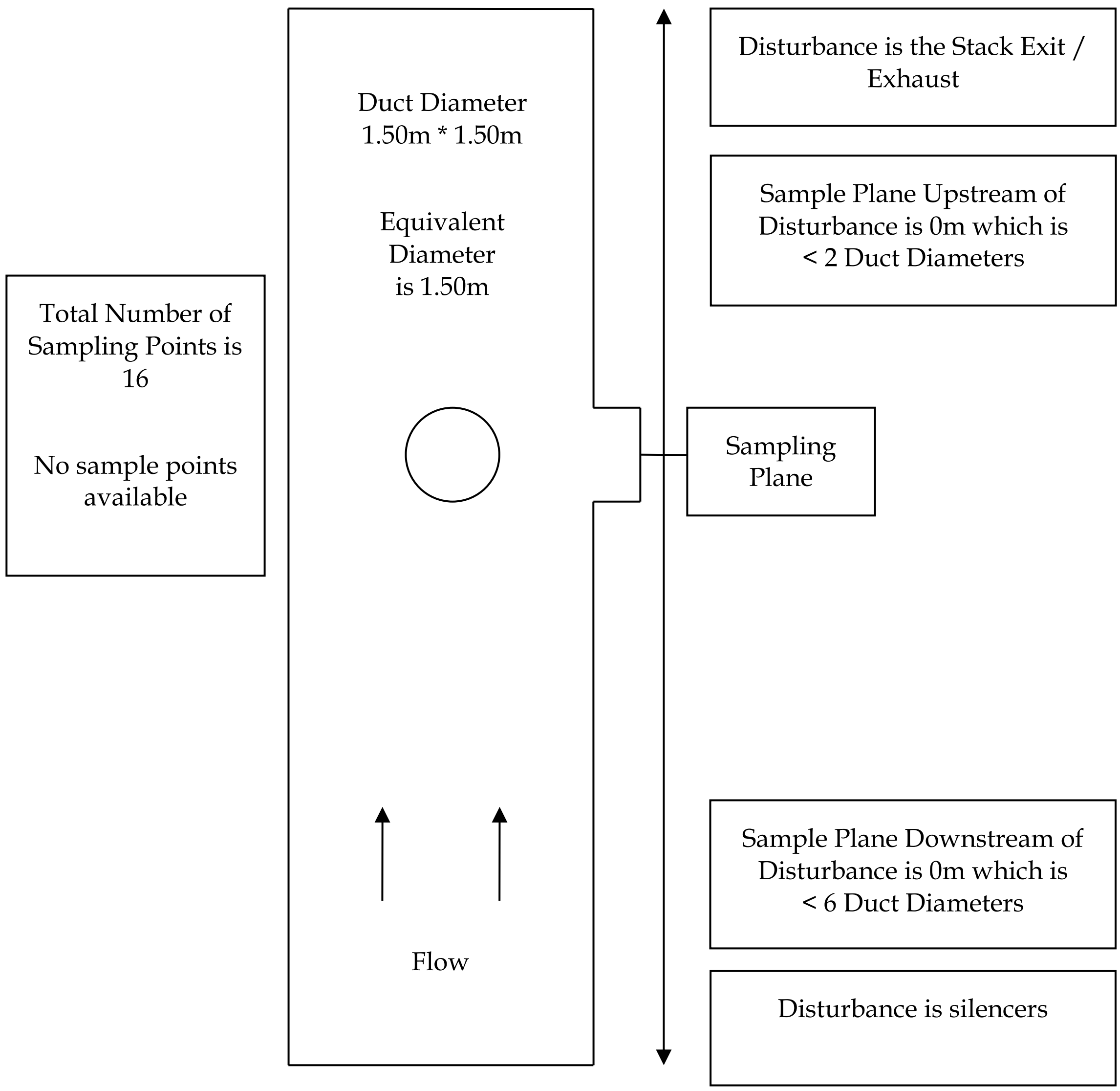
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane does meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-8 GLUTEN DRYER NO. 4 – SAMPLE LOCATION

FIGURE D-9 STARCH DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC



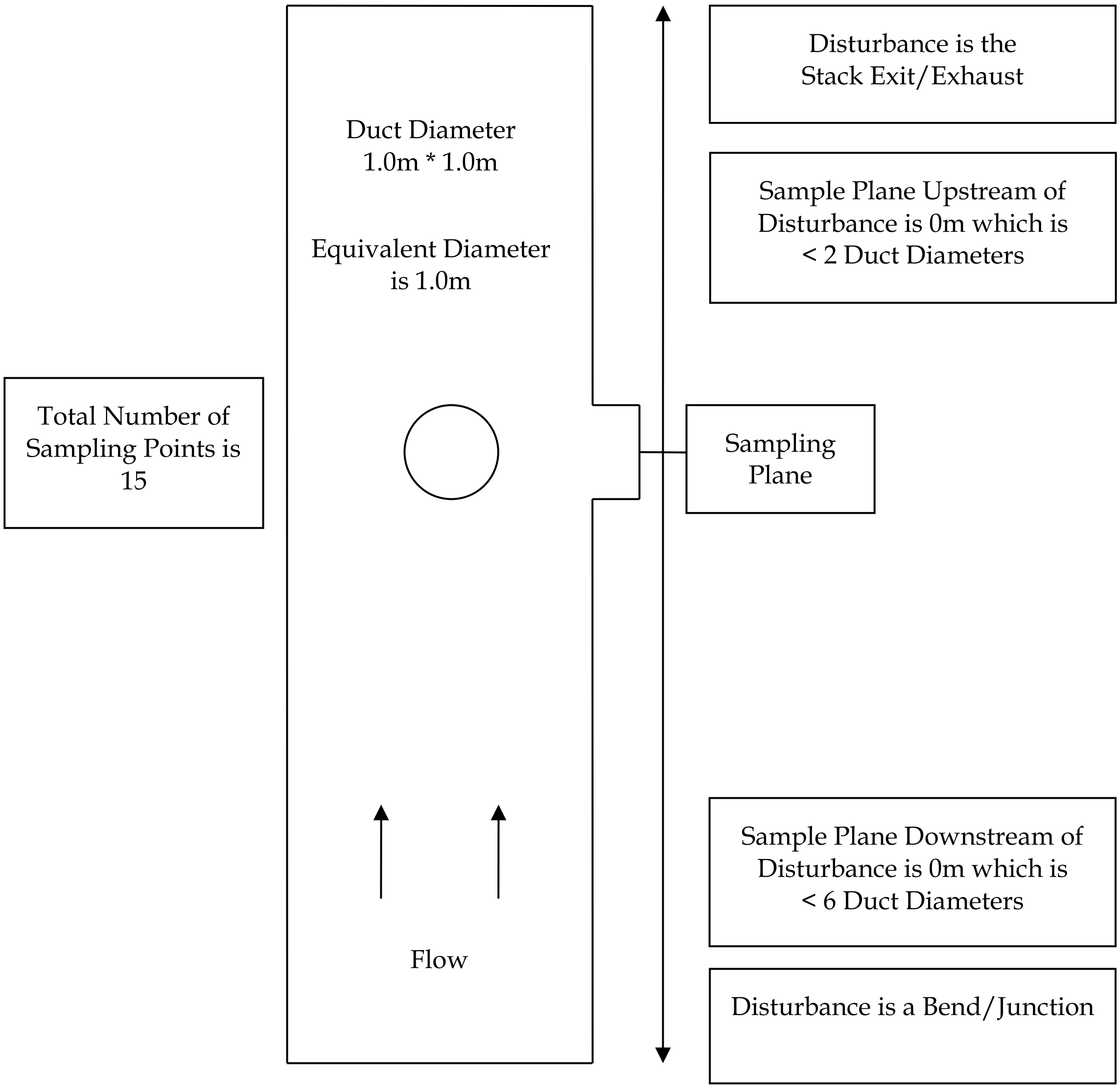
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-10 STARCH DRYER NO. 1 – SAMPLE LOCATION

FIGURE D-11 STARCH DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC



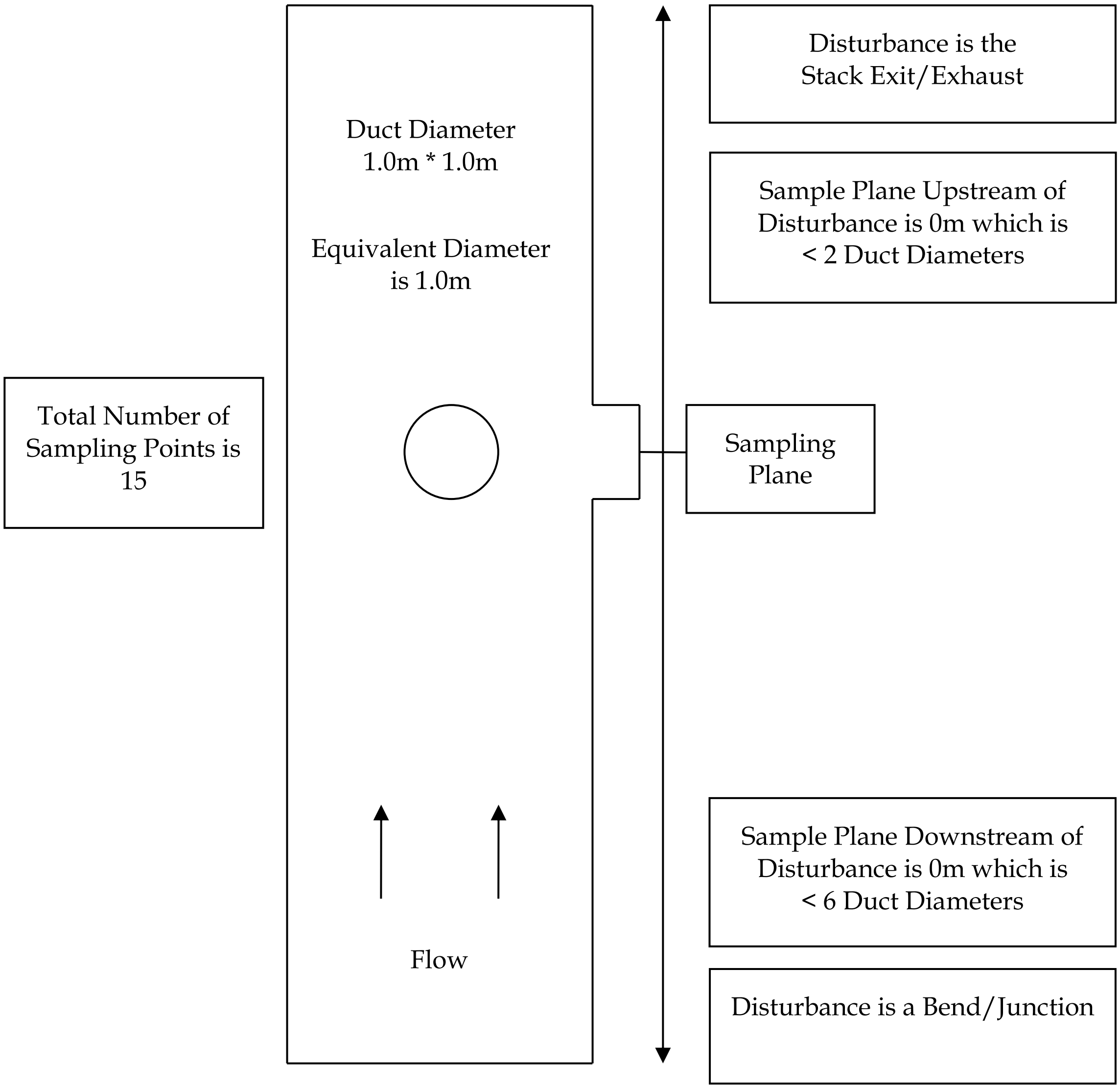
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-12 STARCH DRYER NO. 3 – SAMPLE LOCATION

FIGURE D-13 STARCH DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC



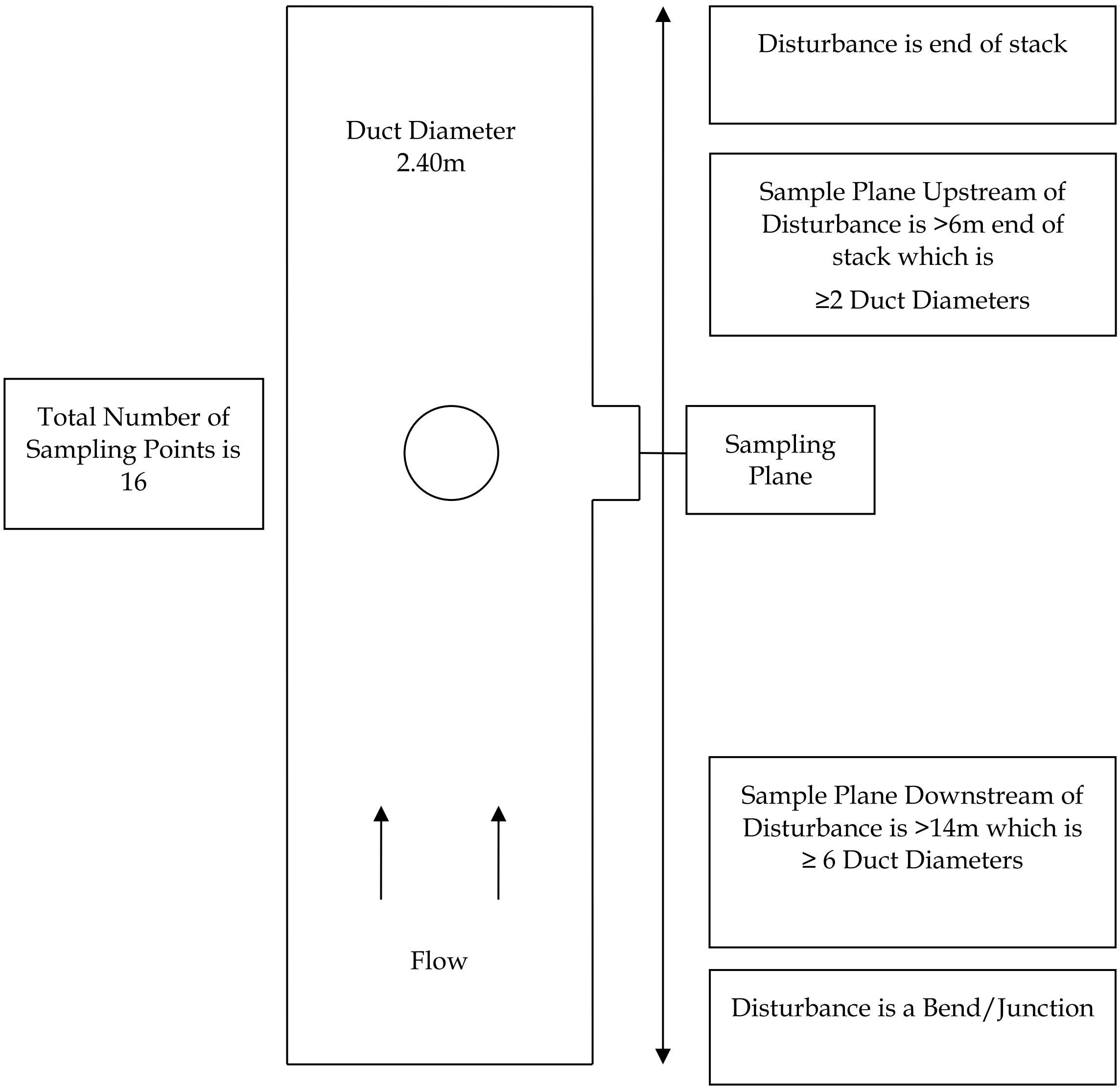
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-14 STARCH DRYER NO. 4 – SAMPLE LOCATION

FIGURE D-15 STARCH DRYER NO. 5 – SAMPLE LOCATION SCHEMATIC

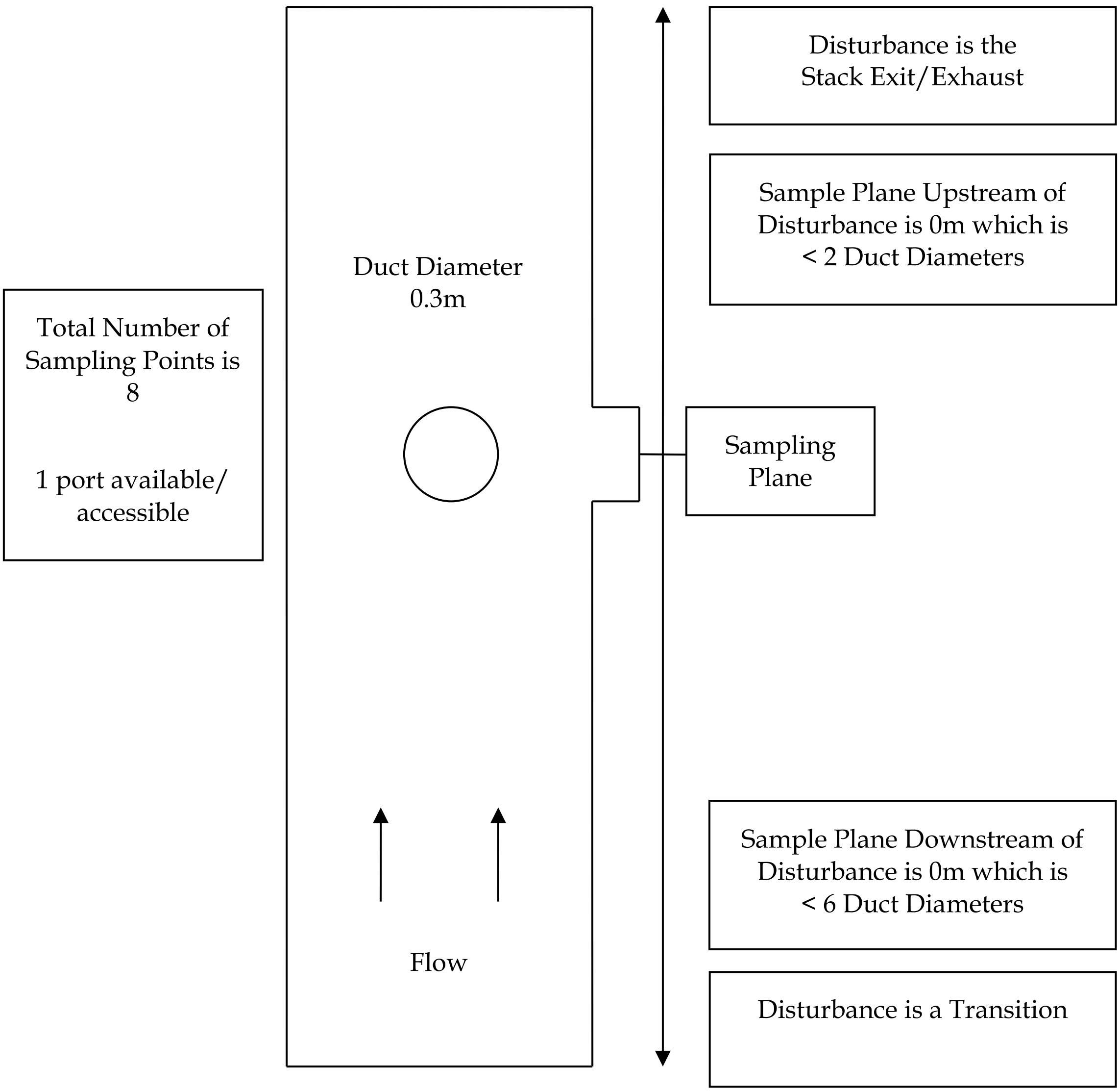


In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does meet this criterion. .

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-16 STARCH DRYER NO. 5 – SAMPLE LOCATION

FIGURE D-17 FERMENTERS – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

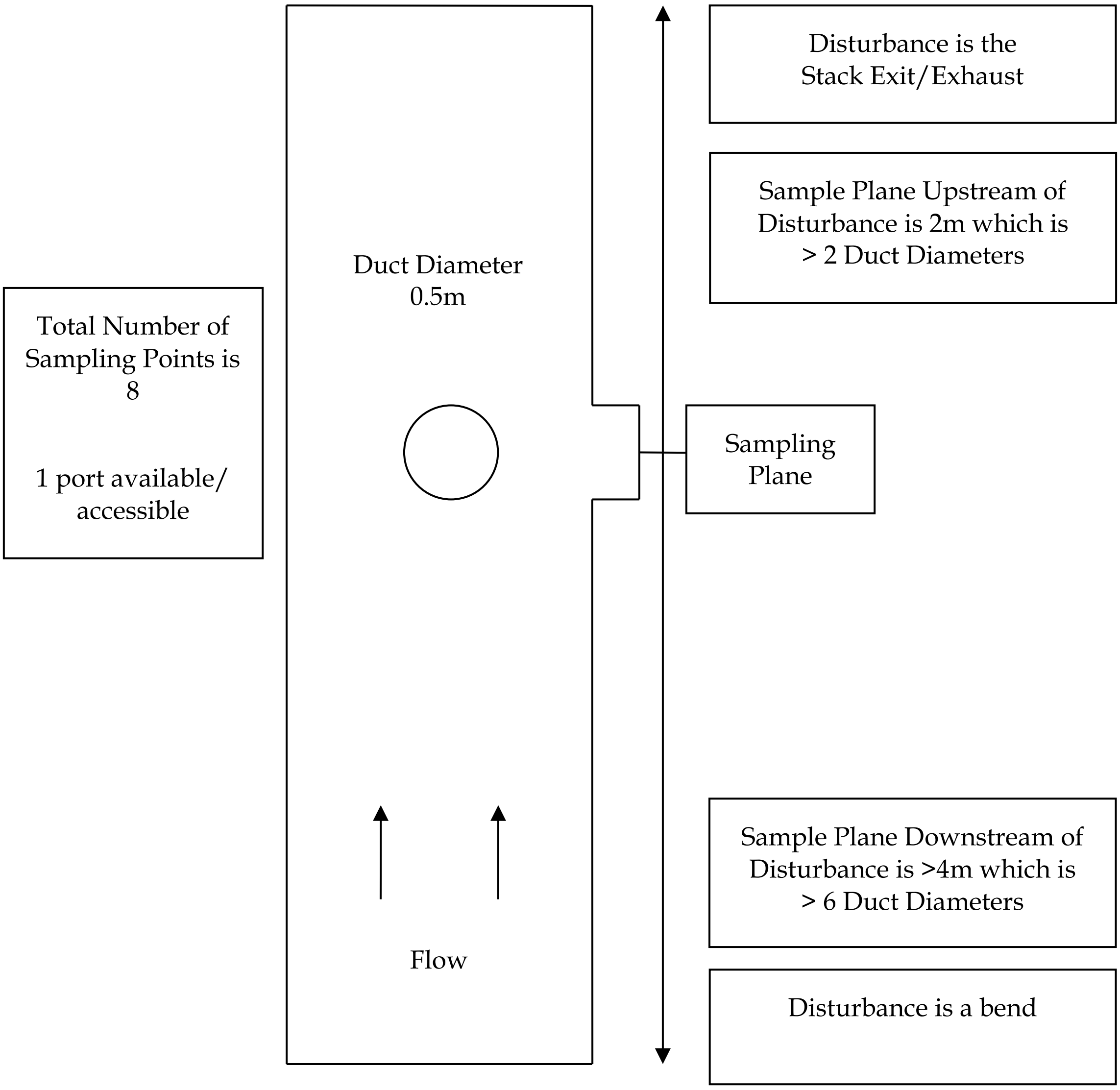
However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The sample location also does not meet the minimum number of access holes available.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of the velocity profile not meeting the minimum 3 metres per second (m/s) at any sampling point. Previous measurements were Average (0.9 m/s), maximum (1.1 m/s) and minimum (0.8 m/s) velocity profile. Current measurements are Average (1.7 m/s), maximum (3.5 m/s) and minimum (0 m/s) velocity profile.

FIGURE D-18 FERMENTERS – SAMPLE LOCATION

FIGURE D-19 CO_2 SCRUBBER OUTLET – SAMPLE LOCATION SCHEMATIC

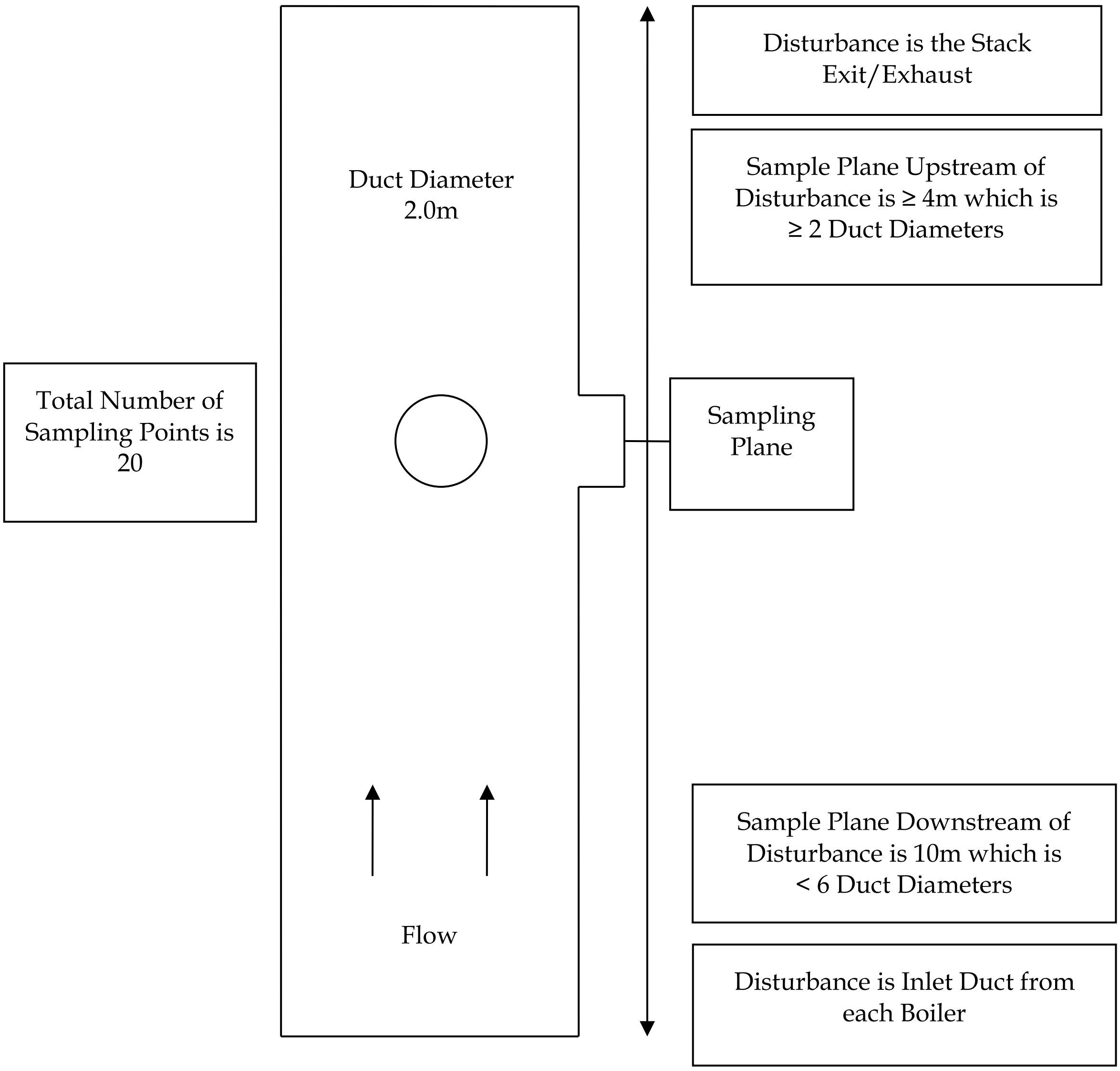


In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does meet this criterion.

The sample location does not meet the minimum number of access holes available.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-20 BOILER NOS. 5 & 6 – SAMPLE LOCATION SCHEMATIC



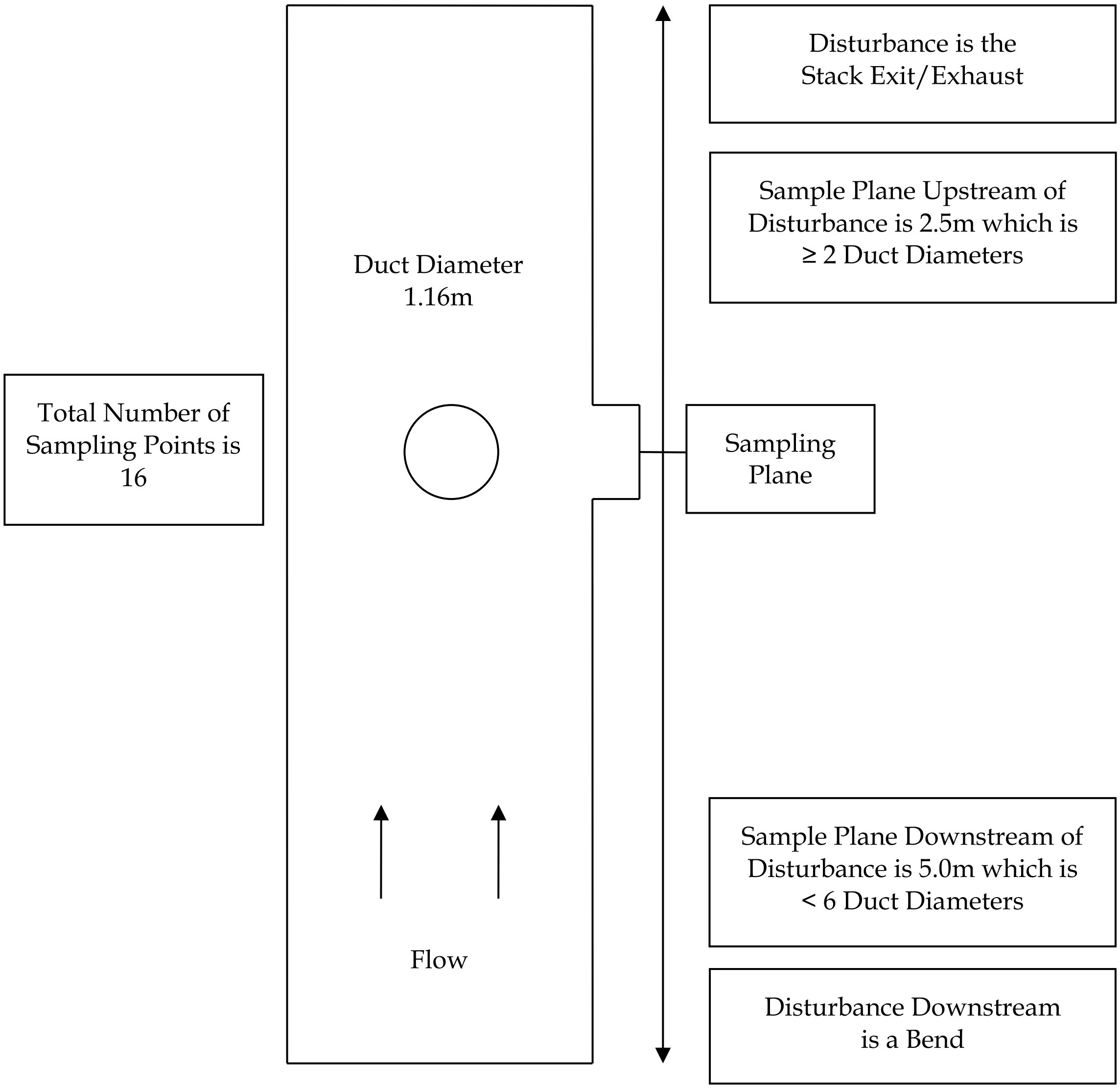
In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-21 BOILER NOS. 5 & 6 – SAMPLE LOCATION

FIGURE D-22 BOILER NO. 4– SAMPLE LOCATION SCHEMATIC



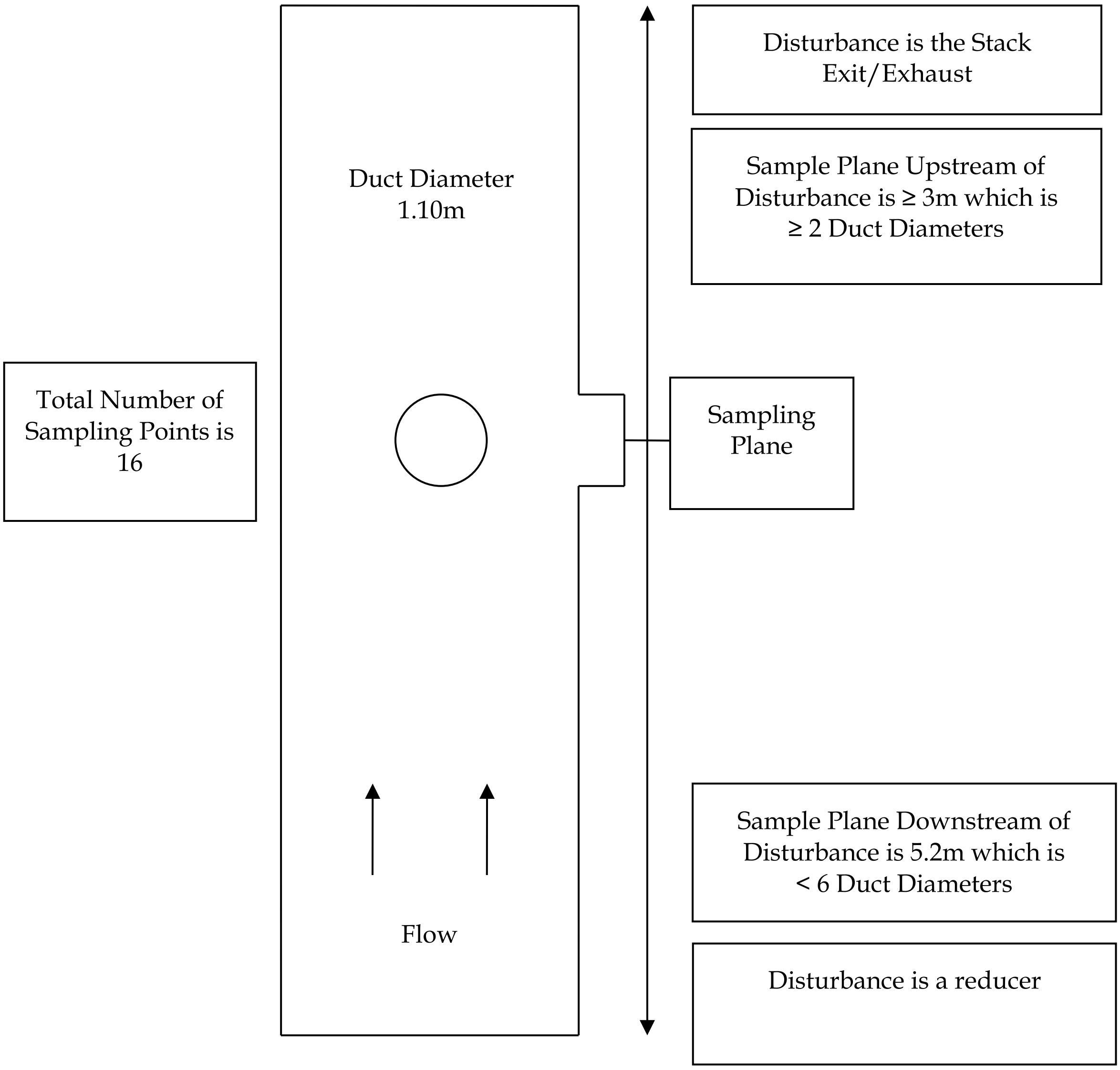
In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-23 BOILER NO 4 – SAMPLE LOCATION

FIGURE D-24 BOILER NO 2 – SAMPLE LOCATION SCHEMATIC

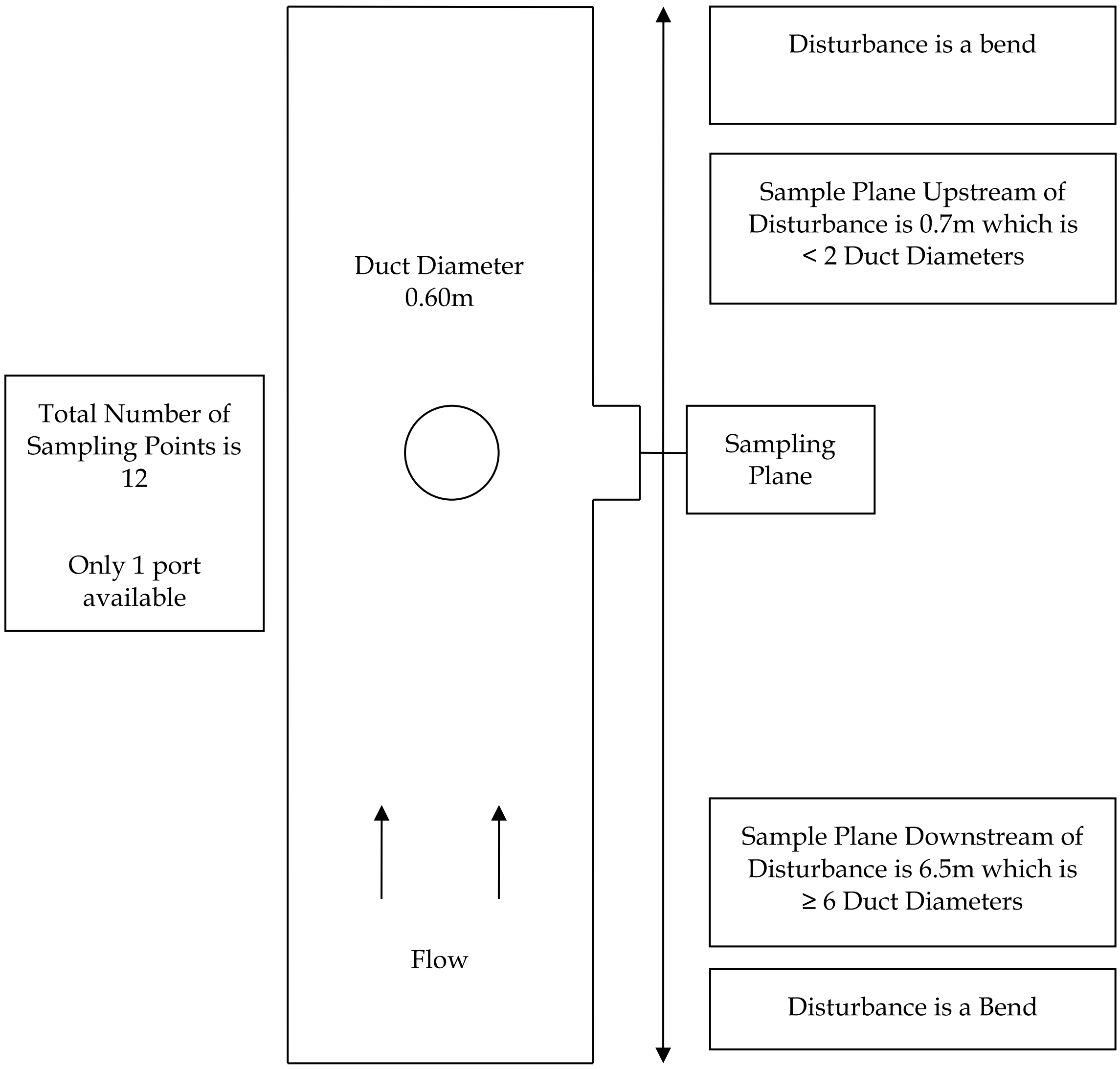


In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-25 BIOFILTER INLET – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

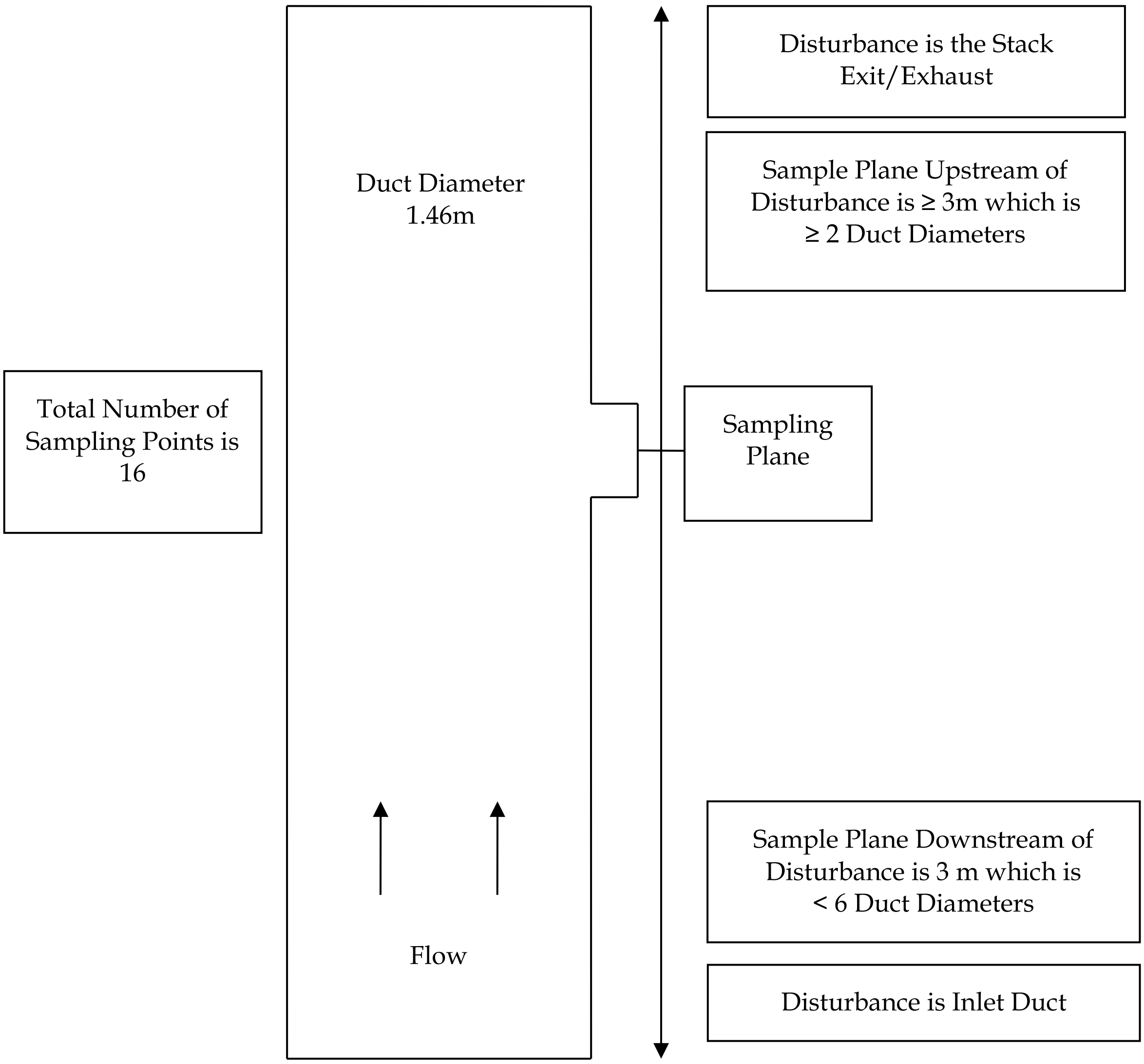
The sample plane also does not meet the minimum number of access points required. Additional sample points were used in compliance with AS4323.1.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of velocity meeting the minimum velocity of 3m/s at every sampling point. Maximum = 5.2 m/s, Average = 2.4 m/s, Minimum = 1.0 m/s.

FIGURE D-26 BIOFILTER OUTLET EAST EPL ID 40 & 41 – SAMPLE LOCATION

FIGURE D-27 BIOFILTER OUTLET WEST EPL ID 41 – SAMPLE LOCATION

FIGURE D-28 DDG PELLET PLANT STACK – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-29 DDG PELLET PLANT STACK – SAMPLE LOCATION PHOTOGRAPH

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→ The Power of Commitment

Shoalhaven Starches Modification 23 – gas fired co-generation

Air Quality Assessment

Manildra Group

19 January 2022

→ **The Power of Commitment**

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4	3	N Spurrett	E Smith, P Pandey		E Smith		01/09/2021
4	4	N Spurrett	E Smith		E Smith		19/01/2022

Contents

1.	**Introduction**		**1**
	1.1	Overview	1
	1.2	Background	1
	1.3	Current proposal: Modification 23	4
	1.4	Scope	4
	1.5	Assumptions	5
	1.6	Report structure	5
	1.7	Limitations	5
2.	**Site location and context**		**7**
	2.1	Site description	7
	2.2	Nearby sensitive receptors	7
3.	**Operation description**		**11**
	3.1	General overview	11
	3.2	Flour mill	11
	3.3	Starch plant	11
	3.4	Glucose plant	12
	3.5	Ethanol and distillation plants	12
	3.6	DDG plant	12
	3.7	Steam production	12
	3.8	Environmental farm	12
	3.9	Packing plant (proposed)	13
	3.10	Other activities	13
		3.10.1 Product load-out areas	13
		3.10.2 Cooling towers	13
		3.10.3 Biofilters	13
	3.11	Proposed modifications	14
		3.11.1 Mod 11, 12, 13, 16, 17, 19 and 21	14
		3.11.2 Mod 23	14
4.	**Criteria for assessment**		**16**
	4.1	Odour	16
		4.1.1 Odour Concentration	16
		4.1.2 Measurement of Odour	16
		4.1.3 EPA Criterion for Odour	16
		4.1.4 Other air quality impacts	17
5.	**Meteorological data**		**19**
	1.1	Overview	19
	1.2	Meteorological modelling	19
		1.2.1 Representative year discussion	20
6.	**Background air quality**		**22**
7.	**Odour assessment**		**24**
	7.1	Emissions inventory	24
		7.1.1 Source identification	24
		7.1.2 Changes to baseline odour model	24

7.1.3 Source summary and comparison 25
7.2 Dispersion modelling 31
7.3 Predicted odour impacts 31
8. Air quality assessment 34
8.1 Emissions inventory 34
8.1.1 Boiler emissions 34
8.1.2 Product dryer emissions 37
1.2.2 Gas cogeneration turbines 37
8.1.3 Other emission sources 37
8.2 Dispersion modelling 44
8.3 Predicted air quality impacts 44
8.3.1 Particulates 44
8.3.1.1 Incremental particulate matter 44
8.3.1.2 Cumulative particulate matter 45
8.3.2 Products of combustion 50
8.3.3 PAH, VOCs and metals 54
9. Conclusions 57
A1 Meteorology 60
A1.1 Data Available 60
A1.2 Data Application 60
A2 Prognostic Meteorological Modelling 60
A2.1 Wind Distribution 61
A3 Diagnostic Meteorological Model - CALMET 64
A3.1 Site-specific meteorology 64

Table index

Table 1.1 Summary of recent proposed modifications on site (2015-2020) 2
Table 2.1 Location of identified sensitive receptors 8
Table 4.1 Odour criterion for the assessment of odour 16
Table 4.2 Air quality impact assessment criteria – other pollutants 18
Table 6.1 Background Air Quality Data – Albion Park South (2016) 22
Table 6.2 Review of particulate monitoring at Albion Park South and Wollongong, $\mu g/m^3$ 23
Table 7.1 Comparison of odour emissions from previous mods to current mod 26
Table 7.2 Predicted peak (99th percentile, short term averaged) odour impact at nearby receptors 32
Table 8.1 Modification 23 boiler and cogeneration operational details 36
Table 8.2 Emission inventory – Particulate matter 37
Table 8.3 Emission inventory – Products of combustion (typical operations) 40
Table 8.4 Emission inventory – Products of combustion (maintenance scenario) 42
Table 8.5 Maximum predicted incremental ground level PM_{10}, $PM_{2.5}$ and TSP concentrations ($\mu g/m^3$) 44
Table 8.6 Maximum predicted cumulative ground level PM_{10}, $PM_{2.5}$ and TSP concentrations ($\mu g/m^3$) 45
Table 8.7 Composition of 24 hour PM_{10} exceedances at C6 46
Table 8.8 Maximum predicted ground level Sulfur Dioxide concentrations (typical operations) 51
Table 8.9 Maximum predicted ground level Sulfur Dioxide concentrations (maintenance scenario) 51

Table 8.10	Maximum predicted ground level Nitrogen Dioxide concentrations (typical operations)	52
Table 8.11	Maximum predicted ground level Nitrogen Dioxide concentrations (maintenance scenario)	52
Table 8.12	Maximum predicted ground level Carbon Monoxide concentrations (typical operations)	53
Table 8.13	Maximum predicted ground level Carbon Monoxide concentrations (maintenance scenario)	53
Table 8.14	Maximum predicted ground level PAH, VOC and metals concentrations (typical operations)	55
Table 8.15	Maximum predicted ground level PAH, VOC and metals concentrations (maintenance scenario)	56
Table A.9.1	Atmospheric Stability Classes and Distribution	67
Table B.1	Complete odour emission inventory (Mod 23)	70

Figure index

Figure 2.1	Site context	9
Figure 2.2	Site location and layout	10
Figure 3.1	Site layout and major odour sources	15
Figure 4.1	Factors for estimating peak concentrations (Extract from NSW Approved Methods)	17
Figure 5.1	CALMET wind rose for the factory	20
Figure 5.2	Comparison of site weather station observations and CALMET meteorological	21
Figure 7.1	Odour impacts, 99th percentile, short term averaged – Modification 23	33
Figure 8.1	Maximum Predicted Incremental Ground Level PM10 Concentrations (24-hour Average, Mod 23 typical operations)	47
Figure 8.2	Maximum Predicted Cumulative Ground Level PM10 Concentrations (24-hour Average, Mod 23 typical operations)	48
Figure 8.3	Maximum Predicted Cumulative Ground Level PM2.5 Concentrations (24-hour Average, Mod 23 typical operations)	49
Figure A1	Scatter Plot of Observed and Predicted Ambient Temperature	61
Figure A2	Nowra AWS - Annual Wind Roses (Year 2004)	62
Figure A3	Farm AWS - Annual Wind Roses (year 2004)	63
Figure A4	Wind Speed Distribution – TAPM and Farm AWS	64
Figure A5	Factory Annual Wind Rose - Year 2004	65
Figure A6	Factory Seasonal Wind Roses - Year 2004	66
Figure A7	Factory Annual Stability Rose - Year 2008	68

Appendices

Appendix A	Meteorological analysis
Appendix B	Complete odour emission inventory
Appendix C	Site sampling reports
Appendix D	GE Power manufacturer design specifications and emissions guarantees for proposed gas-fired co-generation plant

1. Introduction

1.1 Overview

GHD was engaged by Shoalhaven Starches Pty Ltd (Manildra) to conduct an air quality impact assessment for a proposed modification to the approved Shoalhaven Starches Expansion Project (SSEP) (Modification 23 or Mod 23). The Shoalhaven Starches factory is located at Bolong Road in Bomaderry, New South Wales.

This report describes the background and scope of the proposed modifications, the pollutant inventory for odorous and non-odorous emission sources and the predicted air quality impacts at identified sensitive receptors.

1.2 Background

Flour and grains are processed at the factory to produce ethanol, starch, gluten, glucose and distiller's dried grain (DDG). Shoalhaven Starches is the holder of Environment Protection Licence number 883 issued for the plant by the NSW EPA.

The Shoalhaven Starches Bomaderry plant currently produces around 225 million litres (ML) of ethanol per year (production quantity fluctuates year to year based on demand). On 28 January 2009 the (then) Minister for Planning issued Project Approval MP 06_0228 for the Shoalhaven Starches Expansion Project. The Project Approval for the SSEP enabled Shoalhaven Starches, subject to certain conditions, to increase ethanol production in a staged manner at its Bomaderry Plant from the previous approved level of 126 million litres per year to 300 million litres per year. Following the Minister's determination Shoalhaven Starches have been implementing and commissioning works in accordance with this approval. Work on the change in operations has been completed, coupled to quarterly testing (independent audits) of emissions from licensed discharge points (a condition of the Licence), with the purpose to validate the predicted impacts against the original predictions in 2008 for the ethanol expansion.

The increase in ethanol production associated with the SSEP Project Approval was made in response to the NSW Government's ethanol mandate which increased the mandated ethanol content by volume in petrol in NSW from 2% to 6% in October 2011. The SSEP sought to increase ethanol production capacity at the Shoalhaven Starches site to meet the expected increase in demand for ethanol arising from this site. The increase in ethanol production required upgrades to the Stillage Recovery Plant including six additional Dried Distillers Grains Syrup (DDGS) dryers.

However, the anticipated increase in demand for ethanol has not occurred. In response, Manildra have undertaken a series of modifications to the site with a focus on exploring alternative options. These are summarised in Table 1.1.

Modifications 11, 12, 13, 16,17, 19 and 21 were assessed by GHD in the following documents:

– Shoalhaven Starches expansion project – Modification 11 and 12 (Project approval MP_06_0228) Revised odour and air quality assessment (GHD 2017)
– Shoalhaven Starches Mod 13 Air Quality Assessment Cumulative odour assessment (GHD 2017)
– Shoalhaven Starches Mod 13 Air Quality Assessment Updated Cumulative Air Quality Assessment (GHD 2017).
– Shoalhaven Starches Proposed modification application MP 06_0228 Shoalhaven Starches Expansion Project, Proposed new speciality processing facility, new gluten dryer and other associated works at 22, 24 and 171 Bolong Rd, Bomaderry, NSW (Mod 16) (GHD, February 2019).
– Manildra Group Air Quality Assessment Mod 17, 2019 (GHD, 2020)
– Manildra Modification 19 Air Quality Assessment (GHD, 2020)
– Shoalhaven Starches Modification 21 – Proposed Modification to Packing Plant and other works, Air Quality Assessment (GHD, 2021)

Modification 14 did not require an air quality assessment. Modification 15 was separately assessed by GHD for SupaGas in 2017.

Table 1.1 Summary of recent proposed modifications on site (2015-2020)

Modification	Summary of changes
Modification 11	– Reducing the number of approved DDGS Dryers from six to four. – A minor modification to the footprint of the four DDG dryers. – Relocation of the cooling towers in the DDG Plant. – A Mill Feed Silo and structure to feed DDG dryers. – Expanded use of the existing coal and woodchip storage area within the SS Environmental farm. – The addition of two biofilters to cope with the increased number of DDG Dryers. – A forklift maintenance building adjacent to the relocated DDG dryers, along with a container preparation area adjacent to the relocated DDG Dryers.
Modification 12	Modifications to the existing Ethanol Distillery Plant to: – increase the proportion of 'beverage" grade ethanol that is able to be produced on the site. This modification will enable increased flexibility in terms of the range of types of ethanol produced at the site (i.e. between fuel, industrial and beverage grade ethanol) to meet market demands; and – modify the type and location of the Water Balance Recovery Evaporator that has been previously approved under MOD 2 adjacent to the Ethanol Plant.
Modification 13	– Modification of boilers 2 and 4, with the conversion of boiler 4 from gas fired to coal fired. – Installation of an additional baghouse on boiler 6.
Modification 14	– Modifications to the former paper mill site.
Modification 15	– Construction of the SupaGas CO2 plant at the former Dairy Farmers factory site.
Modification 16/17	Modification 16 comprised of the following: – Installation of a third flour mill C within the existing flour mill B building – Undertaking modifications to flour mills A and B – The construction of a new industrial building adjoining the Starch Dryer No. 5 building containing: – The new product dryer – Plant and equipment associated with the processing of specialized speciality products. – Addition to Starch Dryer No 5 building to house a bag house for this dryer – Conversion of two existing gluten dryers (1 and 2) to starch dryers – Additional sifter for the interim packing plant – Construction of a coal-fired co-generation plant to the south of the existing boiler house complex. The co-generation plant will house a new boiler (No. 8) – Construction of lime silos: The lime injection system will consist of two storage silos and associated equipment for injecting powdered lime into each of the coal fired boilers – Relocation of the existing boiler No. 7 to the northern side of the overall boiler house complex – Construction of an indoor electrical substation on the northern side of Bolong Road – Construction of an additional rail intake pit for the unloading of rail wagons – Extension of the existing electrical substation located within the main factory area. Modification 17 comprised of the following: – Modification to the location of the baghouse for the No. 5 Starch Dryer. As part of this baghouse relocation, an additional stack was added to starch dryer 5. – Use of sawmilling residue (woodchips) for boiler fuel by blending woodchip with coal in Boilers 2 & 4 – Installation of a new product dryer (No. 9) within the footprint of the speciality products building as approved under Mod 16. – To install a 'services lift' to the outside of the existing staircase adjacent to the No. 5 Starches Dryer Building to allow on-going access for personnel and customers to the floors within the building

Modification	Summary of changes
	– Modification of the service conduit extending from the Shoalhaven Starches factory site on the southern side of Bolong Road to the proposed Packing Plant on the northern side of Bolong Road by elevating a section of the conduit above ground level – Amendment to design specifications for silencers to exhaust fans for Flour Mill B – Extension of the approved footprint for the product dryer building. The building will need to be wider than the one that has been approved – Installation of a wet end processing plant within the product dryer building – Extension of speciality products building to the north to provide bulk chemical storage to the south of the product dryer building – Demolition of existing stores and maintenance offices building – Repurposing the existing maintenance building – Changes to car parking arrangements.
Modification 18	Modification 18 comprised of the following: – Produce 120 ML/yr of hand sanitiser grade ethanol within the approved 300 ML/yr production limit – Repurposing of existing de-fatting building for the manufacturing of 1.5 ML/yr hand sanitiser – Relocation of approved, but not yet built gas fired boiler to be adjacent to ISO container storage area to the south east of the site to better service the existing distillery – New 24.5 m high boiler emissions stack – Extension of existing gantry and associated steam pipework between gas fired boiler and distillery for steam supply – Additional pipework to increase height of gantry from 9.75 m to 10.8 m – Erection of two 236,000 litre storage tanks for hand sanitiser storage – repurposing of de-fatting plant for hand sanitiser production storage
Modification 19	Modification 19 comprised of the following: – The installation of distillation columns and associated processing equipment immediately to the west of the existing Ethanol Distillery Plant. The proposed plant and equipment is of similar design, size and operation to the existing Beverage Grade Ethanol modification approved under Mod 12. – An additional three (3) ethanol storage tanks within the existing ethanol storage tank area. – The distillery modification in the proposed location will require a boundary adjustment adjacent to Bolong Road. Discussions have commenced with Shoalhaven City Council and an application has been submitted seeking a boundary adjustment with Council. – The construction of three (3) product silos above the existing interim packing plant. The construction of these three (3) silos will necessitate the relocation of an approved electrical substation that was approved (but not yet constructed) below and within the footprint of where it is now proposed to site the proposed product silos. This electrical sub-station is to be relocated to a position on the northern side (Bolong frontage) of the Gluten Dryer No. 5 building. North of Starch Dryer 5 Approved Baghouse. – The relocation of six (6) approved but not yet constructed, and the construction of an additional ten (10) product tanks. Under the existing approvals for the site ten (10) product storage tanks were to be sited to the rear of the Gluten Dryer and Specialty Product Buildings on the western side of Abernethy’s Creek. Following detailed design, the diameter of the tanks has now increased and additional area is required for associated pumps and supporting equipment. As a result there is insufficient room to locate these tanks in the approved location. – The construction of an additional ethanol loadout immediately adjacent to and to the north of the existing loadout facility. – Installation of additional cooling towers within the eastern part of the site – The construction of a cable stay pipe bridge across Abernethy’s Creek to supply power and product to these buildings. – The relocation of the extension of the existing electrical substation located on the eastern side of Abernethy’s Creek – The extension of the existing car park located within the western part of the site in a south-westerly direction to provide an additional thirty-one (31) car parking staff for staff and contractors
Modification 21	Modification 21 comprised of the following:

Modification	Summary of changes
	– Modification of the packing plant layout. It is proposed to construct sixteen (16) smaller silos instead of the original 5 approved silos, install additional packer feed bines and alter the layout of the approved car parking spaces – Modification to the packing plant site layout including addition of a third rail siding, increase the height of the gantry containing the product transfer lines to the product silos, add noise mitigation walls to the train tunnel surrounding the container storage area terminate at the rail line and provide a loader maintenance and cleaning area within the container storage area – Extension of the product transfer lines and services from the Specialty Product Buildings across Bolong Road to the Packing Plant via the approved underground services crossing – Installation of an additional raw waste water tank within the Environmental Farm. The proposed raw waste water tank would be equipped with a floating roof to prevent odour emissions. – Installation of a Nitrogen Generator and Storage Tanks that will supply Nitrogen to the existing and proposed ethanol storage tanks to eliminate in-tank fire risk – Increase to indirect cooking capacity by 50%. – Installation of two additional fermenters (No. 18 and 19)

1.3 Current proposal: Modification 23

Project Approval MP06_0228 for the Shoalhaven Starches Expansion Project made provision for a gas fired co-generation that would comprise two gas turbine generators that would deliver an anticipated net power output of 40 MW of power for the site.

Subsequently under Mod 16 the Independent Planning Commission approved an additional coal fired co-generation plant. This coal fired co-generation plant would generate a total of 15 MW of power for the site.

Neither the approved gas nor coal fired co-generation plants have been constructed to date.

Following the original Project Approval Shoalhaven Starches have obtained approval and / or are seeking approval for a range of modifications to the original Project comprising a range of additional developments that were not envisaged as part of the original Project Approval. Shoalhaven Starches are forecasting that the electrical power load demand created by these and other additional works, subsequent to the original Project Approved development, will exceed the power supply capacity of the approved gas fired and coal fired co-generation plants.

Shoalhaven Starches now propose to construct a new gas-fired co-generation plant which will consist of two natural gas turbines that will generate an anticipated power output each of 30 MW, providing a total power to the site of 60 MW. The new gas fired co-generation plant will replace the approved gas fired and coal fired co-generators. In addition Shoalhaven Starches also proposed to convert their existing coal fired boilers to gas as well. It is proposed to submit a Modification Application (Mod 23) to the Department of Planning, Industry and Environment seeking approval for these proposed works.

1.4 Scope

The proposed changes (Mod 23) requires an application to the EPA assessing the associated off-site odour and air quality impacts.

In order to meet EPA NSW requirements, this report provides:

– A revised emissions inventory for odorous and combustion sources on site. A comparative analysis of the emissions inventory has been undertaken with the last major air quality assessments for the site.

– A level 2 air quality assessment of odour and air quality in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA 2016) (the Approved Methods). Dispersion modelling was undertaken using CALPUFF version 7.

– A comparison of predicted odour and air quality results against the EPA criteria and against the previous modification results.

1.5 Assumptions

The major assumptions used in this assessment are as follows:

- Stack emission testing reports from the past measurements are accurate and representative of normal operations, and do not vary significantly
- The odour dispersion modelling using the NSW EPA and US EPA approved regulatory Gaussian puff dispersion model CALPUFF version 7, which was considered appropriate for the location. Limitations with the predicted odour are inherent within the model and in its ability to handle multiple buildings and stacks in a complex setup, with wake effects included. As such, the layout of the plant was simplified in order for the model to handle the setup
- Odour emissions from the major sources of odour were modelled as both variable emission and fixed point, volume and area sources in CALPUFF with appropriate dispersion characteristics
- The site representative meteorological data was obtained from previous assessments of the plant, which have been approved by EPA NSW in the past. The meteorological data is discussed in Section 5
- Small silos in the Packing Plant are conservatively assumed to be filled 24 hours a day
- Odour sources with horizontal releases have conservatively been modelled with vertical velocities of 0.1 m/s
- The VOC concentration in the biofilter exhaust is not high enough to induce density flows of the exhaust plume in ambient air
- The emissions inventory, and therefore the dispersion modelling results, is largely based on estimates and on data measured on site by Stephenson Environmental Management Australia (SEMA). Actual measurements are dependent on site conditions at the time of measurement and these conditions may change. GHD does not accept any responsibility for updating the measurements or estimates made by SEMA.

1.6 Report structure

This report:

- Describes the operations of the plant
- Describes the site-representative meteorological and background air quality data
- Describes the proposed modifications
- Characterises odour sources at the plant, accounting for the required changes to the Mod 23 model setup
- Presents the results of odour dispersion modelling for the proposed Mod 23 scenario using CALPUFF
- Characterises non-odour sources at the plant
- Presents the results of air quality dispersion modelling for the proposed Mod 23 scenario using CALPUFF
- Presents a summary of the results and draws conclusions as to the off-site impacts (both odour and non-odour)
- Outlines the limitations of the analyses and conclusions presented.

1.7 Limitations

This report: has been prepared by GHD for Shoalhaven Starches Pty Ltd and may only be used and relied on by Shoalhaven Starches Pty Ltd for the purpose agreed between GHD and Shoalhaven Starches Pty Ltd as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than Shoalhaven Starches 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(s) 1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

2. Site location and context

2.1 Site description

Figure 2.1 shows the site context and location of the Shoalhaven Starches plant in Bomaderry, New South Wales. It is located between the Shoalhaven River and township of Bomaderry. The plant comprises a factory, a proposed (but not yet constructed) packing plant and environmental farm. The packing plant lies immediately to the north of the factory, while the environmental farm is situated approximately 400 m to the east. Figure 2.2 shows the site location and layout.

2.2 Nearby sensitive receptors

The Approved Methods define a sensitive receptor as “a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area”.

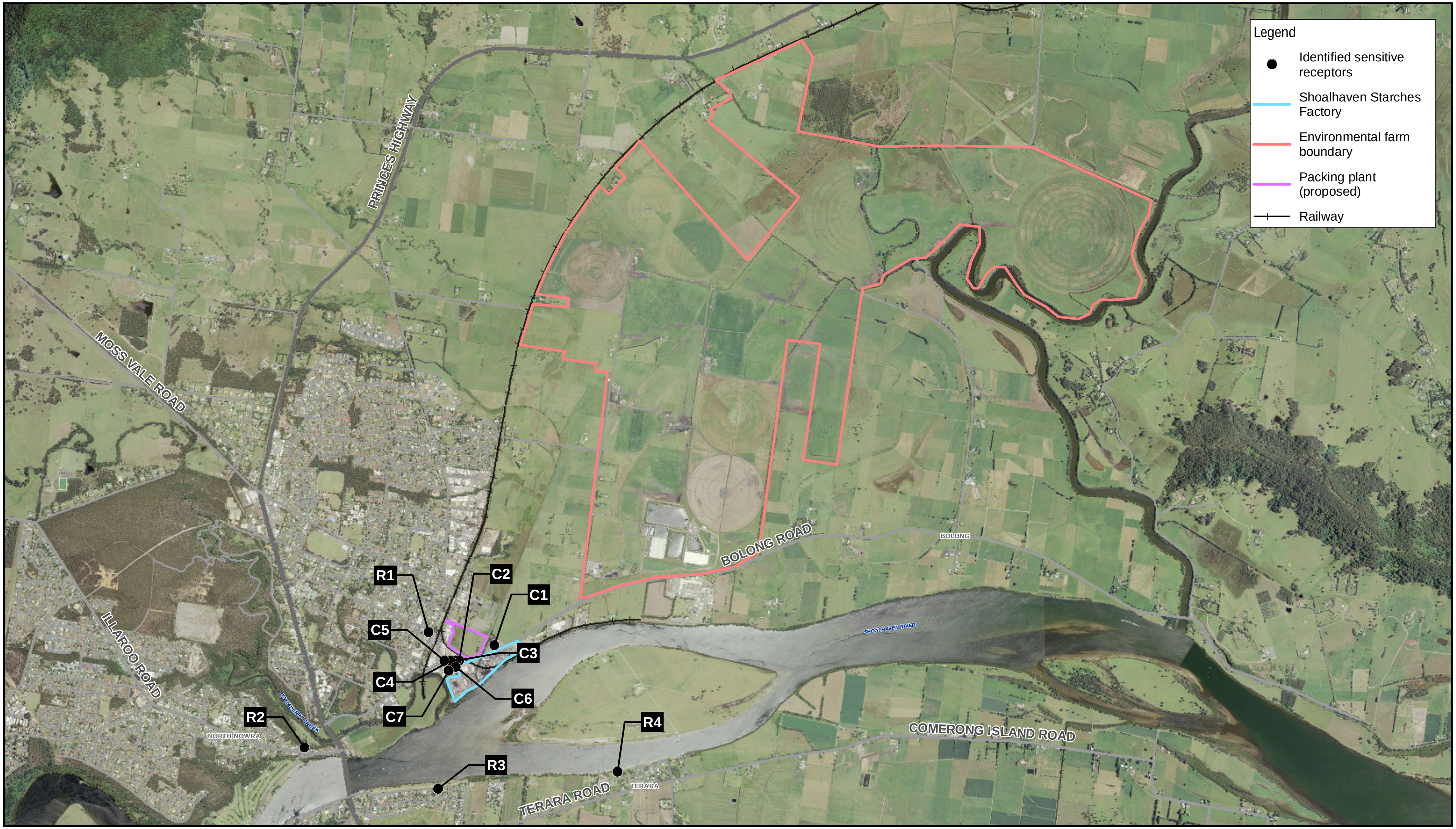
The site is proximate to a number of sensitive receptors. The township of Bomaderry lies to the northwest of the factory and west of the packing plant. Nowra is situated south of the plant. Commercial and industrial sensitive receptors are located directly adjacent to the site and across from it along Bolong Road.

The nearest residential sensitive receptors are located between 150 to 1300 metres from the site. The nearest commercial/industrial sensitive receptors (denoted by a receptor ID beginning with C) and residential sensitive receptors (denoted by a receptor ID beginning with R) to the site have been included in the modelling and are listed in Table 2.1, including the approximate distances and orientation of each receptor from the site. The commercial/industrial receptors also include the operating times in brackets.

The sensitive receptors are shown in Figure 2.1 and Figure 2.2.

Table 2.1 Location of identified sensitive receptors

Receptor ID	Range, m	To nearest odour source	Direction	MGA56. Easting (m)	MGA56. Northing (m)
R1	150	Packing Plant	W	281,430	6,140,610
R2	1300	Factory	SW	280,400	6,139,650
R3	700	Factory	S	281,510	6,139,310
R4	1300	Factory	SE	283,000	6,139,450
C1 (7am to 5pm, weekdays)	45	Factory	N	281,977	6,140,501
C2 (8am to 5pm, weekdays)	20	Factory	N	281,685	6,140,373
C3 (8am to 5pm, weekdays)	30	Factory	N	281,663	6,140,373
C4 (7am to 4pm, weekdays)	75	Factory	NW	281,615	6,140,371
C5 (24 hours)	125	Factory	NW	281,563	6,140,372
C6 (7am to 5pm, weekdays 7am to 12pm, Saturday)	30	Factory	NW	281,655	6,140,320
C7 (8am to 5pm, weekdays, 8am to 12pm, Saturday)	55	Factory	NW	281,597	6,140,289



Paper Size ISO A4

0 0.3 0.6 0.9 1.2

Kilometers

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

N

Manildra Group Pty Ltd
Shoalhaven Starches

Site Context

Project No. 12548374
Revision No. 0
Date 20 May 2021

FIGURE 2.1

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Print date: 20 May 2021 - 12:26

Data source:General Topo: NSW LPI DTDB 2012 © Department of Customer Service 2020. Created by: kpsroba

Paper Size ISO A4

0 20 40 60 80 100 120

Metres

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

N

Manildra Group Pty Ltd
Shoalhaven Starches

Project No. 12548374
Revision No. 0
Date 20 May 2021

Site location and layout

FIGURE 2.2

N:\AU\Sydney\Projects\21\12534209\GIS\Maps\Deliverables\12548374\12548374_007_SiteLocation.mxd
Print date: 20 May 2021 - 12:26

Data source: General Topo: NSW LPI DTDB 2012. © Department of Finance, Services & Innovation 2018. Created by: kpsroba

3. Operation description

3.1 General overview

Wheat flour and grains (wheat) are processed at the Shoalhaven Starches factory to produce ethanol, starch, gluten and glucose. Solid wastes are treated to produce distiller's dried grain (DDG), with liquid wastes being transferred to the environmental farm waste water treatment plant. Excess treated waste water is irrigated onto pasture. The main processing and materials treatment areas at Shoalhaven Starches comprise the:

– Flour mill
– Starch plant
– Glucose plant
– Ethanol and distillation plants
– DDG plant
– Packing plant
– Pellet Plant
– Environmental farm.

A brief description of the production process associated (including emission control) with each plant is given below. Figure 3.1 shows the layout of the plant in terms of its operational areas, along with the major odour sources of the plant, accounting for around 80% of total odour emissions (excluding the environmental farm).

3.2 Flour mill

Shoalhaven Starches commenced full operations at the flour mill in June 2011. The flour mill was originally approved by NSW Department of Planning and Environment in 2007 and was consolidated into the ethanol expansion project approval in 2008.

Proposed Modifications to the flour mill were approved in March 2016, which enabled an increase in the total flour production capacity on the site from the previously approved limit of 265,000 tonnes per annum to 400,000 tonnes per annum.

The flour is used in the plant to produce starch, gluten, glucose and ethanol. All remaining mill feed and pollard (flour sieving rejects) is processed through the DDG dryers for sale as stock feed. Flours from the various grinding operations are collected and blended together before passing through final treatment and weighing operations to bulk storage bins. Flour is taken from these bins for use in existing site production processes.

All air extracted from the mill is passed through Buhler Airjet bag houses prior to being discharged to the atmosphere vertically via ten individual stacks. Approval has previously been obtained for the installation of additional plant to increase production, along with two additional exhausts from the roof of the building.

3.3 Starch plant

Within the starch plant, flour is processed to separate the starch from gluten (the protein component of flour). The starch is graded, dried and packed for shipment. Different grades of starch are manufactured for food and paper making applications. Starch that is not used for these applications is used as a raw material for the ethanol plant. Gluten is dried and sold for use in the food industry.

Aqueous (water-based) wastes are reused within the plant or are transferred to the environmental farm waste water treatment plant.

Starch Dryer No.5 has been constructed and is currently operational (see Figure 3.1). No change to the production volume is predicted.

3.4 Glucose plant

The glucose plant (contained within the starch plant area) houses two lines; the 'confectioners' glucose line and the 'brewers' glucose line. Confectioner's glucose is distinguished by having been demineralised to remove latent odours and flavours that might be carried through to the final product by the glucose.

Both processes use starch as the raw material. The starch is broken down to its constituent glucose molecules using enzymatic and hydrolytic processes. Water is removed from the resulting solutions using evaporation to produce glucose and brewer's solutions of desired concentration. The glucose product is shipped to customers in bulk containers.

The glucose manufacturing process generates aqueous wastes, mostly condensate from the evaporators, which is reused during regeneration of the ion exchangers.

3.5 Ethanol and distillation plants

Waste starch from the starch plant is transferred to the ethanol plant and fermented to produce ethanol. Starch (described in section 3.3), which is in suspension, is heated in jet cookers before being fermented.

Fermentation is carried out in fermentation vessels using the treated substrate to which an ethanol-producing yeast inoculum has been added. The yeast inoculum is generated using yeast propagator vessels, these being seeded using commercial strains of yeast.

Wastes from the fermenters are transferred to the DDG plant (refer to section 3.6) for processing. Fermentation liquor from the ethanol plant is transferred to the distillation plant where water and other impurities are removed to produce various grades of ethanol.

3.6 DDG plant

Wastes from the ethanol and distillation plant are dewatered in decanter centrifuges and dried in steam dryers to produce granular DDG. Light phase from the DDG decanters is evaporated to recover soluble protein (syrup) and produce clear condensate (liquid line). The syrup is added to the dryer feed for recovery of the solids (solids line). DDG granular product is transferred to the DDG Pellet Plant for pelletising; the DDG pellets are stored in silos. Some of the granular DDG product is stored in a storage shed until it is loaded into trucks in the DDG load-out area.

Exhaust gases from the existing DDG dryers (three) are transferred to the boiler air intake in order to destroy odorous components of the gases by combustion.

3.7 Steam production

During Mod 23 opeations, steam would be generated at Shoalhaven Starches by using a combination of gas fired boilers (all existing boiler would be converted to operate on gas) and the proposed gas fired co-generation that would comprise two gas turbine generators.

The site intends to rely primarily on the proposed gas-fired co-generation plant to provide the baseload energy and stream production requirements for site operations. Certain boilers would operate at reduced capacity to meet any unexpected peaks in stream demands whilst other boilers would be allocated to standby duty (offline and not operating) for use during maintenance of the co-generation plant.

An overview of co-generation plant and gas boiler steam generation is provided in Table 8.1.

3.8 Environmental farm

A number of wastewater streams are produced at the factory. These consist of five clear condensate streams (distillation plant condensate, evaporator condensate, DDG condensate, a small flow from the carbon dioxide plant and boiler blowdown) and a combined 'dirty' stream from the factory processes. The 'dirty' wastewater streams are combined in the farm tank (located at the factory) and pumped to the waste water treatment plant. Treated water is pumped back to the factory for re-use, while excess treated water is stored in dams for irrigation on the farm.

3.9 Packing plant (proposed)

It is proposed that dried gluten/starch will be pneumatically transferred from the existing site to the proposed new packing plant via underground pipes. This dried material is proposed to be stored in silos.

At present, the approved packing plant has not been constructed at the Shoalhaven Starches sites. The proposed packing plant was assessed by SEMA in 2015.

The packing plant will consist of seven silos that will store either gluten or starch product. The medium and large silos are to be filled 24 hours a day, seven days a week, while the small silos can be filled at any time of the day for eight hours.

3.10 Other activities

3.10.1 Product load-out areas

Starch, glucose and ethanol products are loaded into road tankers from bulk storage silos and tanks. Load out of starch and glucose does not have the potential to generate odours, as these products have a low inherent odour characteristic.

Given the flammable nature of ethanol, the load out process is strictly controlled for occupational health and safety purposes. These controls have the secondary effects of minimising the potential for vapour generation and spillage.

3.10.2 Cooling towers

Cooling towers operate as part of the cooling water circuit for the ethanol glucose and DDG plants. The recirculated cooling water has the potential to absorb odours and to disperse the odours to atmosphere during the evaporative cooling (aeration) process within the cooling towers. Odour sampling undertaken at the cooling towers observed a decline in odour emissions demonstrating relatively low odour emissions and it has since been removed as an EPL odour monitoring point. Manildra advised that the cooling towers are no longer a source of odour and therefore they were removed from the odour emissions inventory.

3.10.3 Biofilters

Exhaust air from odorous sources at the DDG plant is captured and ducted to two existing soil-bed biofilters, each having a surface area of 110 m^2, located at the southwest corner of the factory (on the southern margin of the container storage area – placed to the left lower margin in Figure 3.1). The biofilters comprise a bed of organic bark and compost material (the matrix), with distribution of the odorous airstream through the floor of the biofilter via a manifold. Biological oxidation of odorous compounds takes place as the foul air percolates upward through the matrix. The oxidation is achieved by a population of microorganisms in the bed.

While the efficiency of biofilters destroying odorous components of the waste air varies according to a range of factors including soil moisture, composition and temperature, it is very high. Any odour in the exhaust air from the biofilter is due to the inherent odour of the matrix materials and typically has an ‘earthy’ characteristic.

The two biofilters at the site operate in parallel and are sized so that one biofilter can be taken offline during periodic replacement of the matrix of the sister filter.

As such, a soil-bed biofilter operating as designed, with no malfunctions, will not vary significantly in its odour emissions; it will emit at the matrix background level independent of fluctuations in the input odour loading.

3.11 Proposed modifications

3.11.1 Mod 11, 12, 13, 16, 17, 19 and 21

Modifications 11, 12 and 13 focused on changing the configuration of the DDG plant (to the southwest of the factory), changes to the ethanol distillery and modification to boilers 2 and 4. These modifications have been discussed in Section 1.2. The resulting air quality impacts have been addressed in GHD's previous quality assessments (GHD 2017).

Mod 16 focused on changing the configuration of the flour mill exhausts, conversion of gluten dryers 1 and 2 to starch, change to boiler 7's location, a new gluten dryer (no. 8) and a new coal-fired boiler (boiler 8). The resulting air quality impacts from Mod 16 have been addressed in GHD's previous air quality assessment (GHD, February 2019).

Mod 17 focused on changes to the baghouse (including the addition of a new stack) for starch dryer 5, addition of a new product dryer and use of sawmilling residue (woodchips) for boilers 2 and 4. The resulting air quality impacts from Mod 17 were assessed by GHD (2020).

The main changes affecting odour and air quality impacts in Mod 19 consist of:

– Additions to the existing Ethanol Distillery Plant. The additional plant will be of a similar design, size and operation to the existing beverage grade ethanol modification approved under Mod 12.
– The construction of three (3) product silos above the existing interim packing plant.
– The main changes affecting odour and air quality impacts in Mod 21 consist of:
– Modification of the packing plant layout. It is proposed to construct sixteen (16) smaller silos instead of the original 5 approved silos. However no change to total packing plant emissions is proposed.
– Installation of an additional raw waste water tank within the Environmental Farm. The proposed raw waste water tank would be equipped with a floating roof to prevent odour emissions. No additional odour emissions are anticipated.
– Increase to indirect cooking capacity by 50%. It is anticipated that this was result in a 50% increase in odour emissions from the glucose plant cooking.
– Installation of two additional fermenters (No. 18 and 19). It is understood the additional fermenters would be operated in batch mode to provide more fermenter redundancy for process upsets, fermenters cleans, etc. The overall throughput of the fermenters would not change and therefore no additional odour emissions are anticipated.

Further discussion of these changes in the context of the dispersion modelling is presented in Section 7.

3.11.2 Mod 23

Modification 23 is discussed in Section 1.3. The main changes affecting odour and air quality impacts consist of:

– A new gas-fired co-generation plant which will consist of two natural gas turbines that will generate an anticipated power output each of 30 MW, providing a total power to the site of 60 MW. The new gas fired co-generation plant will replace the approved gas fired and coal fired co-generators.
– Conversion of existing coal fired boilers to gas.

The proposal is expected to have a neutral impact on odour and a positive impact on combustion emissions compared against the previously modification (Mod 21). The reduction in combustion emissions (compared with Mod 21) is attributed to conversion of boilers from coal to gas which typically has lower emissions.

Paper Size ISO A4

0 10 20 30 40 50 60

Metres

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

N

GHD

Manildra Group Pty Ltd
Shoalhaven Starches

Project No. 12548374
Revision No. 0
Date 20 May 2021

Site layout and major odour sources

FIGURE 3.1

N:\AU\Sydney\Projects\21\12534209\GIS\Maps\Deliverables\12548374\12548374_002_SiteLayout.mxd
Print date: 20 May 2021 - 12:26

Data source: General Topo: NSW LPI DTDB 2012. © Department of Customer Service 2020. Created by: kpsroba

4. Criteria for assessment

4.1 Odour

4.1.1 Odour Concentration

Odour 'strength' or concentration is measured in odour units (OU), where 1 OU represents the concentration of a sample that can just be detected by 50% of people in a controlled situation where there is no background ‘ambient‘ odour.

4.1.2 Measurement of Odour

The most common method of measuring odour concentration is Dynamic Olfactometry using the ‘forced choice’ method. Dynamic olfactometry simply dilutes the odour sample in known ratios with odour free air. At each dilution, the diluted odour and a zero odour is presented in turn to six panellists via two ‘sniffing’ ports. Further, the selection of the port with the diluted odour sample is randomly reassigned at each presentation. Each panellist is required (forced) to nominate the port (left or right) from which the diluted odour emanates. Each panellist’s response (i.e. 'guess', 'likely' or 'certain') is recorded. The sequence of presentations generally follows a decreasing dilution ratio, and when half of the panellists have correctly returned a ‘certain’ response, that dilution ratio is numerically equal to the concentration of the original, undiluted odour sample. Hence, for example, if the dilution needed to get the 50% response was 250:1, then by definition the original sample had an odour concentration of 250 OU.

4.1.3 EPA Criterion for Odour

EPA has defined an odour criterion and the Odour Guideline specifies how it 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:

The **F**requency of the exposure

The **I**ntensity of the odour

The **D**uration of the odour episodes

The **O**ffensiveness of the odour

The **L**ocation of the source

These factors are often referred to as the FIDOL factors.

DEC defined the odour criterion to take account of two of these factors (**F** is set at 99 percentile, **I** is set at from 2 to 7 OU). The choice of criterion odour level has also been made to be dependent on the population of the affected area, and to some extent it could be said that population is a surrogate for location – so that the **L** factor has also been considered. The relationship between the criterion odour level **C** to affected population **P** is given below.

$$C = [\log P - 4.5] \div -0.6 \qquad \text{Equation 1}$$

Table 4.1 lists the values of C for various values of affected populations as obtained using equation 1.

Table 4.1 Odour criterion for the assessment of odour

Population of affected community	Odour performance criteria (nose response odour certainty units at 99th percentile)
Single Residence (≤ ~2)	7
~ 10	6
~ 30	5

Population of affected community	Odour performance criteria (nose response odour certainty units at 99th percentile)
~ 125	4
~ 150	3
Urban (~2,000)	2

The NSW Approved Methods specifies a criterion of two odour units at the 99th percentile over a short term averaging nose-response time of one second for a complex mixture of odorous air pollutants in an urban area (population greater than 2000 or with schools and hospitals). The criterion is applied at the location of the nearest sensitive receptor or likely future location of sensitive receptor.

5 OU is commonly taken as a conservative measure of the odour level which can be distinguished against the ambient background level of odour, and which if offensive, could result in complaint.

1 OU generally cannot be detected in a non-laboratory situation (i.e. where the ambient background odour levels reduce the detectability of a given odorant).

As the CALPUFF dispersion model (utilised in this assessment), when operating in micrometeorological mode can only predict concentrations over an averaging period of one hour, a ratio between the one second peak concentration and 60 minute average concentration has been applied to the source odour emission rates. In this manner, the predicted one hour odour levels predicted in CALPUFF represent the corresponding one second short-term levels required to be compared to the DEC criterion. The ratio is known as the peak to mean ratio (PM60). PM60 is a function of source type, stability category and range (i.e. near or far-field), and values are tabulated in the modelling Guideline[1]. This is reproduced in Figure 4.1.

Table 6.1: Factors for estimating peak concentrations in flat terrain (Katestone Scientific 1995 and 1998)

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

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

Figure 4.1 Factors for estimating peak concentrations (Extract from NSW Approved Methods)

4.1.4 Other air quality impacts

Potential non-odorous air quality impacts from the site include dust and products of combustion. The following pollutants have been assessed against relevant criteria:

– Total suspended particles (TSP)
– Fine particulate matter less than 10 micron equivalent aerodynamic diameter (PM_{10})
– Fine particulate matter less than 2.5 micron equivalent aerodynamic diameter ($PM_{2.5}$)
– Products of combustion including carbon monoxide, oxides of nitrogen (NO_x), sulfur dioxide (SO_2, heavy metals (Type I & II), total volatile organic compounds (VOC) and polycyclic aromatic hydrocarbons (PAHs).

The air quality impact assessment criteria for these pollutants has been sourced from the Approved Methods and is summarised in Table 4.2.

[1] Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005).

Table 4.2 Air quality impact assessment criteria – other pollutants

Pollutant	Averaging period	Criterion
Particulate Matter PM_{10}	24 hours	50 µg/m^3
	Annual	25 µg/m^3
Particulate Matter $PM_{2.5}$	24 hours	25 µg/m^3
	Annual	8 µg/m^3
TSP	Annual	90 µg/m^3
Carbon monoxide (CO)	15 minutes	100 mg/m^3
	1 hour	30 mg/m^3
	8 hours	10 mg/m^3
Sulfur dioxide (SO_2)	10 minutes	712 µg/m^3
	1 hour	570 µg/m^3
	24 hours	228 µg/m^3
Nitrogen dioxide (NO_2)	1 hour	246 µg/m^3
	Annual	62 µg/m^3
Polycyclic aromatic hydrocarbon (PAH)	1 hour	0.0004 mg/m^3
Type 1 metals		
Arsenic	1 hour	0.00009 mg/m^3
Cadmium	1 hour	0.000018 mg/m^3
Lead	Annual	0.5 µg/m^3
Mercury	1 hour	0.0018 mg/m^3
Type 2 metals		
Beryllium	1 hour	0.000004 mg/m^3
Chromium	1 hour	0.00009 mg/m^3
Manganese	1 hour	0.018 mg/ m^3
Nickel	1 hour	0.00018 mg/ m^3

5. Meteorological data

1.1 Overview

A 12-month dataset was constructed using the 3D prognostic modelling package, TAPM and the diagnostic 3D meteorological model, CALMET for the period from January to December 2004. This 12 month period was chosen to be consistent with previous modelling undertaken for the 2008 Air Quality Assessment, approved at the time by EPA and to allow to a direct comparison to previous modelling. Further detail is provided in Appendix A in regards to the selection and construction of the meteorological dataset used in the modelling.

1.2 Meteorological modelling

The CALMET modelling can be summarised as follows:

– Prognostic models TAPM and CALMET were used for initial wind field ‘guesses’
– Observations from both the environmental farm Automatic Weather Station (AWS) and Nowra AWS were used to optimise and check the prognostic model simulations
– Wind speeds and direction observations from the environmental farm AWS were assimilated into the prognostic model to make the data site-specific

The result of assimilating this data into the CALMET simulations makes the data site-specific (required for a Level 2 assessment), and inter-annual variability is not required to be accounted for, with the conditions of the Approved Methods met for using “*at least one-year of site-specific meteorological data*”.

An annual wind rose generated using CALMET is provided in Figure 5.1 to show the wind field at the factory. The following trends are evident from Figure 5.1:

– Annual average wind speed of 3.2 m/s
– Winds are most prevalent from the west and west northwest, accounting for around one third of all winds
– Winds are least prevalent along the north-south axis
– Light winds (shown in grey) are more prevalent from the northwest
– Drainage flows occurring during stable conditions at night time are dominated by the following distinct features (in order of scale):
  - Shoalhaven River running west to east through the site
  - Browns Mountains to the northwest of the site
  - Yalwal State Forest mountain range to the west.

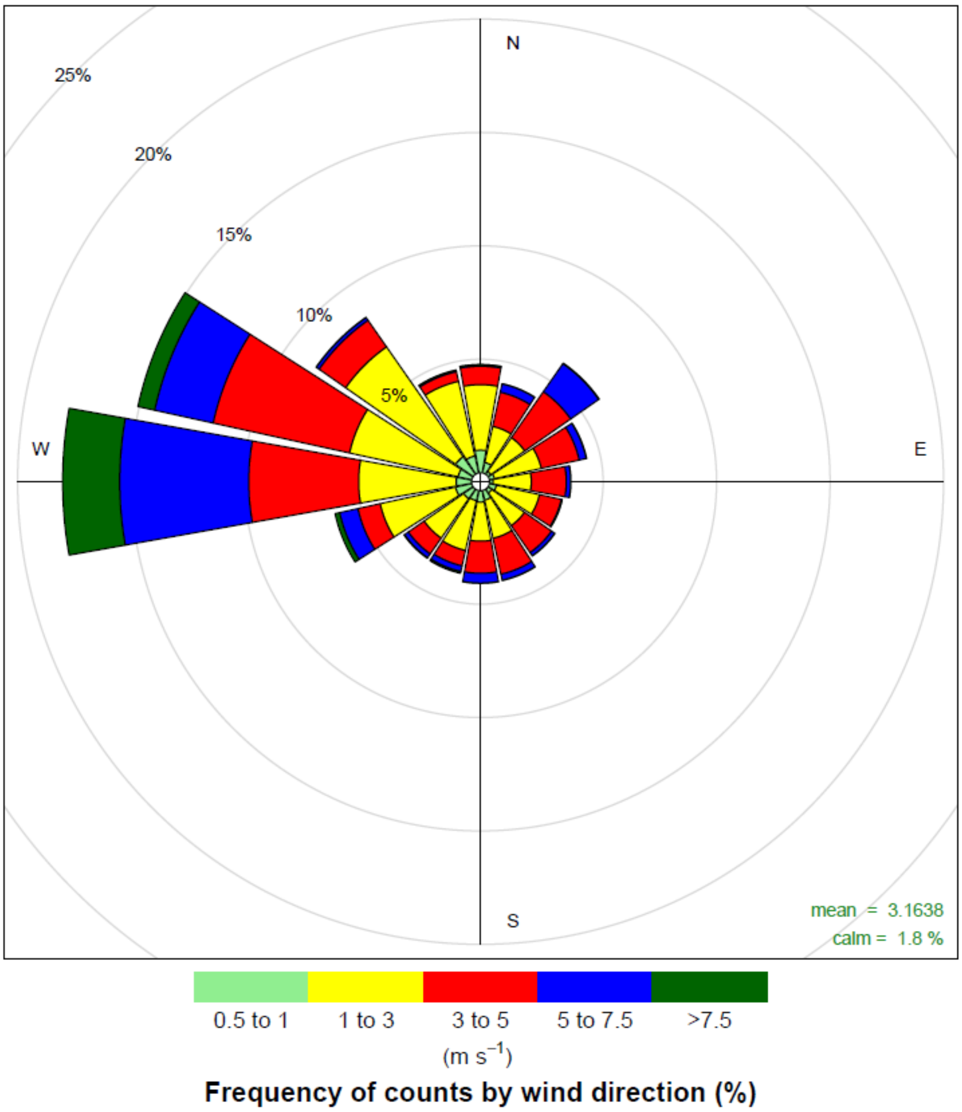


Figure 5.1 CALMET wind rose for the factory

1.2.1 Representative year discussion

GHD has undertaken an analysis of more recent measured meteorological data from the Shoalhaven Starches site, in order to determine if the existing EPA approved model would still be considered representative, given the age of the meteorological data. Figure 5.2 below shows annual wind roses for the site for both 2004 CALMET data (the data used in this assessment) and available site observations (dated from 29/04/2019 to 26/05/2020). The following comments are provided regarding the representativeness and suitability of 2004 CALMET data for use in this assessment:

- General wind pattern alignment between observations and modelled meteorological conditions is considered acceptable. Both wind roses show winds are predominantly from the west and have an even spread of winds from the south and east. The more recent observations have a lower percentage of winds occurring from the north compared to the modelling data. Consequently, the modelling data may be over predicting impacts to the south, (i.e. potential to result in less impact at R3 located to the south of the site which is the worst case receptor in terms of odour)
- Changing the meteorological file used in modelling will not enable a direct comparison of changes at the site between modifications. Recalibration of the baseline model (running original 2008 Air Quality assessment model with new meteorological file) would be required to meaningfully compare the relative change in impacts of each modification.

– Currently, only a limited site-specific meteorological dataset exists. While the comparison of this observed dataset shows good general alignment with the modelled meteorological conditions, it is recommended that site based meteorology be reviewed at the end of 2021 or when there is a sufficient number of years available for representative analysis. Currently, insufficient quantity of data is available to conduct a representative year analysis and therefore the alignment of observations against meteorological trends over longer timeframes cannot be assessed.

Based on this review GHD finds the 2004 meteorological dataset used in the assessment appropriate for use in this assessment.

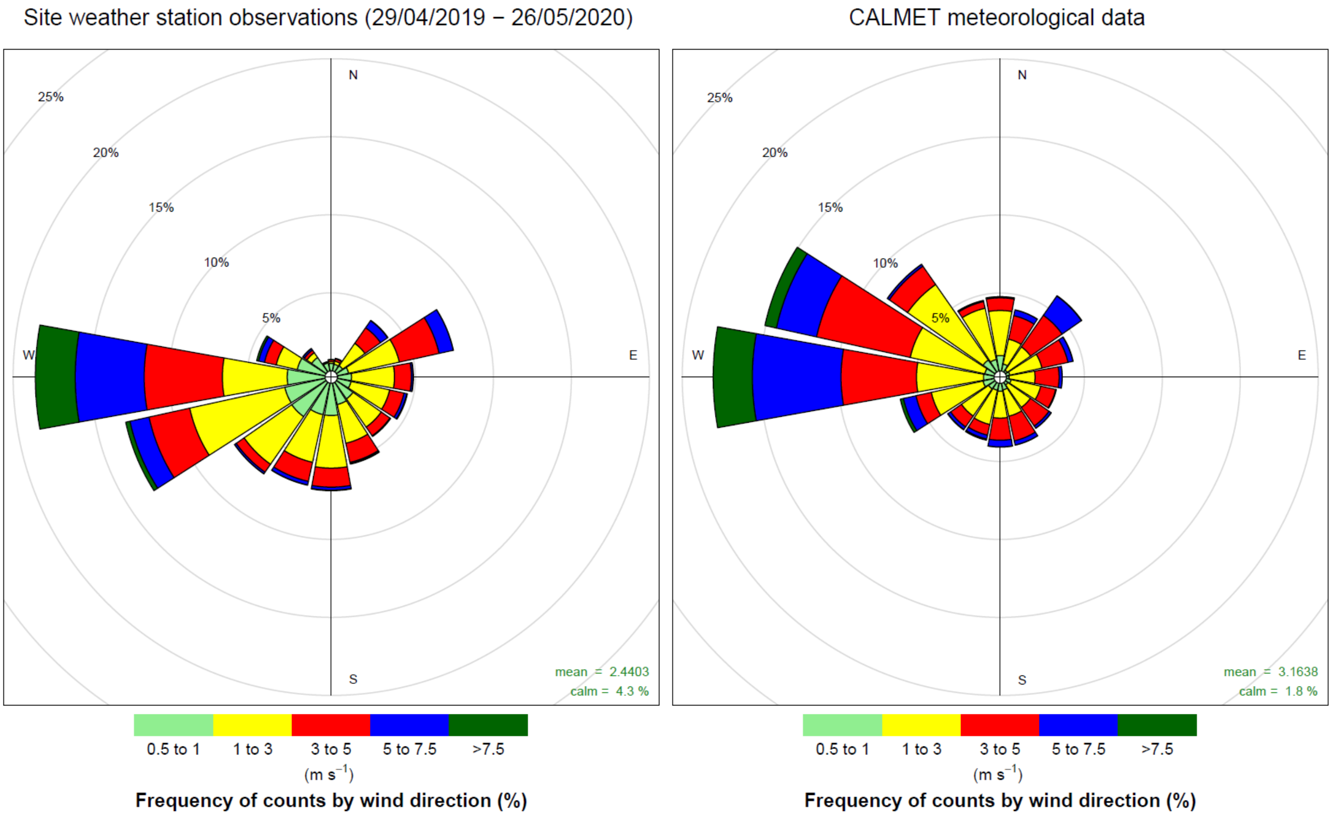


Figure 5.2 ***Comparison of site weather station observations and CALMET meteorological***

6. Background air quality

The Department of Planning, Industry and Environment (DPIE) operate a state wide air quality monitoring network, with the nearest monitoring site to Shoalhaven Starches being the Albion Park South station located approximately 34 km northeast of the site, followed by the Kembla Grange station located approximately 46 km northeast of the site, followed by the Wollongong station located approximately 54 km northeast of the site.

Use of background data from the closest DPIE monitoring station(s) was prioritised where sufficient data was available (stations prioritised in order from Albion Park South to Kembla Grange to Wollongong).

A contemporaneous assessment approach was adopted to assess PM_{10}, $PM_{2.5}$ and NO_2 (NO_2 was assessed using Method 2 from the Approved Methods). Albion Park South commenced operation in 2005 meaning that contemporaneous data was not available for comparison to the GHD CALPUFF model of the site which uses meteorology from 2004. Therefore, contemporaneous 24 hour average variable PM_{10} and $PM_{2.5}$ data was sourced from Wollongong station (insufficient data from Kembla Grange) and contemporaneous one hour average NO_2 and O_3 data was sourced from Kembla Grange station.

Previous modification assessments from Mod 13 (GHD, 2018) onwards utilised the following background data:

- Data from the Albion Park South station for the 2016 calendar year:
  - 1 hour, 24 hour and annual averaged SO_2 data for use in the cumulative assessment
  - 70th percentile PM_{10} and $PM_{2.5}$ data for graphically plotting only (refer Figure 8.2 and Figure 8.3. 70th percentile concentrations were considered a reasonable representation of ambient PM_{10} and $PM_{2.5}$ concentrations)
- Data from the Wollongong station for the 2016 calendar year:
  - 1 hour and 8 hour averaged CO data for use in the cumulative assessment (it is noted that CO predictions are orders of magnitude below the assessment criteria therefore no further investigation regards background CO concentrations was undertaken).

For consistency purposes to allow meaningful comparison between modifications, the same 2016 Albion Park South data was adopted for this assessment. As part of this assessment, GHD reviewed the most recent calendar year of SO_2 data (01/01/2020-01/01/2021) and noted that background 1 hour average SO_2 concentrations were that same as those recorded in 2016 while background 24 hour and annual SO_2 concentrations had both decreased. Therefore use of background 2016 data was considered conservative. Additionally, it is noted that particulate levels in recent years (particularly in 2019 to 2020) were not considered representative of typical concentrations due to elevated levels cause by bushfires and therefore GHD did not update the 70th percentile data used for plotting purposes.

Background levels of SO_2, CO and 70th percentile PM_{10} and $PM_{2.5}$ used in the assessment are provided in Table 6.1.

Table 6.1 Background Air Quality Data – Albion Park South (2016)

Pollutant	Averaging Period	Concentration [2]	Units
Sulfur dioxide (SO_2)	1 hour	57.6	µg/m^3
	24 hour	15.7	
	Annual	1.6	
Carbon monoxide (CO)[3]	1 hour	1.0	mg/m^3
	8 hour	0.6	
PM_{10}	24 hours	43.2	µg/m^3
	70th percentile 24 hour average	18.3	

[2] Values are 100th percentile, except where stated as 70th percentile for PM_{10} and $PM_{2.5}$
[3] CO was sourced from the Wollongong monitoring station as this was not available at Albion Park South

Pollutant	Averaging Period	Concentration [2]	Units
	Annual	14.9	
$PM_{2.5}$	24 hours	30.7	µg/m^3
	70th percentile 24 hour average	8.0	
	Annual	7.2	

The contemporaneous particulate assessment was undertaken using data from Wollongong in 2004. A review of particulate levels at Wollongong and Albion Park is provided in Table 6.2. Average particulate levels at Wollongong have reduced from 2004 to 2016. Levels at Albion Park South in 2016 are lower than the levels at Wollongong over the same period. Therefore use of contemporaneous 2004 PM_{10} and $PM_{2.5}$ data from Wollongong is likely conservative as background concentrations have decreased over time (shown via comparison of 2004 Wollongong data to 2016 Wollongong data) and concentrations in Wollongong are higher than those closer to the site (shown via comparison of 2016 Wollongong to 2016 Albion Park data).

Table 6.2 Review of particulate monitoring at Albion Park South and Wollongong, µg/m^3

Site and Year	Albion Park 2016	Wollongong 2016	Wollongong 2004
Annual average PM_{10}	14.9	17.3	18.7
70th percentile PM_{10}	18.3	20.7	21.9
90th percentile PM_{10}	25.6	29.7	30.5
24 hour maximum PM_{10}	43.1	52.9	49.0
Annual average $PM_{2.5}$	7.2	7.4	6.7
70th percentile $PM_{2.5}$	8.0	8.3	8.3
90th percentile $PM_{2.5}$	11.2	11.6	12.3
24 hour maximum $PM_{2.5}$	30.7	33.7	22.6

Shoalhaven Starches engaged Stephenson Environmental Management Australia to conduct targeted background ambient air quality monitoring at 26 Coomea Street, Bomaderry over four seasons. (AMBIENT AIR QUALITY MONITORING –SUMMARY REPORT 2015-2016, Stephenson Environmental Management Australia, April 2016). The maximum measured levels of pollutants measured over the monitoring periods with a 24 hour averaging period were:

– SO_2 – 10.2 µg/m^3
– NO_2 – 54.5 µg/m^3
– PM_{10} – 28.1 µg/m^3

The results show all pollutants are significantly lower than the levels recorded at Albion Park South, and would include any emissions from the Shoalhaven Starches site. The maximum levels all readily comply with the relevant criteria. Using the background SO_2 and CO data from the Albion Park South monitoring station in this assessment allows for additional conservatism.

7. Odour assessment

7.1 Emissions inventory

7.1.1 Source identification

Odour emanating from Shoalhaven Starches is comprised of a complex mixture of primarily odorous volatile organic compounds (VOCs). VOC speciation data from a range of principal odour sources indicates that the individual VOCs within the mixture tend to be classified under odour-based air quality criteria rather than toxicity-based[4] criteria. Therefore, the identified sources of odour are modelled collectively as odour.

Consistent with the previous air quality assessments, the following sources contribute to the majority of the odour impacts from the Shoalhaven Starches sites:

– DDG Plant (including Pellet Plant exhaust stack and biofilters)
– Starch Plant (Gluten and Starch Dryers)
– Ethanol Plant (yeast propagators and retention tank).

A number of other minor odour sources contribute to the remainder of the plant's odour impact. These are detailed in Appendix B.

7.1.2 Changes to baseline odour model

The baseline odour model includes all existing and proposed odour sources at the Shoalhaven Starches plant, including EPA monitored sources and all minor sources, up to Mod 21. The odour sources associated with these modifications have been discussed in depth in previous air quality assessments.

The following assumptions and additional changes were made to the baseline odour model:

– Peak odour emission rates were sourced from the odour monitoring conducted by SEMA in the previous four quarters for EPA ID sources. The sources were scaled to an ethanol production rate of 300 ML per year production. The quarter with the maximum measured total OER was selected for use in the assessment and is consistent with guidance in the Approved Methods and the recommendation from EPA (16 February 2017) that peak emissions should be assessed. The peak period was found to be quarter 2, 2020 (August 2020).
– The exit velocities and temperatures for EPA ID sources were adjusted to the modelled quarter. These measurements include the mitigation modifications made to No. 3 and No. 4 gluten dryer exhausts as part of the Mod 11 and 12 air quality assessment recommendations.
– No. 1 and No. 2 gluten dryers were proposed to be modified to starch dryers as part of 16 assessment. Therefore, the emission rates assigned to these dryers remains unchanged from the Mod 16 assessment as the dryers have not been modified yet.
– Mod 16 assessed the addition of a new gluten dryer (GD8). The emission rates assumed in Mod 16 remain unchanged as the dryer has not been constructed yet.
– Mod 17 assessed the addition of a new product dryer (No. 9) (PD9), which is planned to be installed within the speciality products building. The product dryer will comprise about 20% of the size and production capacity of the approved (but not yet constructed) Gluten Dryer 8. It is envisaged that Product Dryer 9 will be used on an interim basis to process gluten allowing for an incremental increase in processing of gluten until the approved product dryer building is constructed and gluten dryer 8 is operational.
– Once gluten dryer 8 is operational, it is envisaged that product dryer 9 will revert to processing starch. PD9 will not result in any increase in production above the current approval limit for flour processing under Mod 16 of 25,400 tonnes per week.
– For the purposes of odour modelling, as part of Mod 17, PD9 was modelled as processing gluten with odour emission rates conservatively modelled as per gluten dryer 1 (which is of a similar size). The stack from the dryer will rise above and through the roof of the speciality product building at a height of 35.6 m. The diameter

[4] Based on VOC speciation data for selected sources in the DDG plant: DDG dryers, palmer cooler and condensate tanks.

of the stack is proposed to be 0.85 m. The flow rates were calculated based on 20% of the proposed gluten dryer 8.

– As part of the Mod 19 proposal, a new distillation plant (with columns and associated processing equipment) is proposed to be installed immediately to the west of the existing Ethanol Distillery Plant. One additional emission source associated with this change is the new Distillation plant Column Washing Vent (CWV2), which is a duplication of the existing source (CWV). The stack height of the new source as provided by Manildra, is 55 metres tall. Stack diameter, exit velocity and temperature were sourced from the sampling report for the similar existing source (*Odour Research Laboratories Australia (2020) Olfactometry Test Report for Beverage Ethanol D500 Vent Report No. 7091/ORLA/01)*. Cooling tower odours were removed in Mod 19 due to improvements at the site and subsequently being removed as a EPL odour sampling point.
– As part of the Mod 21 proposal, the following changes were added:
  - installation of additional biofilter capacity to improve odour performance and increase biofilter ability to treat a higher volume of odorous air. Therefore odour concentrations from biofilter sampling undertaken prior to the diversion of odorous air from DDG4 have been used in this assessment.
  - odour emissions from the indirect cooking facility were increased by 50%.
  - Boiler 5/6 emissions were modelled with an exit velocity of 10 metres per second.
– As part of the current proposal (Mod 23), the following changes were made:
  - All boilers would be converted to gas fired. Odour emissions from boiler no 5 & 6 (gas fired) was estimated based on quarterly odour sampling data scaled based on proposed flowrate.
– Odour emission rates were assumed to be unchanged for the other emission sources.

7.1.3 Source summary and comparison

Modelling for the proposed Mod 23 scenario comprised the following sources:

– 65 point sources in total throughout the site;
– 63 point sources with constant emissions
– Two point sources with variable emissions
– 11 area sources (consisting of two biofilters and the effluent treatment ponds)
– Five volume sources within the factory area.
– These sources are detailed in Table 7.1 and Appendix B.

A comparison of the sources and Mass Odour Emission Rates (MOER) between Mod 13, Mod 16, Mod 17, Mod 19, Mod 21 and the current modification is provided in Table 7.1.

This shows that the total odour levels from the current proposal decrease by approximately 15% compared with the previous Mod 21 Q2 (attributed to conversion of boilers to gas and therefore removal of coal/woodchip fired boilers 2 and 4 as an odour source) and increased by approximately 10% compared with previous Mod 21 Q3 (attributed to variability in odour sampling data).

Table 7.1 Comparison of odour emissions from previous mods to current mod

Source	Model Reference	MOER OU.m³/s (Mod 13)	MOER OU.m³/s (Mod 16)	Modelled Mod 17 MOER OU.m³/s	Modelled Mod 19 MOER OU.m³/s	Modelled Mod 21 MOER OU.m³/s		Modelled Mod 23 MOER OU.m³/s
						Q2	Q3	
Boilerhouse								
Boiler no 2	BOILR2	-	-	-	12,677	8,309	7,025	-
Boiler no 4	BOILR4	3,171	5,666	22,077	27,988	37,247	29,207	-
Boiler no 5 & 6	BOILR5	38,463	43,711	68,610	88,902	94,550	102,780	70,708
Sub total MOER		**41,634**	**49,377**	**90,687**	**129,567**	**140,106**	**139,013**	**70,708**
% of total MOER		**15.0%**	**18.3%**	**23.8%**	**29.9%**	**29.7%**	**37.9%**	**17.6%**
DDG Plant								
Condenser drain	VCD	31	31	31	4,419	4,419	4,419	4,419
DDG tent storage area	DDG36	1,929	1,929	1,929	1,929	1,929	1,929	1,929
Product storage sheds	DDG34	1,023	1,023	1,023	1,023	1,023	1,023	1,023
Light phase tank	DDG19	20	20	20	74	74	74	74
Cooling towers	DDG46	172	172	172	-	0	0	-
DDG Loadout Shed Awning	DDG35	923	923	923	923	923	923	923
Pellet exhaust stack	PPES	38,240	31,544	88,073	67,000	84,100	40,442	84,100
Pellet silo	S12	350	350	350	350	350	350	350
Stillage surge tank	SST	149	149	149	173	173	173	173
Pellet plant fugitives (non-DDG sources)	PPF	5,771	5,771	5,771	5,771	5,771	5,771	5,771
Additional Cooling towers	CTP	172	172	172	-	0	0	-
Sub total MOER		**48,780**	**42,084**	**98,613**	**81,661**	**98,761**	**55,103**	**98,761**
% of total MOER		**17.5%**	**15.6%**	**25.9%**	**18.9%**	**20.9%**	**15.0%**	**24.5%**
Ethanol Plant								
Yeast Propagators -tanks 4 and 5	YP45	820	820	820	820	820	820	820
Grain retention tank	GRT	3,250	3,250	3,250	4,535	4,535	4,535	4,535
Ethanol recovery scrubber	ERESC	3,132	10,660	15,405	33,091	41,258	15,198	41,258

Source	Model Reference	MOER OU.m³/s (Mod 13)	MOER OU.m³/s (Mod 16)	Modelled Mod 17 MOER OU.m³/s	Modelled Mod 19 MOER OU.m³/s	Modelled Mod 21 MOER OU.m³/s		Modelled Mod 23 MOER OU.m³/s
						Q2	Q3	
Fermenters 10-16	FERM	2,668	3,298	795	2,500	2,000	2,804	2,000
Jet cooker 1 retention tank	E13	1,067	1,067	1,067	1,067	1,067	1,067	1,067
Jet cooker 2/4 grain retention	E7	567	567	567	567	851	851	851
Feed to distillery	E22	83	83	83	83	83	83	83
Sub total MOER		**11,587**	**19,745**	**21,987**	**42,663**	**50,613**	**25,358**	**50,613**
% of total MOER		**4.2%**	**7.3%**	**5.8%**	**9.9%**	**10.7%**	**6.9%**	**12.6%**
Distillery								
Incondensable gases vent	D6	558	558	558	558	558	558	558
Molec. sieve vacuum drum	D2	1,350	1,350	1,350	1,350	1,350	1,350	1,350
Column Washing Vent	CWV	23	25	27	1,399	1,218	1,218	1,218
Distillation plant Column Washing Vent	CWV2				1,399	1,218	1,218	1,218
Sub total MOER		**1,931**	**1,933**	**1,935**	**4,707**	**4,344**	**4,344**	**4,344**
% of total MOER		**0.7%**	**0.7%**	**0.5%**	**1.1%**	**1.0%**	**1.0%**	**1.0%**
Starch and Glucose								
Flour mill A Exhaust	A4	679	679	679	679	679	679	679
Flour mill A Exhaust	A5	96	96	96	96	96	96	96
Flour mill A Exhaust	A6	449	449	449	449	449	449	449
Flour mill A Exhaust	A7	932	932	932	932	932	932	932
Drum vac receiver	C4	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Dry gluten roof bin	S07	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Enzyme tanks	B7	2,042	2,042	2,042	2,042	2,042	2,042	2,042
Flash vessel jet cooker	C1	970	970	970	970	970	970	970
Flour bin aspirator	S13A	500	500	500	500	500	500	500
Flourbin aspirator	S13B	500	500	500	500	500	500	500
Flourbin motor drive	S06	283	283	283	283	283	283	283
Flour mill aspiration (Mod 8)	FMP1	266	205	205	205	205	205	205

Source	Model Reference	MOER OU.m³/s (Mod 13)	MOER OU.m³/s (Mod 16)	Modelled Mod 17 MOER OU.m³/s	Modelled Mod 19 MOER OU.m³/s	Modelled Mod 21 MOER OU.m³/s		Modelled Mod 23 MOER OU.m³/s
						Q2	Q3	
Flour mill aspiration (Mod 8)	FMP2	205	266	266	266	266	266	266
High protein dust collector	S08	600	600	600	600	600	600	600
Ion exchange effluent tank	C18	250	250	250	250	250	250	250
No 1 gluten dryer baghouse	S02	5,925	5,166	5,166	9,800	9,800	7,136	9,800
No 1 starch dryer	S01	5,193	5,193	11,316	2,800	3,200	6,358	3,200
No 2 gluten/starch dryer	S04	2,354	5,166	5,166	7,200	6,000	3,362	6,000
No 3 gluten dryer baghouse	S03	58,917	29,036	21,696	12,700	32,000	11,540	32,000
No 3 starch dryer	S18	1,663	5,166	5,166	3,800	6,800	1,942	6,800
No 4 gluten dryer baghouse	S05	31,222	22,433	13,693	9,100	20,000	9,768	20,000
No 4 starch dryer	S19	1,824	4,008	5,020	3,600	2,500	1,848	2,500
No 5 ring dryer gluten/starch	SDR5	4,817	4,817	4,817	4,350	4,625	3,378	4,625
No 5 starch dryer (existing)	SD5C	6,800	6,800	3,393	4,931	2,123	3,172	2,123
No 5 starch dryer (new stack)	SD5N	-	-	17,387	25,269	10,877	16,256	10,877
No 6 gluten dryer	GD6	12,568	12,568	12,568	12,568	12,568	12,568	12,568
No 7 gluten dryer	GD7	9,553	9,553	9,553	9,553	9,553	9,553	9,553
Spray dryer	S20	738	738	738	738	738	738	738
Starch factory rejects	E10	183	183	183	183	183	183	183
Farm tank	F18	3,834	3,834	3,834	3,833	3,833	3,833	3,833
Pellet mill silo	PMFS	173	173	173	173	173	173	173
Flour Mill B Exhaust	FMBA to FMBM	5,637	4,621	4,621	3,621	3,621	3,621	3,621
Flour Mill C Exhaust	FMC1 to FMC3	n/a	1,658	1,658	1,560	1,560	1,560	1,560
Gluten dryer No.8	GD8	n/a	12,568	12,568	12,568	12,568	12,568	12,568
Product dryer 9	PD9	n/a	n/a	5,166	9,800	9,800	7,136	9,800
Sub total MOER		**165,073**	**147,353**	**157,553**	**151,819**	**166,194**	**130,365**	**166,194**
% of total MOER		**59.3%**	**54.7%**	**41.3%**	**35.1%**	**35.2%**	**35.6%**	**41.3%**

Source	Model Reference	MOER OU.m³/s (Mod 13)	MOER OU.m³/s (Mod 16)	Modelled Mod 17 MOER OU.m³/s	Modelled Mod 19 MOER OU.m³/s	Modelled Mod 21 MOER OU.m³/s		Modelled Mod 23 MOER OU.m³/s
						Q2	Q3	
Packing Plant (Not constructed)								
Starch silo 1	PPL1	86	86	86	86	86	86	86
Starch silo 2	PPL2	86	86	86	86	86	86	86
Gluten silo 1	PPM1	173	173	173	173	173	173	173
Gluten silo 2	PPM2	173	173	173	173	173	173	173
Gluten silo 3	PPM3	173	173	173	173	173	173	173
Small gluten silo	PPS1	92	92	92	92	92	92	92
Small starch silo	PPS2	35	35	35	35	35	35	35
Sub total MOER		**818**	**818**	**818**	**818**	**818**	**818**	**818**
% of total MOER		**0.3%**	**0.3%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**
Area sources: Environmental farm after WWTP								
Biofilter A (additional capacity installed in Mod 21)	BIO1	440	1,408	1,386	502	1,307	1,239	1,307
Biofilter B (additional capacity installed in Mod 21)	BIO2	330	803	1,111	1,648	1,208	1,187	1,208
Biofilter C	BIO3	1,089	1,089	1,089	1,089	1,089	1,307	1,089
Biofilter D	BIO4	1,280	1,280	1,280	1,280	1,281	1,208	1,281
Storage dam 1	PO1	148	71	119	1,475	948	948	948
Storage dam 2	PO2	1,656	248	143	973	687	687	687
Storage dam 3	PO3	192	569	1,231	2,962	1,626	1,626	1,626
Storage dam 5	PO5	515	971	1,922	6,538	1,248	1,248	1,248
Storage dam 6	PO6	1,775	1,435	793	3,097	1,435	1,435	1,435
Sulfur oxidisation basin	SOBAS	830	349	535	1,939	489	489	489
Membrane bio-reactor	MBR	62	62	62	54	54	54	54
Sub total MOER		**8,317**	**8,286**	**9,671**	**21,557**	**11,372**	**11,429**	**11,177**
% of total MOER		**3.0%**	**3.1%**	**2.5%**	**5.0%**	**2.4%**	**3.1%**	**2.8%**
Total (Mod 11 and Mod 12)		**278,140**						

Source	Model Reference	MOER OU.m³/s (Mod 13)	MOER OU.m³/s (Mod 16)	Modelled Mod 17 MOER OU.m³/s	Modelled Mod 19 MOER OU.m³/s	Modelled Mod 21 MOER OU.m³/s		Modelled Mod 23 MOER OU.m³/s
						Q2	Q3	
Total (Mod 16)			**269,595**					
Total (Mod 17)				**381,265**				
Total (Mod 19)					**432,792**			
Total (Mod 21)						**472,208**	**366,428**	
Total (Mod 23)								**402,811**

7.2 Dispersion modelling

The odour dispersion modelling was conducted using the Gaussian puff model CALPUFF Version 7. This model is also a recognised regulatory model in NSW. Where the modelling of odour dispersion is in complex terrain (as is the case at the Shoalhaven site), CALPUFF is recommended for use under NSW Guidelines. CALPUFF is especially suited for modelling light to calm wind conditions.

The following settings were used in the simulations:

- Model: CALPUFF Version 7
- The receptor grid was 10 km x 10 km, with a 200 m grid resolution
- The nearest receptors from the townships of Bomaderry (to the west) and Nowra (to the south) were used as sensitive receptors, along with a few isolated residences around the factory and environmental farm
- Ground level receptor heights have been modelled using the same terrain data as the original 2008 GHD assessment. This terrain data was used in the CALMET 2004 model which is used for CALPUFF modelling
- Emissions were scaled based on a nose-response time for odour of one second, applying a peak-to-mean ratio to the one hour average concentration of 2.3 for wake affected point sources and volume sources, and variable scaling for non-wake affected sources and area sources
- Meteorology was taken from the CALMET 2004 synthesised dataset, approved for use in previous studies
- Building wake effects (including changes to the building layouts) were modelled to the extent practicable.

7.3 Predicted odour impacts

Table 7.2 shows the predicted 99th percentile odour impacts (one second nose-response time) for the proposed Mod 23 operations and the previous modifications. Figure 7.1 shows the predicted odour levels for the proposal Mod 23 and the previous modification results.

The predicted odour levels for Mod 23 show a general decrease compared against Mod 21 (Q2) predictions and are relatively unchanged compared against Mod 21 (Q3) predictions. The decrease compared to Mod 21 Q2 odour levels is attributed to conversion of boilers to gas and therefore removal of coal/woodchip fired boilers 2 and 4 as an odour source. The relatively minor fluctuation in odour predictions compared to Mod 21 Q3 is attributed to variability in odour sampling.

The results for Mod 23 show that the impact assessment odour criteria are achieved at all residential sensitive receptors.

Seven commercial/industrial receptors are included in the assessment. These are all located within approximately 125 m of the site. One second, 99th percentile odour impacts have been predicted based on the hours of operation of the receptors as per Section 2.2 (i.e. predicted odour impacts when the sites are not operational have been excluded from the assessment).

Mod 23 predicted marginal exceedances of the 6 OU criteria (assumed the same criteria as R1) at commercial/industrial receptors C2, C3, C4, C5, and C7 due to the higher quarterly odour sampling results.

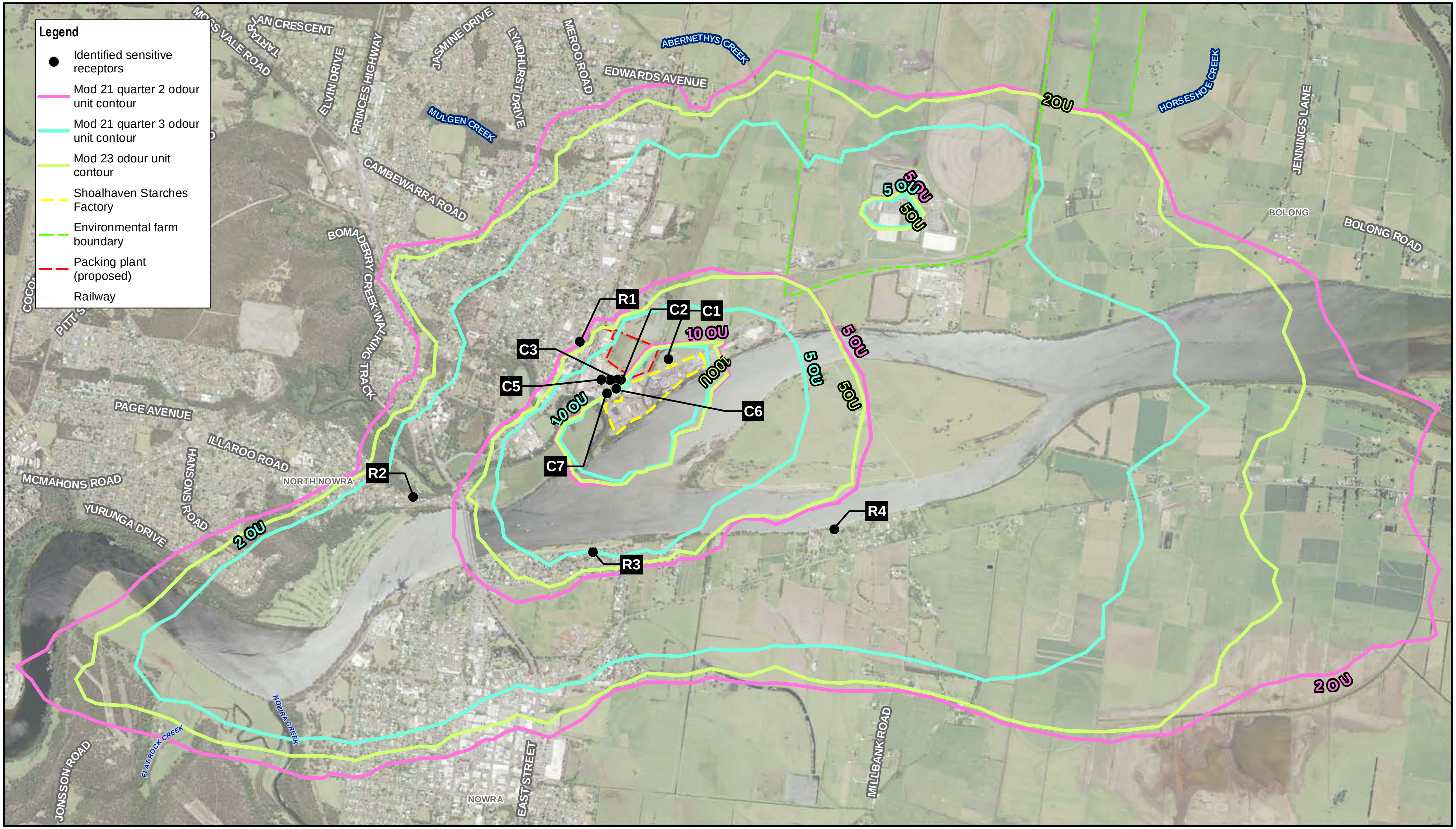
Commercial receptors C1 and C6 are located approximately 45 and 80 metres from the site. Given the industrial nature of these receptor, and its existing proximity to the site no significant odour impacts are anticipated from the proposal.

Two odour complaints (one in October 2020 and one in March 2021) attributed to the Shoalhaven Starches plant was received in the last year.

Table 7.2 Predicted peak (99th percentile, short term averaged) odour impact at nearby receptors

Receptor	Range, m	To nearest odour source	Direction	2009 EA approved 'base case' Odour criterion	Odour impact, OU, 99th percentile, nose-response time						
					Mod 13	Mod 16	Mod 17[5]	Mod 19	Mod 21 (Q2)	Mod 21 (Q3)	Mod 23
R1 Bomaderry	150	Packing Plant	W	6	3.3	3.5	4	4	5	4	5
R2 North Nowra	1300	Factory	SW	3	2.5	2.6	3	3	4	3	3
R3 Nowra	700	Factory	S	5	4	4.6	5	5	6	5	5
R4 Terara	1300	Factory	SE	5	3.7	3.7	4	4	5	4	5
C1	45	Factory	N	n/a	n/a	10.3	12	12	14	12	12
C2	20	Factory	N	n/a	n/a	5.8	8	10	10	9	8
C3	30	Factory	N	n/a	n/a	5.3	7	9	9	8	8
C4	75	Factory	NW	n/a	n/a	4.4	6	7	8	7	7
C5	125	Factory	NW	n/a	n/a	6.1	7	7	8	7	7
C6	30	Factory	NW	n/a	n/a	5.4	7	10	10	9	9
C7	55	Factory	NW	n/a	n/a	4.8	7	8	9	8	8

[5] Predicted odour concentrations rounded to nearest whole number from MOD17 onwards as per EPA advice



Paper Size ISO A4

0 160 320 480 640 800 960

Metres

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

N

GHD

Manildra Group Pty Ltd
Shoalhaven Starches

Odour impacts, 99th percentile, short term averaged – Modification 23

Project No. **12548374**
Revision No. **0**
Date **18 Aug 2021**

FIGURE 7.1

\\ghdnet\ghd\AU\Sydney\Projects\21\12534209\GIS\Maps\Deliverables\12548374\12548374_003_Odour_Mod23.mxd
Print date: 18 Aug 2021 - 09:59

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Customer Service 2020. Created by: kpsroba

8. Air quality assessment

8.1 Emissions inventory

In addition to odour emissions, the operation of the Shoalhaven Starches plant also has the potential to generate emissions of particulate matter and products of combustion.

The emissions inventory for Modification 23 includes all existing air emissions sources at the site and those proposed in previous Modifications (up to and including Modification 21). Emission rates were estimated for a factory throughput of 300 ML per annum (maximum approved throughput).

Two new emission sources associated with the operation of the new gas-fired co-generation plant (consists of two natural gas turbines) are proposed as part of Modification 23. The new gas fired natural gas turbines would replace the approved (but not constructed) gas fired and coal fired co-generators. Additionally, all existing coal fired boilers would be converted to gas fired.

The gas turbines and gas-fired boilers would be a source of particulates, combustion pollutants, PAH, VOC's and metals.

The air quality scenarios considered as part of Mod 23 included:

– **Typical operations** – This is the typical scenario that Manildra intend to operate in accordance with during Mod 23. Both co-generation plant natural gas turbines would be operational to provide the baseload energy requirements for the site. Boilers 5 and 6 would operate at low capacity to cover short term changes to steam demand.

– **Maintenance scenario** – This is a rare operating scenario that would occur for 1 – 2 weeks a year when a gas turbine is brought offline for statutory maintenance and repairs. Boilers 5 and 6 would be increased in output and boiler 8 would operate to cover short term changes to steam demand. It is noted that a boiler alternative to boiler 8 may be used in the maintenance scenario, however the gas consumption from all site boilers would remain constant and therefore emissions to air are expected to remain constant and corresponding changes to ground level air quality concentrations are expected to be negligible.

The proposed co-generation plant and boiler operation and fuel usage for each scenario is summarised in Table 8.1.

Generally the emissions estimation methodology adopted for Modification 23 was consistent with that of previous modifications. Modification 23 emission rates were updated based on most recent sampling data to reflect the site's current operations. A refined particulate matter assessment methodology was adopted to speciate particulate fractions from TSP to PM_{10} and $PM_{2.5}$ based on a review of particle size distribution data provided in *Appendix B.1 Particle Size Distribution Data and Sized Emission Factors for Selected Sources* of *United States Environmental Protection Agency Air Emissions Factors and Quantification AP-42: Compilation of Air Emissions Factors* (US EPA guidance) refer Section 8.3.1 for further detail.

Assumptions and changes made to the baseline air quality model as part of this assessment are discussed in detail below for each of the individual source types.

8.1.1 Boiler emissions

Emission estimation based on site specific sampling data was used where available, however sampling data for gas fired boiler was not available for all pollutants. At the time of this assessment, sampling data was only available for VOC's (refer to preliminary VOC sampling results provided in Preliminary Report REF: R012021p supplied in Appendix C) and therefore, emissions factors from the *National Pollutant Inventory Emission estimation technique manual for Combustion in boilers Version 3.6 (December 2011)* (NPI factors) were used for all other pollutants (emissions factors for natural gas (≤30MW wall fired)). Emissions of VOCs were estimated based on the maximum sampled VOC concentration from existing boilers scaled based on gas consumption to calculate the VOC exhaust concentration of proposed gas boilers.

The existing gas boilers (boilers 1, 3, 7 and proposed gas boiler 8) will continue to be maintained and the existing coal and mixed coal and woodchip fired boilers (boilers 2, 4, 5, 6) will be converted from coal to biogas / natural gas fired.

For typical operational conditions, boilers 1, 2, 3, 4, 7 and 8 would be on standby, while only boilers 5 and 6 are proposed to be used.

Boilers allocated to standby duty (i.e. Boilers 1, 2, 3, 4, 7 and 8) would not be operational (no fuel usage and no emissions) and would only be brought online during statutory maintenance periods while a gas turbine or boiler 5 and 6 is offline for inspection and maintenance or in emergency situations.

Boilers 5 and 6 are proposed to operate at reduced capacity at approximately 40% and 30% of their capacity respectively. Boilers would contribute approximately 14% of the site's total steam production requirements.

Conversion of existing coal fired boilers to gas is expected to significantly reduce the emissions of combustion pollutants (CO, SO_2 and NO_2), PAH, VOC's and metals and eliminates the emission of some pollutants including antimony, tin and vanadium (emissions factors for these pollutants are not provided for gas fired boilers).

The proposed boiler and fuel usage for each scenario is summarised in Table 8.1.

Table 8.1 Modification 23 boiler and cogeneration operational details

Plant	Purpose	Fuel type		Modification 23 fuel usage (GJ/hour)		Steam production (tonnes/hour)		Emission estimation methodology for active boilers
		Current	Mod 23	Typical operations	Maintenance scenario	Typical operations	Maintenance scenario	
Cogen plant (two gas turbines)	Provide baseload energy requirements	N/A	Gas	784	392	212	106	Manufacturer specifications and guarantees
Boiler 1	Standby duty (offline and not operating)	Gas	Gas	0	0	0	0	N/A
Boiler 2	Standby duty (offline and not operating)	Coal and woodchips	Gas	0	0	0	0	N/A
Boiler 3	Standby duty (offline and not operating)	Gas	Gas	0	0	0	0	N/A
Boiler 4	Standby duty (offline and not operating)	Coal and woodchips	Gas	0	0	0	0	N/A
Boiler 5	Active (approximately 40% capacity for typical operations)	Coal	Gas	48.3	131	17	45	NPI emission factors for natural gas (<30MW wall fired) for all pollutants except VOC's
Boiler 6	Active (approximately 30% capacity for typical operations)	Coal	Gas	48.3	174	17	60	NPI emission factors for natural gas (<30MW wall fired) for all pollutants except VOC's
Boiler 7	Standby duty (offline and not operating)	Gas	Gas	0	0	0	0	N/A
Boiler 8	Under construction – to be on standby duty (offline and not operating) for Mod 23	N/A	Gas	0	99	0	34	NPI emission factors for natural gas (<30MW wall fired) for all pollutants except VOC's
TOTAL				**880**	**795**	**245**	**245**	

8.1.2 Product dryer emissions

Product dryer emissions were estimated based on site specific sampling data for particulate matter (TSP, PM_{10} and $PM_{2.5}$) and NO_x and relied on NPI factors (Table 20: Emissions Factors for natural gas (tangential fired)) for CO, SO_2 and VOC.

The following updates have been made to the site emissions inventory for the product dryers:

– The total natural gas consumption across all dryers was updated to 472,916 GJ/year to align with 2021 FY actual gas usage in the dryers.

– Dryer emissions were updated to include VOC emissions which were estimated based on NPI factors

No other changes to product dryer emissions were made from those presented in Mod 21.

1.2.2 Gas cogeneration turbines

Emissions from the proposed gas-fired co-generation were supplied by GE Power (the supplier of the equipment). GE Power's emission estimation and manufacturer emission guarantees are supplied in Appendix D.

The proposed cogeneration plant operation and fuel usage for each scenario is summarised in Table 8.1.

8.1.3 Other emission sources

The DDG Pellet Plant (model ID: PPF) was replaced by two new sources: wheat silos (model ID: A04) and bulk bag aspiration fan (model ID: B46) based on feedback from Manildra that changes to exhaust ducting mean emissions would no longer be released via the DDG Pellet Plant (model ID: PPF) source.

Other emissions sources would remain unchanged from previous air quality assessments.

It should be noted that the gas turbines assessed as part of the 2008 air quality assessment (GHD, 2008) previously approved by EPA were removed from the model as they would be replaced by the new gas-fired co-generation plant proposed as part of this modification.

The modelled emission rates from Mod 23 are summarised in Table 8.2 and Table 8.3.

Table 8.2 Emission inventory – Particulate matter

Discharge Point	Model ID	EPA ID	Emission control	Typical operations			Maintenance scenario		
				TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Boiler No. 5/6	BOILR5	35	Fabric filter	0.00097	0.00097	0.00097	0.003	0.003	0.003
Boiler No. 8	BOILR8		Gas-fired				0.00099	0.00099	0.00099
Gluten dryer No. 1	S02	8	Fabric filter	0.015	0.0003	0.000069	0.015	0.0003	0.000069
Gluten dryer No. 2	S04	9	Fabric filter	0.015	0.001	0.00023	0.015	0.001	0.00023
Gluten dryer No. 3	S03	10	Fabric filter	0.02	0.012	0.0028	0.02	0.012	0.0028
Gluten dryer No. 4	S05	11	Fabric filter	0.02	0.012	0.0028	0.02	0.012	0.0028
Ring Dryer No. 5	SDR5		Fabric filter	0.012	0.0072	0.0017	0.012	0.0072	0.0017
Gluten dryer No. 6	GD6		Fabric filter	0.02	0.012	0.0028	0.02	0.012	0.0028
Gluten Dryer No. 7	GD7		Fabric filter	0.035	0.021	0.0049	0.035	0.021	0.0049

Discharge Point	Model ID	EPA ID	Emission control	Typical operations			Maintenance scenario		
				TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Gluten Dryer No. 8	GD8		Fabric filter	0.02	0.012	0.0028	0.02	0.012	0.0028
Starch dryer No. 1	S01	12	Cylone and wet-scrubber	0.044	0.033	0.0076	0.044	0.033	0.0076
Starch dryer No. 3	S18		Cylone and wet-scrubber	0.04	0.013	0.003	0.04	0.013	0.003
Starch dryer No. 4	S19	14	Cylone and wet-scrubber	0.057	0.029	0.0066	0.057	0.029	0.0066
Starch dryer No. 5	SD5C	47	Cyclone	0.062	0.038	0.0087	0.062	0.038	0.0087
No. 5 Starch Dryer	SD5N		Cyclone	0.32	0.19	0.045	0.32	0.19	0.045
Spray dryer 5	S20		Fabric filter	0.0028	0.0019	0.00043	0.0028	0.0019	0.00043
Flour Mill	FMP1, FMP2		Fabric filter	0.0005	0.00031	0.00007	0.0005	0.00031	0.00007
New Flour Mill B (MOD 10)	FMBA-FMBF		Fabric filter	0.0037	0.0023	0.00052	0.0037	0.0023	0.00052
Flour Mill C (new)	FMC1-FMC3		Fabric filter	0.0013	0.00077	0.00018	0.0013	0.00077	0.00018
Packing Plant (MOD 9 approved)	PPL1-2, PPM1-3, PPS1-2		Fabric filter	0.016	0.0098	0.0022	0.016	0.0098	0.0022
Co-generator turbine No. 1 (proposed)	turb1		Gas-fired	0.71	0.71	0.71	0.71	0.71	0.71
Co-generator turbine No. 2 (proposed)	turb2		Gas-fired	0.71	0.71	0.71			
Silo source 1 (combined stack for 3 silos)	SILO1		Fabric filter	0.0042	0.0025	0.00058	0.0042	0.0025	0.00058
Silo source 2 (combined stack for 6 silos)	SILO2		Fabric filter	0.0042	0.0025	0.00058	0.0042	0.0025	0.00058
Silo source 3 (combined stack for 2 silos)	SILO3		Fabric filter	0.017	0.01	0.0023	0.017	0.01	0.0023
Silo source 4 (combined stack for 6 silos)	SILO4		Fabric filter	0.0042	0.0025	0.00058	0.0042	0.0025	0.00058
Silo source 5 (combined stack for 3 silos)	SILO5		Fabric filter	0.013	0.0076	0.0018	0.013	0.0076	0.0018

Discharge Point	Model ID	EPA ID	Emission control	Typical operations			Maintenance scenario		
				TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Product dryer 9	PD9		Fabric filter	0.015	0.0003	0.000069	0.015	0.0003	0.000069
Wheat silos	A04		Fabric filter	0.0034	0.0021	0.00048	0.0034	0.0021	0.00048
Bulk bag aspiration fan	B46		Fabric filter	0.0027	0.0016	0.00037	0.0027	0.0016	0.00037

Table 8.3 *Emission inventory – Products of combustion (typical operations)*

Discharge Point	Boiler No. 5/6	Gluten dryer No. 1	Gluten dryer No. 2	Gluten dryer No. 3	Gluten dryer No. 4	Ring Dryer No. 5	Gluten dryer No .6	Gluten Dryer No. 7	Gluten Dryer No. 8	Starch dryer No. 3	Starch dryer No. 4	Starch dryer No. 5	No. 5 Starch Dryer	Spray dryer 5	Product dryer 9	Co-generator turbine No. 1	Co-generator turbine No. 2
Model ID	BOILR5	S02	S04	S03	S05	SDR5	GD6	GD7	GD8	S18	S19	SD5C	SD5N	S20	PD9	turb1	turb2
Fuel type	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Status / details	Existing, changing from coal-fired to gas	Natural gas is fed through to the dryers for combustion														Proposed in MOD23, to replace approved Co-generator turbines	
Stack height (m)	54	25.5	27	21	30	25	35	29	29	20	20	34	30	19	36	45	45
Exhaust temp. (K)	410	344	337	347	345	320	346	341	346	309	312	341	341	344	346	374	374
Stack diameter (m)	2.05	3.2	3.2	2.5	2.7	1.2	1.7	1.8	1.9	1.2	1.2	2.4	2.4	1.4	0.9	2.7	2.7
Exhaust velocity (m/s)	10	0.1	0.1	11.0	21.0	0.1	20.0	19.0	20.0	23.0	22.0	2.9	14.7	0.1	15.3	16.9	16.9
Oxygen (%)	ND	20.9	20.9	20.9	20.6	20.9	20.9	20.9	ND	20.9	20.9	ND	ND	20.5	ND	12.0	12.0
Moisture (%)	ND	7.3	5.9	6.3	6.4	6.8	7.0	6.5	ND	5.8	3.2	ND	ND	3.5	ND	6.3	6.3
Exhaust Flow rate, actual (m3/s)	22.4	20.2	17.1	48.3	40.2	20.6	45.4	40.1	56.7	23.0	21.0	12.4	63.8	12.2	8.7	96.7	96.6
Ratio (Actual to normalised flow)	ND	1.3	1.4	1.3	1.3	1.4	1.4	1.3	ND	1.2	1.2	ND	ND	1.3	ND	ND	ND
Emission rate (g/s)																	
CO	1.1	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.0022	0.011	0.013	0.013	4.7	4.7
SO_2	0.014	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00010	0.00052	0.00062	0.00062	0.31	0.31
NO_2	0.65	0.12	0.024	0.43	0.060	0.075	0.10	0.062	0.23	0.038	0.036	0.016	0.082	0.048	0.035	3.7	3.7
VOC	0.22	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.00050	0.0026	0.0031	0.0031	0.32	0.32
Arsenic (As) Type I	2.6E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium (Cd) Type I	1.4E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead (Pb) Type I	6.5E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury (Hg) Type I	3.4E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium (Be) Type II	1.6E-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium (Cr) Type II	1.8E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Discharge Point	Boiler No. 5/6	Gluten dryer No. 1	Gluten dryer No. 2	Gluten dryer No. 3	Gluten dryer No. 4	Ring Dryer No. 5	Gluten dryer No .6	Gluten Dryer No. 7	Gluten Dryer No. 8	Starch dryer No. 3	Starch dryer No. 4	Starch dryer No. 5	No. 5 Starch Dryer	Spray dryer 5	Product dryer 9	Co-generator turbine No. 1	Co-generator turbine No. 2
Cobalt (Co) Type II	1.1E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese (Mn) Type II	5.0E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel (Ni) Type II	2.7E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Selenium (Se) Type II	3.1E-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycyclic Aromatic Hydrocarbons (PAH)	8.3E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Emission rates, normalised (mg/Nm^3, dry, 273 K, 101.3 K)[6]																	
CO	ND	0.90	1.12	0.37	0.45	0.90	0.41	0.44	ND	0.71	0.75	ND	ND	1.4	ND	49	49
SO_2	ND	0.041	0.052	0.017	0.021	0.041	0.019	0.020	ND	0.033	0.034	ND	ND	0.066	ND	3.2	3.2
NO_2	ND	8.0	2.0	12.0	2.0	5.0	3.0	2.0	ND	2.0	2.0	ND	ND	5.1	ND	39	39
TSP	ND	1.0	1.3	0.56	0.67	0.79	0.61	1.12	ND	2.1	3.2	ND	ND	0.30	ND	7.3	7.3
Type 1 and 2 metals (combined)	ND																
Cadmium	ND																
Mercury	ND																
VOC	ND																

The emission rate limits are as follows:

Protection of the Environment Operations (Clean Air) Regulation (2010): CO: 125 mg/m^3, SO_2: 1000 mg/m^3, NO_2: 350 mg/m^3 (any boiler operating on a fuel other than gas), NO_2: 70 mg/m^3 (any turbine operating on gas), TSP: 50 mg/m^3, Type 1 and 2 metals (combined): 1 mg/m^3, Cadmium: 0.2 mg/m^3, Mercury: 0.2 mg/m^3, VOC: 40 mg/m^3, HCL: 100 mg/m^3, FL: 50 mg/m^3

EPA: SO_2: 600 mg/m^3, NO_2: 500 mg/m^3, TSP: 30 mg/m^3, Type 1 and 2 metals (combined): 1 mg/m^3, Cadmium: 0.2 mg/m^3, Mercury: 0.2 mg/m^3, VOC: 40 mg/m^3.

[6] For co-generator turbine No.1 and 2, normalized emission concentrations are presented as mg/Nm^3, dry, 273 K, 101.3 K at 15% O_2 based on emissions guarantees provided by GE Power

Table 8.4 Emission inventory – Products of combustion (maintenance scenario)

Discharge Point	Boiler No. 5/6	Boiler No. 8	Gluten dryer No. 1	Gluten dryer No. 2	Gluten dryer No. 3	Gluten dryer No. 4	Ring Dryer No. 5	Gluten dryer No .6	Gluten Dryer No. 7	Gluten Dryer No. 8	Starch dryer No. 3	Starch dryer No. 4	Starch dryer No. 5	No. 5 Starch Dryer	Spray dryer 5	Product dryer 9	Co-generator turbine No. 1	Co-generator turbine No. 2
Model ID	BOILR5	BOILR8	S02	S04	S03	S05	SDR5	GD6	GD7	GD8	S18	S19	SD5C	SD5N	S20	PD9	turb1	turb2
Fuel type	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Status / details	Existing, changing from coal-fired to gas		Natural gas is fed through to the dryers for combustion														Proposed in MOD23, to replace approved Co-generator turbines	
Stack height (m)	54	24	25.5	27	21	30	25	35	29	29	20	20	34	30	19	36	45	45
Exhaust temp. (K)	410	527	344	337	347	345	320	346	341	346	309	312	341	341	344	346	374	374
Stack diameter (m)	2.05	1.7	3.2	3.2	2.5	2.7	1.2	1.7	1.8	1.9	1.2	1.2	2.4	2.4	1.4	0.9	2.7	2.7
Exhaust velocity (m/s)	10	10.3	0.1	0.1	11.0	21.0	0.1	20.0	19.0	20.0	23.0	22.0	2.9	14.7	0.1	15.3	16.9	16.9
Oxygen (%)	ND	ND	20.9	20.9	20.9	20.6	20.9	20.9	20.9	ND	20.9	20.9	ND	ND	20.5	ND	12.0	12.0
Moisture (%)	ND	ND	7.3	5.9	6.3	6.4	6.8	7.0	6.5	ND	5.8	3.2	ND	ND	3.5	ND	6.3	6.3
Exhaust Flow rate, actual (m3/s)	22.4	23.3	20.2	17.1	48.3	40.2	20.6	45.4	40.1	56.7	23.0	21.0	12.4	63.8	12.2	8.7	96.7	96.6
Ratio (Actual to normalised flow)	ND	ND	1.3	1.4	1.3	1.3	1.4	1.4	1.3	ND	1.2	1.2	ND	ND	1.3	ND	ND	ND
	Emission rate (g/s)																	
CO	3.5	1.13	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.0022	0.011	0.013	0.013	4.7	0
SO_2	0.045	0.01	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00010	0.00052	0.00062	0.00062	0.31	0
NO_2	2.06	0.67	0.12	0.024	0.43	0.060	0.075	0.10	0.062	0.23	0.038	0.036	0.016	0.082	0.048	0.035	3.7	0
VOC	0.71	0.24	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.00050	0.0026	0.0031	0.0031	0.32	0
Arsenic (As) Type I	8.2E-06	2.7E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cadmium (Cd) Type I	4.5E-05	1.5E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead (Pb) Type I	2.1E-05	6.7E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury (Hg) Type I	1.1E-05	3.5E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium (Be) Type II	4.9E-08	1.6E-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Discharge Point	Boiler No. 5/6	Boiler No. 8	Gluten dryer No. 1	Gluten dryer No. 2	Gluten dryer No. 3	Gluten dryer No. 4	Ring Dryer No. 5	Gluten dryer No .6	Gluten Dryer No. 7	Gluten Dryer No. 8	Starch dryer No. 3	Starch dryer No. 4	Starch dryer No. 5	No. 5 Starch Dryer	Spray dryer 5	Product dryer 9	Co-generator turbine No. 1	Co-generator turbine No. 2
Chromium (Cr) Type II	5.8E-05	1.9E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt (Co) Type II	3.3E-06	1.1E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese (Mn) Type II	1.6E-05	5.1E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel (Ni) Type II	8.6E-05	2.8E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Selenium (Se) Type II	9.7E-07	3.2E-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycyclic Aromatic Hydrocarbons (PAH)	2.6E-05	8.6E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Emission rates, normalised (mg/Nm^3, dry, 273 K, 101.3 K)[7]																		
CO	ND	ND	0.90	1.12	0.37	0.45	0.90	0.41	0.44	ND	0.71	0.75	ND	ND	1.4	ND	49	
SO_2	ND	ND	0.041	0.052	0.017	0.021	0.041	0.019	0.020	ND	0.033	0.034	ND	ND	0.066	ND	3.2	
NO_2	ND	ND	8.0	2.0	12.0	2.0	5.0	3.0	2.0	ND	2.0	2.0	ND	ND	5.1	ND	39	
TSP	ND	ND	1.0	1.3	0.56	0.67	0.79	0.61	1.12	ND	2.1	3.2	ND	ND	0.30	ND	7.3	
Type 1 and 2 metals (combined)	ND	ND																
Cadmium	ND	ND																
Mercury	ND	ND																
VOC	ND	ND																

The emission rate limits are as follows:

Protection of the Environment Operations (Clean Air) Regulation (2010): CO: 125 mg/m^3, SO_2: 1000 mg/m^3, NO_2: 350 mg/m^3 (any boiler operating on a fuel other than gas), NO_2: 70 mg/m^3 (any turbine operating on gas), TSP: 50 mg/m^3, Type 1 and 2 metals (combined): 1 mg/m^3, Cadmium: 0.2 mg/m^3, Mercury: 0.2 mg/m^3, VOC: 40 mg/m^3, HCL: 100 mg/m^3, FL: 50 mg/m^3

EPA: SO_2: 600 mg/m^3, NO_2: 500 mg/m^3, TSP: 30 mg/m^3, Type 1 and 2 metals (combined): 1 mg/m^3, Cadmium: 0.2 mg/m^3, Mercury: 0.2 mg/m^3, VOC: 40 mg/m^3.

[7] For co-generator turbine No.1 and 2, normalized emission concentrations are presented as mg/Nm^3, dry, 273 K, 101.3 K at 15% O_2 based on emissions guarantees provided by GE Power

8.2 Dispersion modelling

The air quality dispersion modelling was conducted using the Gaussian puff model CALPUFF Version 7. The model settings were as described in Section 7.2.

8.3 Predicted air quality impacts

8.3.1 Particulates

8.3.1.1 Incremental particulate matter

The impact of dust emissions principally relates to the potential effect on human health of inhalation of particles in the air column, and it is the finer fraction that have the greater potential to cause respiratory health effects. EPA have advised to assess $PM_{2.5}$, if PM_{10} impacts are significant. As the boilers are proposed to be converted to gas fired, it is anticipated that particulate emissions would be primarily composed of finer fraction particulates.

The $PM_{2.5}$ emissions from some sources on site are not known, however guidance is available from the National Pollutant Inventory. For gas fired boilers, a PM_{10} to $PM_{2.5}$ emissions ratio of 1:1 was adopted in accordance with *National Pollutant Inventory Emission estimation technique manual for Combustion in boilers Version 3.6 (December 2011)*.

For other sources lacking specific PM_{10} or PM_2.5 sampling data, a PM_{10}/TSP ratio of 0.61 and a $PM_{2.5}$/PM_{10} ratio of 0.23 was adopted in accordance with particle size distribution data provide for Grain processing in *Appendix B.1 Particle Size Distribution Data and Sized Emission Factors for Selected Sources* of *United States Environmental Protection Agency Air Emissions Factors and Quantification AP-42: Compilation of Air Emissions Factors* (US EPA guidance).

A summary of the maximum incremental predicted levels at each receptor site for Mod 23 typical operations and maintenance scenario is presented in Table 8.5.

The worst case predicted incremental 24 hour PM_{10} level at a residential sensitive receptors is at R1 with a level of 1.7 µg/m^3 for typical operations and 1.4 µg/m^3 for the maintenance scenario.

Table 8.5 Maximum predicted incremental ground level PM_{10}, $PM_{2.5}$ and TSP concentrations (µg/m^3)

Receptor	Predicted incremental concentrations (µg/m^3)									
	Typical operations					Maintenance scenario				
	TSP	PM_{10}		$PM_{2.5}$		TSP	PM_{10}		$PM_{2.5}$	
Averaging period	Annual	24 hour	Annual	24 hour	Annual	Annual	24 hour	Annual	24 hour	Annual
Criteria µg/m^3	90	50	25	25	8	90	50	25	25	8
R1	0.4	1.7	0.3	1.0	0.1	0.3	1.4	0.2	0.6	0.1
R2	0.2	1.0	0.1	0.5	0.0	0.1	0.8	0.1	0.3	0.0
R3	0.1	0.9	0.1	0.2	0.0	0.1	0.9	0.1	0.2	0.0
R4	0.2	0.8	0.1	0.2	0.0	0.2	0.8	0.1	0.2	0.0
C1	1.2	3.8	0.7	1.1	0.2	1.2	3.8	0.6	0.9	0.2
C2	1.5	4.7	0.9	1.4	0.3	1.4	4.7	0.8	1.1	0.2
C3	1.4	4.6	0.8	1.6	0.3	1.3	4.7	0.8	1.1	0.2
C4	1.2	4.2	0.7	1.6	0.3	1.1	4.2	0.6	1.0	0.2
C5	0.9	3.4	0.6	1.5	0.3	0.8	3.4	0.5	0.8	0.2
C6	1.6	6.7	0.9	1.5	0.3	1.5	6.7	0.9	1.6	0.2

Receptor	Predicted incremental concentrations (µg/m³)									
	Typical operations					Maintenance scenario				
	TSP	PM_{10}		$PM_{2.5}$		TSP	PM_{10}		$PM_{2.5}$	
Averaging period	**Annual**	**24 hour**	**Annual**	**24 hour**	**Annual**	**Annual**	**24 hour**	**Annual**	**24 hour**	**Annual**
Criteria µg/m³	**90**	**50**	**25**	**25**	**8**	**90**	**50**	**25**	**25**	**8**
C7	1.2	5.0	0.8	1.2	0.3	1.3	7.6	1.0	1.9	0.4

8.3.1.2 Cumulative particulate matter

A contemporaneous assessment has been undertaken for the year 2004 in accordance with the Approved Methods. Predicted 24 hour $PM_{2.5}$ and PM_{10} values from the site in 2004 have been added to the 24 hour measured values at Wollongong for every day in the year. As background TSP data was not available, a TSP/PM_{10} ratio of 2 was adopted (refer Table 6.2 for PM_{10} data) and therefore a background annual average TSP concentration of 37.4 µg/m³ was used.

A summary of the maximum cumulative predicted levels at each receptor site is presented in Table 8.6.

An exceedance of the cumulative 24 hour PM_{10} criteria is predicted at commercial receptor C6 for two 24 hour periods (0.5% of the time) for both typical operations and the maintenance scenario (exceedances highlighted). Compliance with the assessment criteria was predicted for all other particulate matter factions and averaging periods at all other receptors.

Table 8.6 Maximum predicted cumulative ground level PM_{10}, $PM_{2.5}$ and TSP concentrations (µg/m³)

Receptor	Predicted cumulative concentrations (µg/m³)									
	Typical operations					Maintenance scenario				
	TSP	PM_{10}		$PM_{2.5}$		TSP	PM_{10}		$PM_{2.5}$	
Averaging period	**Annual**	**24 hour**	**Annual**	**24 hour**	**Annual**	**Annual**	**24 hour**	**Annual**	**24 hour**	**Annual**
Criteria µg/m³	**90**	**50**	**25**	**25**	**8**	**90**	**50**	**25**	**25**	**8**
R1	37.7	49.0	18.4	22.6	6.6	37.7	49.0	18.3	22.6	6.5
R2	37.5	49.0	18.2	22.6	6.5	37.5	49.0	18.2	22.6	6.5
R3	37.5	49.0	18.2	22.6	6.5	37.5	49.0	18.2	22.6	6.5
R4	37.5	49.5	18.2	22.6	6.5	37.5	49.5	18.2	22.6	6.5
C1	38.6	49.3	18.8	22.7	6.6	38.5	49.2	18.7	22.7	6.6
C2	38.8	49.5	19.0	22.8	6.7	38.7	49.5	18.9	22.8	6.7
C3	38.8	49.6	18.9	22.9	6.7	38.7	49.6	18.9	22.9	6.7
C4	38.5	49.5	18.8	22.8	6.7	38.4	49.5	18.7	22.8	6.7
C5	38.3	49.4	18.7	22.7	6.7	38.2	49.3	18.6	22.7	6.6
C6	38.9	50.8	19.0	23.2	6.8	38.9	50.8	19.0	23.2	6.7
C7	38.6	49.8	18.9	22.9	6.7	38.5	49.7	18.8	22.9	6.7

The 24 hour PM_{10} exceedances at C6 were composed of relatively small incremental components (impacts due to site operation) and a relatively large background concentrations. The composition of the predicted 24 hour PM_{10} exceedances at C6 for both typical operations and the maintenance scenario is provided in Table 8.7 which shows incremental components account for 8% and 4% of the assessment criteria (50 µg/m³) respectively while background concentrations account for 94% and 97% of the assessment criteria respectively. Therefore, the exceedances were primarily attributed to high background concentrations and do not necessarily reflect site operations. Background particulate matter concentrations of this magnitude are likely driven by abnormal environmental events in the region such as bushfires and dust storms which are outside the control of Manildra.

Table 8.7 Composition of 24 hour PM_{10} exceedances at C6

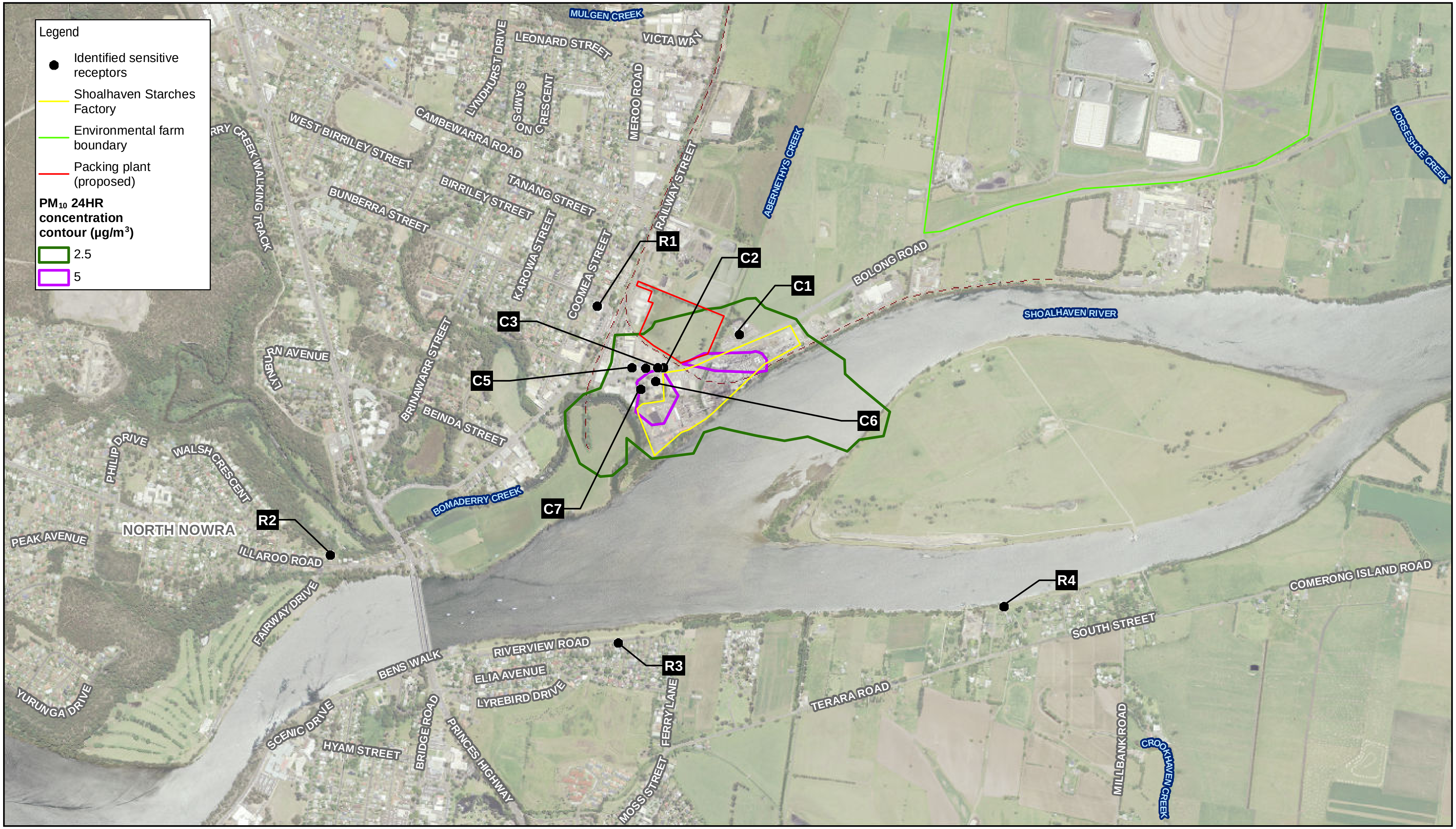
Rank	Exceedance date	Incremental prediction at C6 (µg/m^3)	Background component (µg/m^3)	Cumulative prediction at C6 (µg/m^3)
Typical operations				
1	21/02/2004	3.8	47.0	50.8
2	27/11/2004	1.8	48.4	50.2
Maintenance scenario				
1	21/02/2004	3.8	47.0	50.8
2	27/11/2004	1.7	48.4	50.1

Site incremental contributions at C6 on the two predicted cumulative exceedances were considered relatively minor as they accounted for less than 10% of the assessment criteria.

It is understood that Manildra intend to purchase the land were C6 is situated for future expansion works. Once the land has been acquired, no offsite exceedances of the 24 hour PM_{10} criteria are expected.

The following contour dispersion plots are provided for typical operations:

– Figure 8.1 – Maximum predicted 24 hour ground level PM_{10} concentrations (incremental impact)
– Figure 8.2 – Maximum predicted 24 hour ground level PM_{10} concentrations (cumulative impact with 70th percentile PM_{10} levels at Albion Park South 2016 for comparative purposes)
– Figure 8.3 – Maximum predicted 24 hour ground level $PM_{2.5}$ concentrations (cumulative impact with 70th percentile $PM_{2.5}$ levels at Albion Park South 2016 for comparative purposes)



Paper Size ISO A4

0 100 200 300 400 500 600

Metres

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

N

GHD

Manildra Group Pty Ltd
Shoalhaven Starches

Maximum Predicted Incremental Ground Level PM_{10} Concentrations (24-hour Average, Mod 23 typical operations)

Project No. 12548374
Revision No. A
Date 19 Jan 2022

FIGURE 8.1

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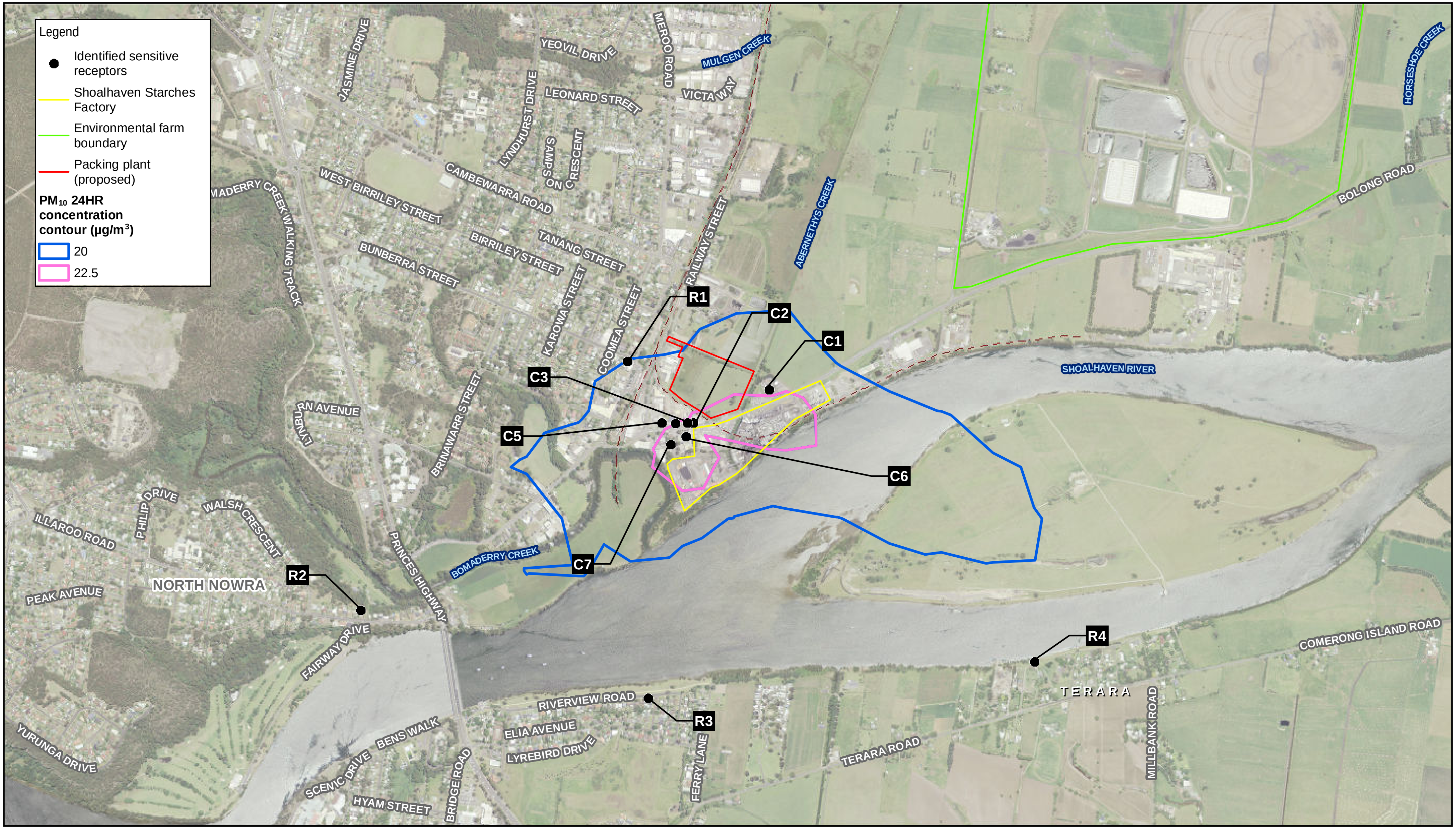
Print date: 19 Jan 2022 - 09:16

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Customer Service 2020. Created by: kpsroba



Paper Size ISO A4

0 110 220 330 440 550 660

Metres

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

N

GHD

Manildra Group Pty Ltd
Shoalhaven Starches

Maximum Predicted Cumulative Ground Level PM_{10} Concentrations (24-hour Average, Mod 23 typical operations)

Project No. 12548374
Revision No. A
Date 19 Jan 2022

FIGURE 8.2

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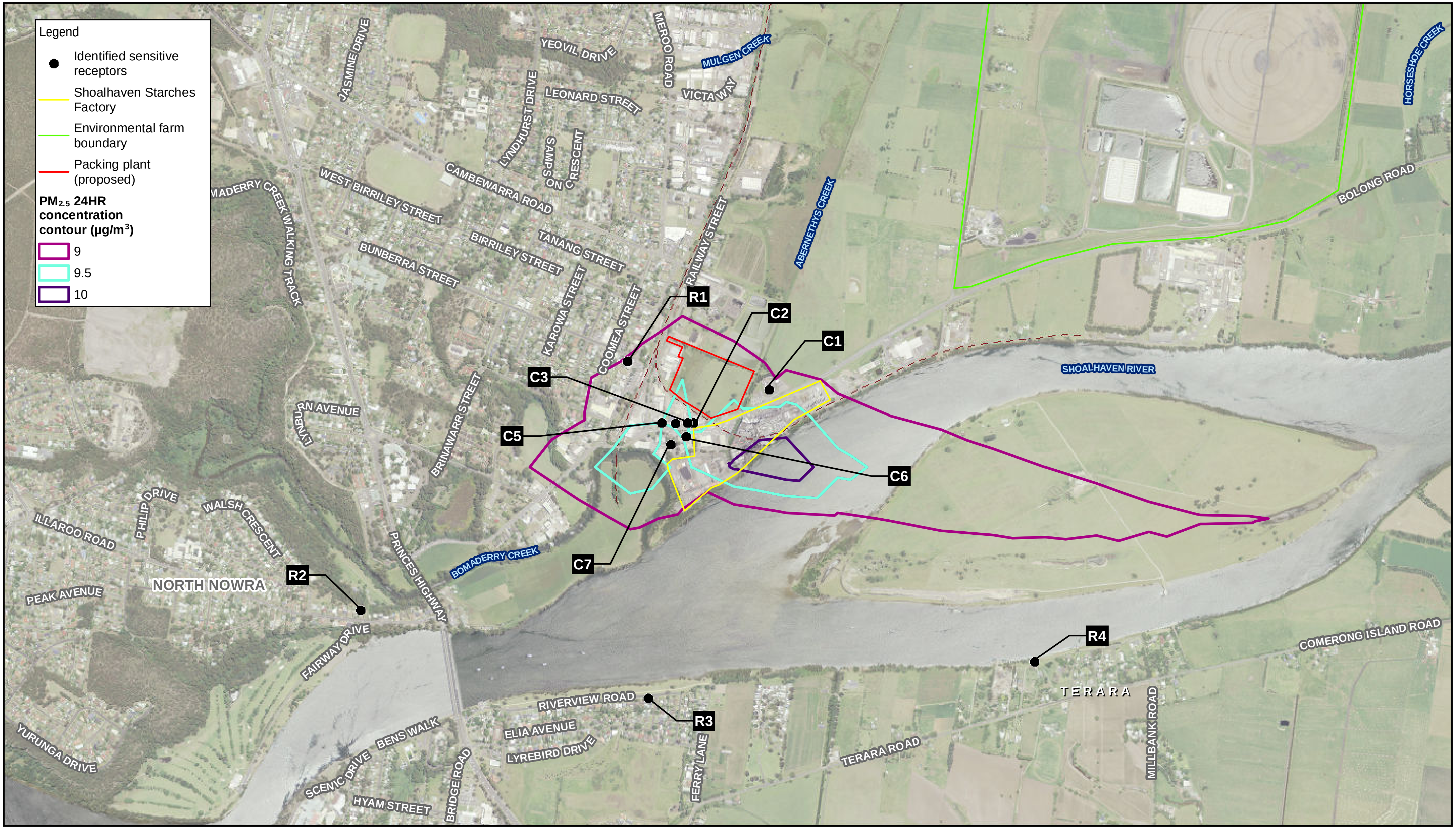
Print date: 19 Jan 2022 - 09:16

Data source: Aerial Imagery: SIXMAPS, 2018. General Topo: NSW LPI DTDB 2012© Department of Finance, Services & Innovation 2018. Created by: kpsroba



Paper Size ISO A4

0 110 220 330 440 550 660

Metres

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

N

GHD

Manildra Group Pty Ltd
Shoalhaven Starches

Maximum Predicted Cumulative Ground Level $PM_{2.5}$ Concentrations (24-hour Average, Mod 23 typical operations)

Project No. 12548374
Revision No. A
Date 19 Jan 2022

FIGURE 8.3

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8.3.2 Products of combustion

The primary pollutants in gas fired boilers and gas turbines emissions are oxides of nitrogen (NO_x), formed by the high temperatures in the combustors, carbon monoxide (CO), VOCs, and polycyclic aromatic hydrocarbons (PAH) all formed by incomplete combustion of the fuel.

All pollutants have all been assessed against their relevant criteria from the Approved Methods.

Predicted levels for SO_2, NO_2 and CO are provided in Table 8.8 to Table 8.13 for typical operations and the maintenance scenario. The predicted levels comply at all receptors for SO_2, NO_2 and CO for both scenarios.

The predicted levels for nitrogen dioxide were presented for two cases. The first case assumed that 100% of NO will be converted to NO_2 as per Method 1 (Section 8.1.1) of the Approved Methods. This is considered extremely conservative as in reality, only a fraction of the NO will be converted to NO_2. The second case adopted a more detailed assessment by using Method 2 (Section 8.2.2) of the Approved Methods which is based on NO reacting with ozone in the atmosphere to form NO_2. Background ozone data was sourced from Kembla Grange for the year 2004. The calculated NO_2 levels using Method 2 are provided in Table 8.10 and Table 8.11 for typical operation and maintenance scenarios respectively. Compliance was predicted for both methods.

Effect of Mod 23 changes

Conversion of existing coal fired boilers to gas significantly reduces the emissions of combustion pollutants and consequently the proposal was predicted to have a positive impact (compared with Mod 21) on combustion emissions as air emissions from gas are typically lower than coal.

Table 8.8 Maximum predicted ground level Sulfur Dioxide concentrations (typical operations)

Receptor	Total impact (Incremental plus background) (µg/m³)			
Criteria, µg/m³	712 (10 min[1])	570 (1 hour)	228 (24 hour)	60 (Annual)
Background, µg/m³	No data[2]	57.6	15.7	1.6
Bomaderry (R1)	61.2	60.1	16.1	1.7
North Nowra (R2)	59.5	58.9	15.9	1.6
Nowra (R3)	58.7	58.4	15.8	1.6
Terara (R4)	58.3	58.1	15.8	1.6
C1	60.2	59.4	16.0	1.6
C2	62.2	60.8	16.3	1.7
C3	62.2	60.8	16.4	1.7
C4	61.8	60.5	16.4	1.7
C5	62.8	61.2	16.3	1.7
C6	62.8	61.3	16.2	1.7
C7	63.4	61.6	16.2	1.7

Note 1: The 10 minute concentrations were calculated from the hourly values by applying a peak to mean factor of $(60/10)^{0.2}$.
Note 2: The 10 minute background levels were assumed to be the same as the 1 hour background levels in the absence of monitoring data.

Table 8.9 Maximum predicted ground level Sulfur Dioxide concentrations (maintenance scenario)

Receptor	Total impact (Incremental plus background) (µg/m³)			
Criteria, µg/m³	712 (10 min[1])	570 (1 hour)	228 (24 hour)	60 (Annual)
Background, µg/m³	No data[2]	57.6	15.7	1.6
Bomaderry (R1)	59.4	58.9	15.9	1.6
North Nowra (R2)	58.6	58.3	15.9	1.6
Nowra (R3)	58.5	58.2	15.8	1.6
Terara (R4)	58.1	58.0	15.8	1.6
C1	59.8	59.1	16.1	1.7
C2	60.1	59.4	16.0	1.7
C3	60.1	59.4	16.0	1.7
C4	60.1	59.4	16.1	1.7
C5	60.7	59.8	16.0	1.7
C6	60.5	59.6	16.0	1.7
C7	61.0	60.0	16.0	1.7

Note 1: The 10 minute concentrations were calculated from the hourly values by applying a peak to mean factor of $(60/10)^{0.2}$.
Note 2: The 10 minute background levels were assumed to be the same as the 1 hour background levels in the absence of monitoring data.

Table 8.10 Maximum predicted ground level Nitrogen Dioxide concentrations (typical operations)

Receptor	Total impact (Incremental plus background) (µg/m³)		
Criteria, µg/m³	**246 (1 hour, Method 1)**	**246 (1 hour, Method 2)**	**62 (Annual)**
Background, µg/m³	**80.8**	**n/a**	**7.1**
Bomaderry (R1)	110.9	97.8	8.2
North Nowra (R2)	98.1	97.8	7.5
Nowra (R3)	99.6	97.8	7.4
Terara (R4)	95.0	102.9	7.5
C1	129.1	97.8	9.9
C2	131.3	97.8	9.8
C3	129.4	97.8	9.6
C4	130.6	97.8	9.4
C5	138.2	97.8	9.2
C6	127.8	97.8	9.7
C7	140.3	97.8	9.4

Table 8.11 Maximum predicted ground level Nitrogen Dioxide concentrations (maintenance scenario)

Receptor	Total impact (Incremental plus background) (µg/m³)		
Criteria, µg/m³	**246 (1 hour, Method 1)**	**246 (1 hour, Method 2)**	**62 (Annual)**
Background, µg/m³	**80.8**	**n/a**	**7.1**
Bomaderry (R1)	108.2	97.8	8.2
North Nowra (R2)	98.3	97.8	7.6
Nowra (R3)	112.7	97.8	7.7
Terara (R4)	107.2	108.9	7.8
C1	148.0	97.8	10.9
C2	147.9	97.8	10.5
C3	141.7	97.8	10.2
C4	132.1	97.8	9.7
C5	130.4	97.8	9.3
C6	135.8	97.8	10.4
C7	128.3	97.8	9.8

Table 8.12 Maximum predicted ground level Carbon Monoxide concentrations (typical operations)

Receptor	Total impact (Incremental plus background) (mg/m^3)		
Criteria, $\mu g/m^3$	**100 (15 min[1])**	**30 (1 hour)**	**10 (8 hour)**
Background, $\mu g/m^3$	**No data[2]**	**1**	**0.6**
Bomaderry (R1)	1.03	1.02	0.61
North Nowra (R2)	1.02	1.01	0.60
Nowra (R3)	1.01	1.01	0.60
Terara (R4)	1.05	1.03	0.61
C1	1.07	1.05	0.62
C2	1.06	1.05	0.63
C3	1.06	1.05	0.63
C4	1.08	1.06	0.63
C5	1.07	1.06	0.62
C6	1.09	1.07	0.62
C7	1.03	1.02	0.61

Note 1: The 15 minute concentrations were calculated from the hourly values by applying a peak to mean factor of $(60/15)^{0.2}$.
Note 2: The 15 minute background levels were assumed to be the same as the 1 hour background levels in the absence of monitoring data.

Table 8.13 Maximum predicted ground level Carbon Monoxide concentrations (maintenance scenario)

Receptor	Total impact (Incremental plus background) (mg/m^3)		
Criteria, $\mu g/m^3$	**100 (15 min[1])**	**30 (1 hour)**	**10 (8 hour)**
Background, $\mu g/m^3$	**No data[2]**	**1**	**0.6**
Bomaderry (R1)	1.03	1.02	0.61
North Nowra (R2)	1.04	1.03	0.61
Nowra (R3)	1.03	1.02	0.61
Terara (R4)	1.09	1.07	0.64
C1	1.10	1.07	0.63
C2	1.09	1.07	0.63
C3	1.08	1.06	0.62
C4	1.07	1.06	0.62
C5	1.08	1.06	0.63
C6	1.07	1.06	0.62
C7	1.03	1.02	0.61

Note 1: The 15 minute concentrations were calculated from the hourly values by applying a peak to mean factor of $(60/15)^{0.2}$.
Note 2: The 15 minute background levels were assumed to be the same as the 1 hour background levels in the absence of monitoring data.

8.3.3 PAH, VOCs and metals

The maximum predicted (99.9 percentile, 1-hour average) ground level incremental PAH, VOC and metal concentrations (with the exception of lead which is presented as a 100 percentile annually averaged concentration to align with its assessment criteria), within and beyond the factory site boundary are provided in Table 8.14 for typical operations and Table 8.15 for the maintenance scenario.

In absence of a specific VOC assessment criteria, predicted VOC concentrations were compared against the assessment criteria for toluene and acetone as they were identified as being present in the gas boiler VOC speciation data, refer Appendix C for VOC sampling report. As the assessment criteria for toluene (0.36 mg/m^3) is more stringent than that of acetone (22 mg/m^3), the toluene criteria is included in Table 8.14 and Table 8.15 for comparative purposes.

The predicted levels are significantly lower than the respective EPA principal toxic air pollutant criteria for all substances both within and beyond the site boundary.

Effect of Mod 23 changes

Conversion of existing coal fired boilers to gas significantly reduces the emissions of PAH, VOC's and metals and eliminates the emission of some pollutants including antimony, tin and vanadium. Consequently the proposal is predicted to have a positive impact (compared with Mod 21) on combustion emissions as air emissions from gas are typically lower than coal.

Table 8.14 Maximum predicted ground level PAH, VOC and metals concentrations (typical operations)

Receptor	Incremental Impact (mg/m^3)[8]									
Pollutant	**PAH**	**VOC**	**Arsenic**	**Cadmium**	**Mercury**	**Beryllium**	**Chromium**	**Manganese**	**Nickel**	**Lead**
Criteria	**0.0004 mg/m^3 (1 hour)**	**Individual VOCs (Toluene 0.36 mg/m^3) (1 hour)**	**9.00E-05 mg/m^3 (1 hour)**	**1.80E-05 mg/m^3 (1 hour)**	**1.80E-03 mg/m^3 (1 hour)**	**4.00E-06 mg/m^3 (1 hour)**	**9.00E-05 mg/m^3 (1 hour)**	**1.80E-02 mg/m^3 (1 hour)**	**1.80E-04 mg/m^3 (1 hour)**	**5.0E-04 mg/m^3 (Annual)[9]**
Averaging period and percentile	**1 hour, 99.9th percentile**									**Annual, 100th percentile**
Bomaderry (R1)	2.0E-08	1.7E-03	6.3E-09	3.5E-08	8.2E-09	3.8E-11	4.4E-08	1.2E-08	6.6E-08	5.8E-10
North Nowra (R2)	1.7E-08	1.1E-03	5.2E-09	2.8E-08	6.7E-09	3.1E-11	3.6E-08	9.8E-09	5.4E-08	3.2E-10
Nowra (R3)	2.4E-08	9.3E-04	7.5E-09	4.1E-08	9.7E-09	4.5E-11	5.2E-08	1.4E-08	7.8E-08	1.5E-10
Terara (R4)	1.3E-08	6.0E-04	4.1E-09	2.3E-08	5.3E-09	2.5E-11	2.9E-08	7.8E-09	4.3E-08	7.3E-11
C1	7.3E-08	3.4E-03	2.3E-08	1.3E-07	3.0E-08	1.4E-10	1.6E-07	4.3E-08	2.4E-07	1.3E-09
C2	4.4E-08	2.8E-03	1.4E-08	7.6E-08	1.8E-08	8.3E-11	9.7E-08	2.6E-08	1.4E-07	9.8E-10
C3	4.1E-08	2.7E-03	1.3E-08	7.1E-08	1.7E-08	7.8E-11	9.1E-08	2.5E-08	1.4E-07	9.5E-10
C4	3.5E-08	2.8E-03	1.1E-08	6.1E-08	1.4E-08	6.6E-11	7.7E-08	2.1E-08	1.2E-07	9.0E-10
C5	3.1E-08	2.8E-03	9.7E-09	5.3E-08	1.3E-08	5.8E-11	6.8E-08	1.8E-08	1.0E-07	8.7E-10
C6	4.2E-08	3.0E-03	1.3E-08	7.3E-08	1.7E-08	8.0E-11	9.3E-08	2.5E-08	1.4E-07	9.8E-10
C7	3.4E-08	3.4E-03	1.1E-08	5.8E-08	1.4E-08	6.4E-11	7.4E-08	2.0E-08	1.1E-07	9.6E-10
Maximum level (on site)	1.1E-07	3.8E-03	3.3E-08	1.8E-07	4.3E-08	2.0E-10	2.3E-07	6.2E-08	3.4E-07	1.4E-09

[8]

[9] Lead criteria converted from $\mu g/m^3$ to mg/m^3 so that all results have consistent units

Table 8.15 Maximum predicted ground level PAH, VOC and metals concentrations (maintenance scenario)

Receptor	Incremental Impact (mg/m^3)[10]									
Pollutant	**PAH**	**VOC**	**Arsenic**	**Cadmium**	**Mercury**	**Beryllium**	**Chromium**	**Manganese**	**Nickel**	**Lead**
Criteria	**0.0004 mg/m^3 (1 hour)**	**Individual VOCs (Toluene 0.36 mg/m^3) (1 hour)**	**9.00E-05 mg/m^3 (1 hour)**	**1.80E-05 mg/m^3 (1 hour)**	**1.80E-03 mg/m^3 (1 hour)**	**4.00E-06 mg/m^3 (1 hour)**	**9.00E-05 mg/m^3 (1 hour)**	**1.80E-02 mg/m^3 (1 hour)**	**1.80E-04 mg/m^3 (1 hour)**	**5.0E-04 mg/m^3 (Annual)[11]**
Averaging period and percentile	**1 hour, 99.9th percentile**									**Annual, 100th percentile**
Bomaderry (R1)	1.3E-07	4.0E-03	4.0E-08	2.2E-07	5.2E-08	2.4E-10	2.8E-07	7.6E-08	4.2E-07	3.7E-09
North Nowra (R2)	9.3E-08	2.9E-03	2.9E-08	1.6E-07	3.8E-08	1.7E-10	2.0E-07	5.5E-08	3.1E-07	2.3E-09
Nowra (R3)	1.7E-07	4.9E-03	5.2E-08	2.9E-07	6.7E-08	3.1E-10	3.6E-07	9.8E-08	5.4E-07	2.9E-09
Terara (R4)	1.3E-07	3.8E-03	4.0E-08	2.2E-07	5.2E-08	2.4E-10	2.8E-07	7.6E-08	4.2E-07	3.0E-09
C1	4.0E-07	1.2E-02	1.3E-07	6.9E-07	1.6E-07	7.6E-10	8.8E-07	2.4E-07	1.3E-06	1.3E-08
C2	2.9E-07	8.8E-03	9.0E-08	5.0E-07	1.2E-07	5.4E-10	6.3E-07	1.7E-07	9.5E-07	1.1E-08
C3	2.6E-07	7.9E-03	8.0E-08	4.4E-07	1.0E-07	4.8E-10	5.6E-07	1.5E-07	8.4E-07	1.0E-08
C4	2.1E-07	6.3E-03	6.5E-08	3.6E-07	8.4E-08	3.9E-10	4.5E-07	1.2E-07	6.8E-07	8.4E-09
C5	1.8E-07	5.7E-03	5.7E-08	3.1E-07	7.4E-08	3.4E-10	4.0E-07	1.1E-07	6.0E-07	7.0E-09
C6	2.8E-07	8.5E-03	8.7E-08	4.8E-07	1.1E-07	5.2E-10	6.1E-07	1.7E-07	9.1E-07	1.2E-08
C7	2.8E-07	8.4E-03	8.8E-08	4.8E-07	1.1E-07	5.3E-10	6.1E-07	1.7E-07	9.2E-07	9.5E-09
Maximum level (on site)	7.4E-07	2.1E-02	2.3E-07	1.3E-06	3.0E-07	1.4E-09	1.6E-06	4.4E-07	2.4E-06	4.4E-08

10

11 Lead criteria converted from $\mu g/m^3$ to mg/m^3 so that all results have consistent units

9. Conclusions

GHD was engaged by Manildra to conduct an air quality and odour impact assessment for a proposed modification to the approved SSEP. The modification proposes a new gas-fired co-generation plant (to replace the approved gas fired and coal fired co-generators) and conversion of existing coal fired boilers to gas. In addition, Manildra propose to install additional biofilter capacity in the previously approved location to improve odour performance.

Odour dispersion modelling was undertaken for the quarter with maximum odour emissions (in accordance with the methodology adopted for past modification air quality assessments). A marginal decrease in odour levels was predicted compared against Mod 21 Q2 and relatively unchanged odour levels was predicted compared against Mod 21 Q3. The decrease compared to Mod 21 Q2 odour levels is attributed to conversion of boilers to gas and therefore removal of coal/woodchip fired boilers 2 and 4 as an odour source. The relatively minor fluctuation in odour predictions compared to Mod 21 Q3 is attributed to variability in odour sampling.

The odour dispersion modelling predicted compliance of the odour criteria at all residential receptors.

Dispersion modelling of combustion products, particulates, PAH, VOCs and metals predicted compliance with the criteria at all residential sensitive receptors.

Overall, the proposal should be acceptable from an air quality perspective.

Appendices

Appendix A

Meteorological analysis

The following section is taken from the Shoalhaven Starches Report on Ethanol Upgrade: Air Quality Assessment (GHD, 2008), and describes the meteorology of the area and how the dataset was compiled.

A1 Meteorology

The three-dimensional meteorological data for a CALPUFF model simulation are provided by CALMET[12], its meteorological pre-processor. CALMET requires meteorological input from surface weather station networks and upper air stations.

The following sub-sections describe the available meteorological data, how the data was applied and the features of the dispersion meteorological data used to run CALPUFF.

A1.1 Data Available

Wind data were collected at three locations within the Shoalhaven Starches facility. Of these three stations, only one station, the automated weather station (AWS) located near the storage ponds at the environmental farm (hereafter referred to as Farm AWS), is compliant with the Australian Standard for the measurement of horizontal wind for air quality applications (AS 2923:1987). The other two stations, in particular the weather station located at the factory, are compromised by building and equipment infrastructure. Wind data have been collected at the Farm AWS since 2003, with the most complete data set collected in 2004.

The nearest source of additional surface meteorological data was the Bureau of Meteorology (BoM) Nowra AWS located approximately 12 km to the west at the Royal Australian Navy base at Nowra (HMAS ALBATROSS). This data source was considered to be too far from the subject area to be site-representative.

The nearest source of upper air meteorological data was also the HMAS ALBATROSS site, which does irregular upper air soundings based on operational requirements. However, the time gap between these vertical atmospheric soundings is too large to be suitable for use as model input.

A1.2 Data Application

To take full advantage of the CALPUFF features, described in Section 7.1, and make use of the available meteorological data described above, a combined prognostic/diagnostic meteorological modelling approach was used to synthesise the three-dimensional meteorological data input required by CALPUFF.

The regional-scale prognostic meteorological model, TAPM[13], was used to simulate the meteorology over the subject site with consideration to the DECC *Approved Methods*. TAPM is an approved model for specialist applications and its use, as part of this assessment, is described in the next section.

The observations from the Farm AWS and Nowra AWS were first used for optimising and checking the performance of the prognostic model simulation.

Wind speed and wind direction data from the Farm AWS were then assimilated into the prognostic model.

The subsequent TAPM output (with assimilated Farm AWS data) was then passed to meteorological pre-processor model CALMET (version 5.5).

A2 Prognostic Meteorological Modelling

TAPM (version 3.0.7) was developed at CSIRO Division of Atmospheric Research as a PC-based prognostic modelling system that can predict regional scale three-dimensional meteorology. TAPM accesses databases of synoptic weather analyses from the Bureau of Meteorology. The model then provides the link between the

[12] Scire J.S., E.M. Insley, R.J. Yamartino, and M.E. Fernau, 1995: A User's Guide for the CALMET Meteorological Model. Report prepared for the USDA Forest Service by EARTH TECH, Concord, MA. See: http://www.src.com/calpuff/calpuff1.htm
[13] Hurley, P. The Air Pollution Model (TAPM) version 3. CSIRO Atmospheric Research Paper No. 31, 2005

synoptic large-scale flows and local climatology, which includes characterising such factors as local land use and topography, and their influence on atmospheric stability and mixing height.

TAPM was initially configured with a nested model grid coverage designed to capture:

- Broad scale synoptic flows
- Regional to local scale wind channelling
- The influence of local land use

The nested grids were then configured with surface characteristics, such as terrain elevation, surface type (land use and vegetation type), soil type and deep soil moisture content.

Specific model settings were:

- Four nested grids at 1 000 m, 3 000 m, 10 000 m and 25 000 m resolution, with 55 x 55 grid points. The grid was set to ensure the locations of the Farm AWS and Nowra AWS were within the inner nested grid
- Surface vegetation and precipitation processes were included, whereas, non-hydrostatic processes were not included

Following an initial model run, the model output from the grid point nearest to the Farm AWS was compared with data recorded at that station. Specifically, the predicted hourly ambient temperatures and the annual wind rose (wind speed and direction distributions) were compared with corresponding recordings. Model output from the model grid point nearest to the Nowra AWS was also compared with an annual wind rose derived from data recorded at that station.

Figure A1 shows the scatter plot of observed and predicted ambient temperature at the Farm AWS. The determined optimal model configuration produced a correlation coefficient of 0.88 for predicted temperature. The strong correlation between predicted and recorded temperature indicates that the model is accurately calculating the surface energy balance, which, in turn, adds confidence to the hourly varying predictions made for atmospheric stability and the height of the mixed layer.

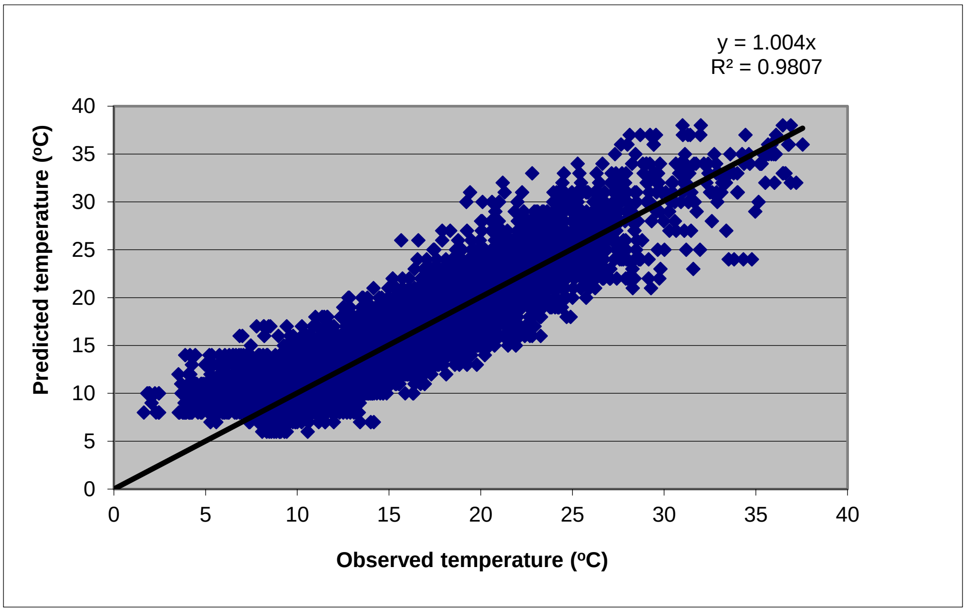


Figure A1 Scatter Plot of Observed and Predicted Ambient Temperature

A2.1 Wind Distribution

Figure A2 shows the predicted (a) and observed (b) wind roses for the location of the Nowra AWS. The directional distribution of winds predicted by TAPM shows reasonable agreement with the recorded observations and with the wind patterns expected for this region.

Figure A3 shows the predicted (a) and observed (b) wind roses for the location of the Farm AWS after the initial TAPM simulation. The directional distribution of winds predicted by TAPM shows reasonable agreement with the recorded wind patterns expected for this region.

The wind speed and direction observations from the Farm AWS were assimilated into the prognostic model simulation to improve the ability of the model to capture the effects of local wind channelling and low wind speed conditions. The improvement to wind direction distributions in the model output is clearly evident in Figure A3(c). The marked improvement in the capture of low wind events is examined below.

It is understood that TAPM performs reasonably well at simulating low wind speeds when the atmosphere is unstable but is known to perform relatively poorly during stable atmospheric conditions[14]. This is a critical factor in this assessment given that odour emissions occur 24-hours per day, resulting in predictions of maximum odour impact dominating during these conditions.

Figure A4 shows a histogram of wind speed distribution for observations at the Farm AWS, predictions from TAPM and predictions from TAPM after wind speed and direction data from the Farm AWS were assimilated into TAPM. It is clear from this figure that TAPM did reasonably well at originally predicting moderate to high wind speeds but did relatively poorly predicting low wind speeds. However, Figure A4 also shows that the representation of low winds in the TAPM output was significantly improved once the Farm AWS data were assimilated into the model.

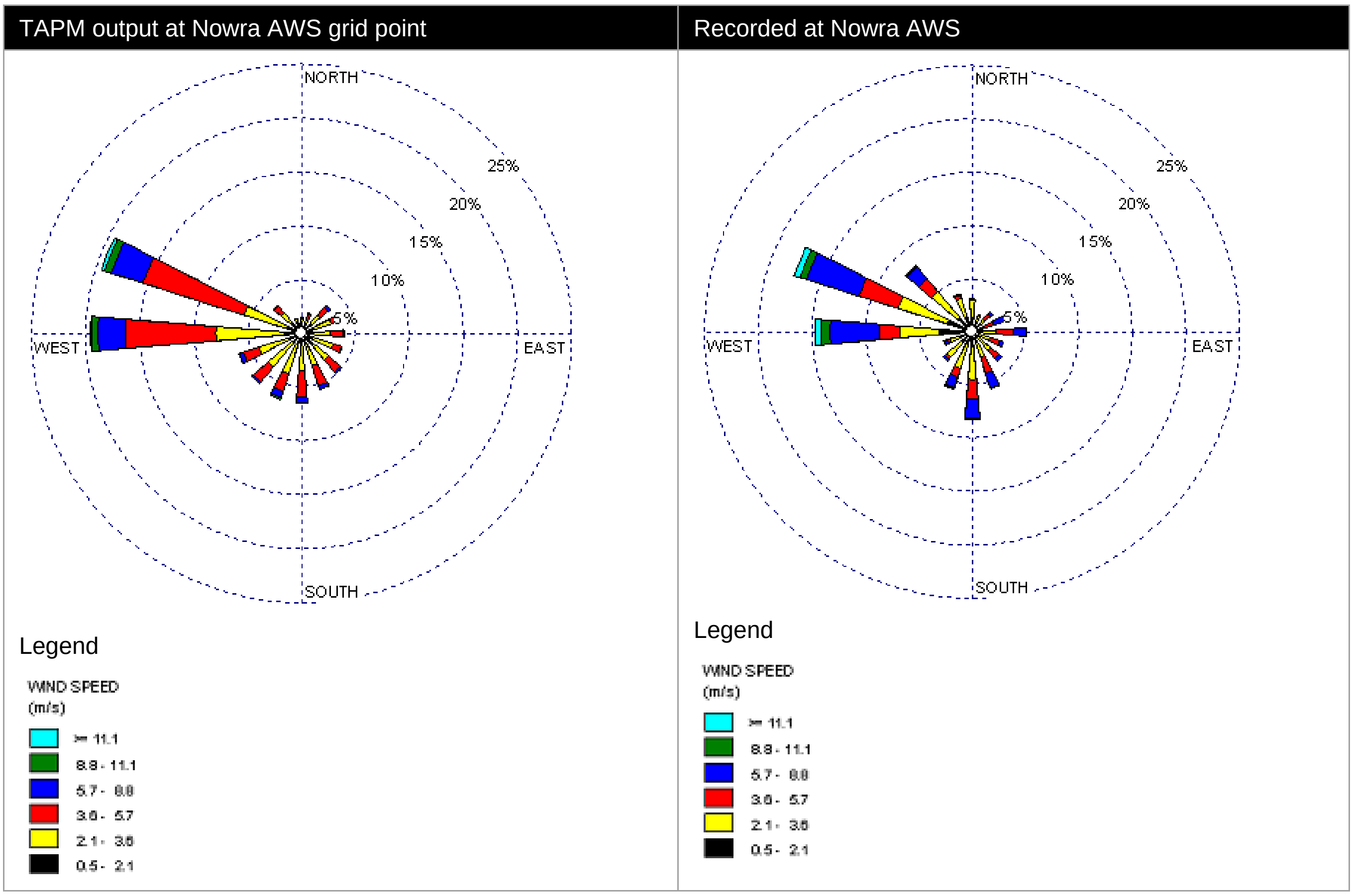
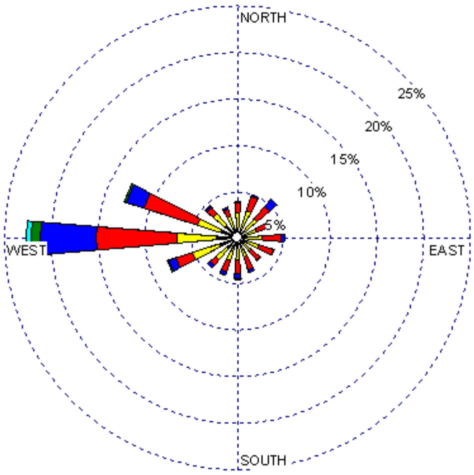


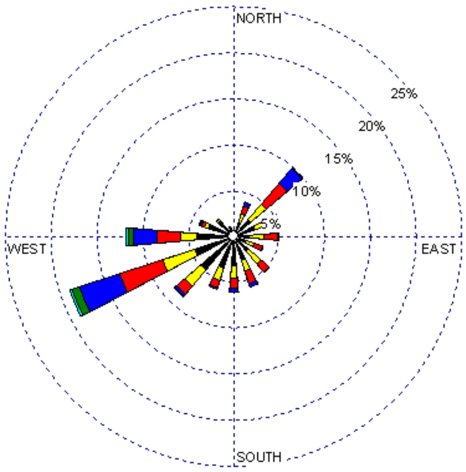
Figure A2 ***Nowra AWS - Annual Wind Roses (Year 2004)***

[14] Luhar, A., Hurley, P. and Rayner, K. Improving Land Surface Processes in TAPM. Part 2: Low Wind Stable Conditions. 14th IUAPPA World Congress 2007

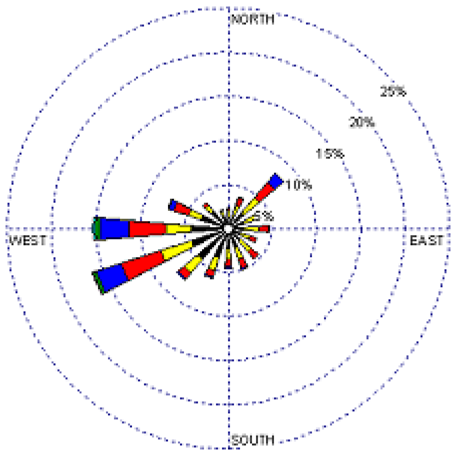
a) TAPM output at Farm AWS



b) Recorded at Farm AWS



c) TAPM output at Farm AWS grid point after Farm AWS data assimilated



Legend

Figure A3 *Farm AWS - Annual Wind Roses (year 2004)*

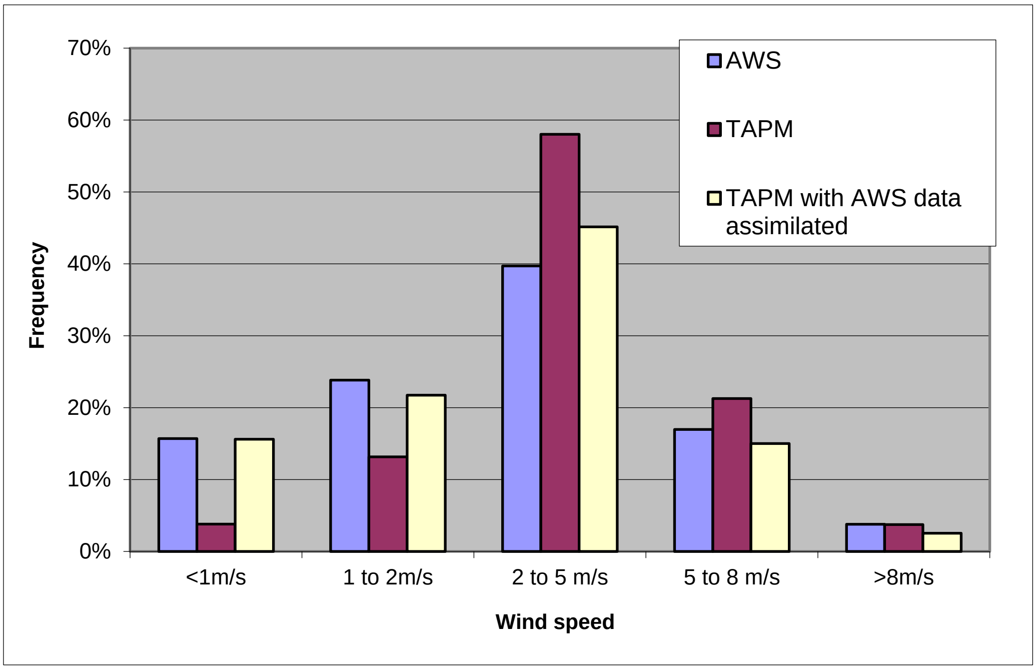


Figure A4 Wind Speed Distribution – TAPM and Farm AWS

To further investigate the effect of data assimilation on model output, a sensitivity analysis was conducted to compare the subsequent CALPUFF model predictions using meteorological input derived with and without the assimilation of observed wind speed and wind direction data from the Farm AWS into TAPM. Good agreement was found in the general pattern of dispersion (i.e. similar directions of poor dispersion), however, the highest ground level odour concentrations were predicted when the assimilated meteorological data file was used, which was expected given the higher frequency of light winds.

A3 Diagnostic Meteorological Model - CALMET

The TAPM output (with assimilated data) was then passed to model CALMET (version 5.5)[15], which is the 3D meteorological diagnostic model pre-processor to the CALPUFF 3D puff based dispersion model.

Hourly varying 3D meteorological data, at a 1000 m resolution, were extracted from the TAPM inner nested grid and passed to CALMET in their entirety as initial guess fields. Surface meteorological parameters and vertical profile data were also extracted from TAPM at a grid point near the factory, and used as if they were observations in the diagnostic model (i.e. pseudo-data).

CALMET was configured with a 15 km by 15 km grid at 200 m resolution and with local scale surface characteristics, such as terrain elevation and land use (e.g. forest or sparse growth, water or residential). The land use and terrain elevation information was derived from US Geological Survey and AusLig data, respectively, with adjustments based upon inspection of aerial photographs, topographical and land uses maps, and a site inspection.

CALMET was used to produce hourly site-representative winds and micrometeorological information, which was used with the CALPUFF 3D puff-based dispersion model to assess the impacts of the air pollutants on the surrounding land uses.

A3.1 Site-specific meteorology

Figure A5 shows a wind rose that illustrates the distribution of wind speed and direction at the location of the Factory. On an annual basis the prevailing winds are from the west with winds also from the west-north-west, north-west, west-south-west and north-east. The mean wind speed is 3.2 m/s, with higher speed winds associated

[15] Scire J.S., E.M. Insley, R.J. Yamartino, and M.E. Fernau, 1995: A User's Guide for the CALMET Meteorological Model. Report prepared for the USDA Forest Service by EARTH TECH, Concord, MA. See: http://www.src.com/calpuff/calpuff1.htm

with westerly winds with speeds up to 11 m/s; such speeds are not reached from other directions. The highest frequency of light winds occurs from the south-west, west and north.

Figure A6 provides a seasonal breakdown of the predicted wind distribution at the Factory, this figure reveals a north-easterly predominance during summer (sea-breeze) and a westerly predominance during the other seasons, in particular during winter.

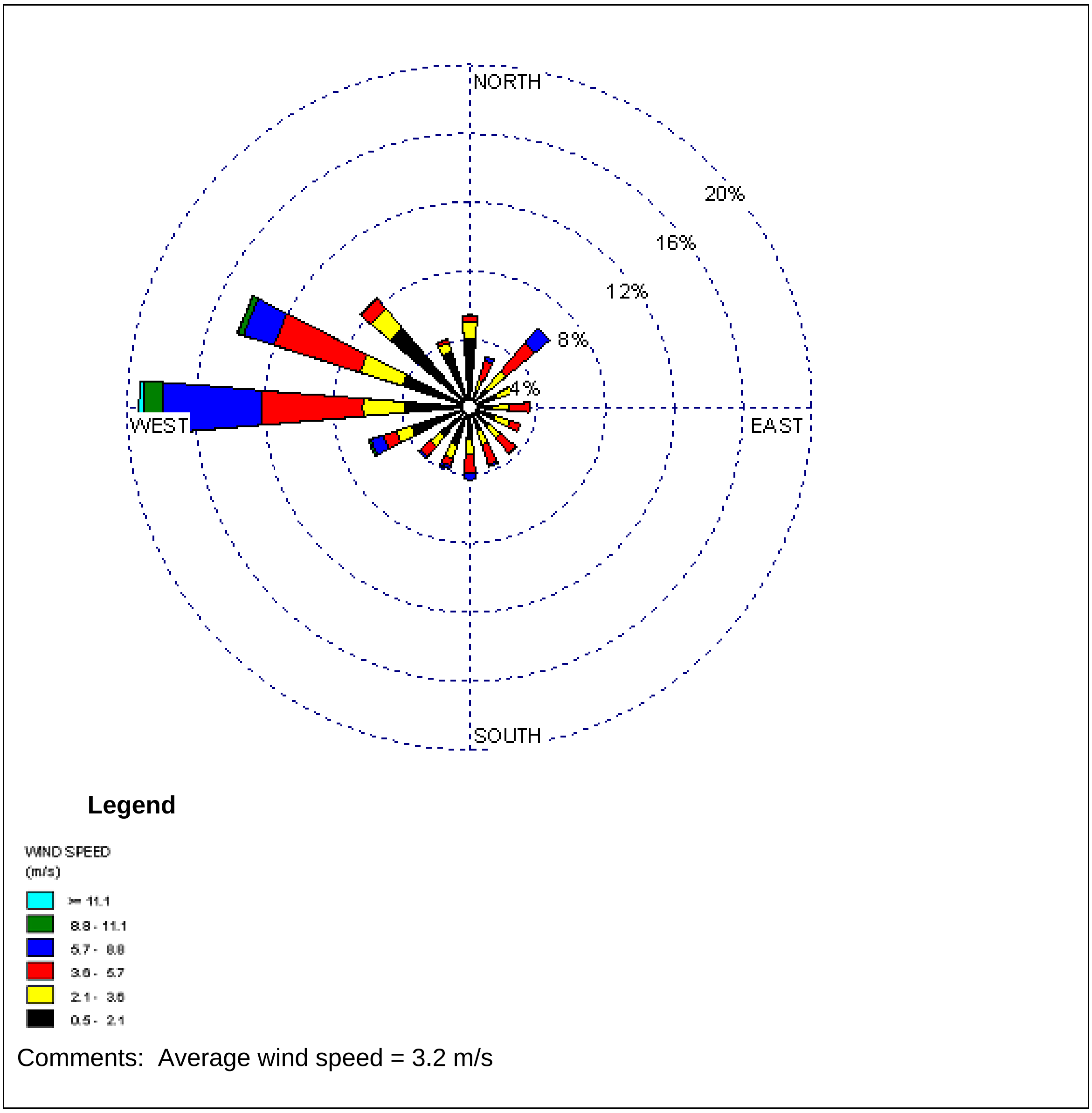


Figure A5 *Factory Annual Wind Rose - Year 2004*

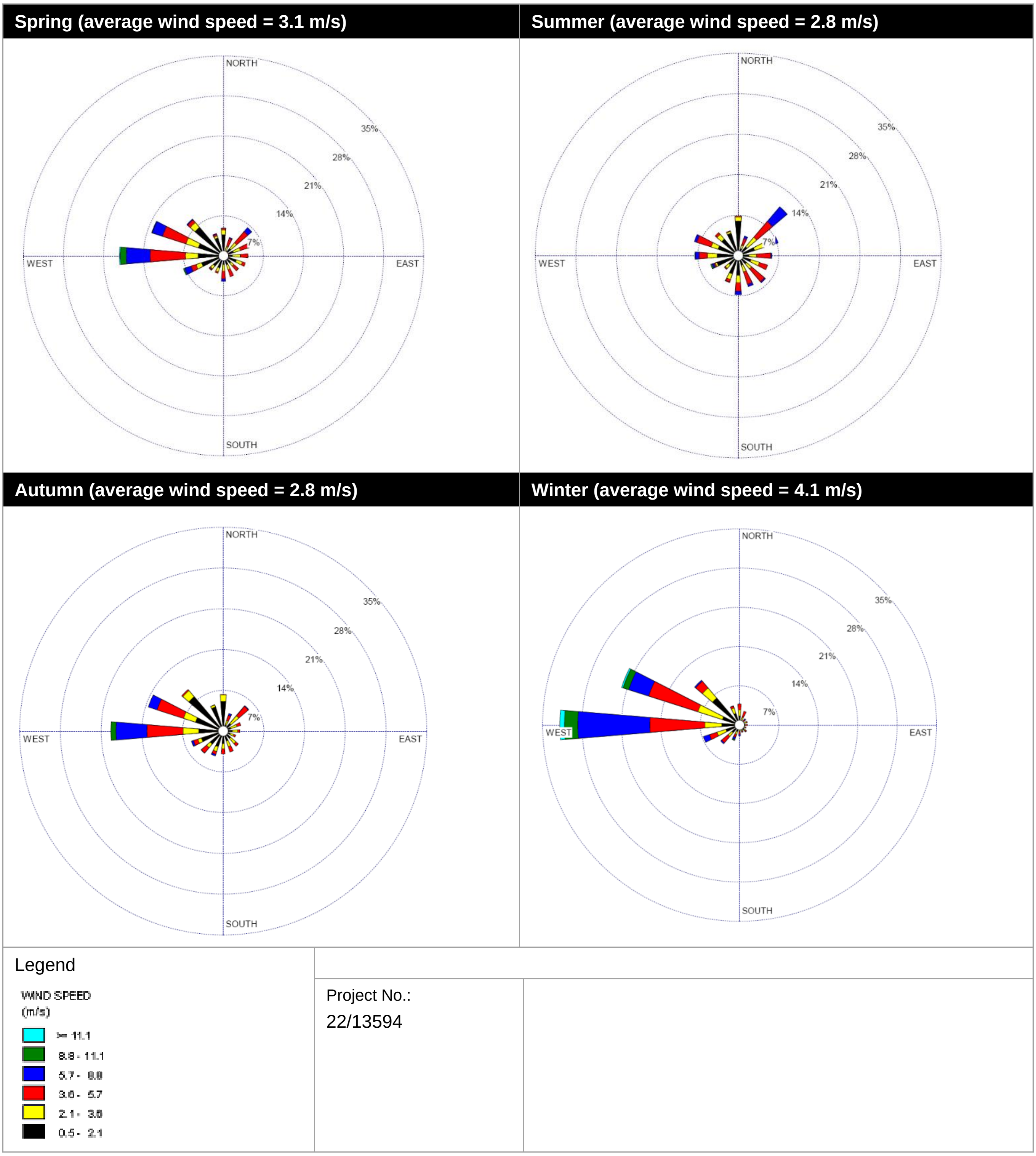


Figure A6 *Factory Seasonal Wind Roses - Year 2004*

A categorised measure of atmospheric stability is also output from the model. These can be broadly defined as listed in Table A1.

Table A.9.1 Atmospheric Stability Classes and Distribution

Stability Class	Description	Frequency of Occurrence[16]
A	Extremely unstable atmospheric conditions, occurring near the middle of day, with very light winds, no significant cloud.	2%
B	Moderately unstable atmospheric conditions occurring during mid-morning/mid-afternoon with light winds or very light winds with significant cloud.	14%
C	Slightly unstable atmospheric conditions occurring during early morning/late afternoon with moderate winds or lighter winds with significant cloud.	17%
D	Neutral atmospheric conditions. Occur during the day or night with stronger winds. Or during periods of total cloud cover, or during twilight (transition) period.	22%
E	Slightly stable atmospheric conditions occurring during the night-time with some cloud and/or light-moderate winds.	12%
F	Moderately stable atmospheric conditions occurring during the night-time with no significant cloud and light winds.	32%

Potential off-site odour impact would tend to be maximised when winds are light and the atmosphere is stable, conditions that typically occur during the early evening and night-time. Table A1 shows that these conditions occurred for approximately 44% of the time.

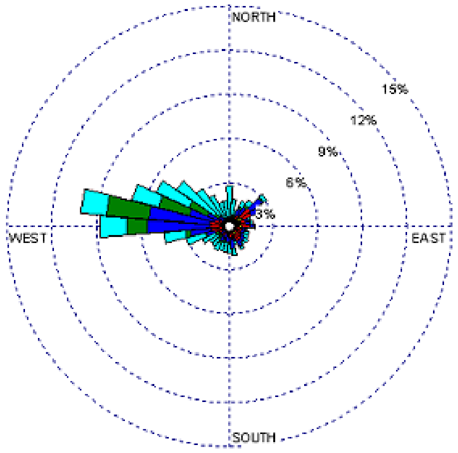
The occurrence of stable air flows is of significance as these generally provide the conditions for worst case dispersion of emissions to air from ground based (or near-ground based) sources, and hence potentially the highest impact to odour amenity. This is due to the limited mixing in the vertical plane of these light wind airflows, and hence less dilution of the emissions from the majority of odour sources, which are either at ground level or wake affected short stacks. Therefore, the distribution of light wind stable flows can define the directions of “poor odour dispersion” from the factory and environmental farm.

Vertical mixing of airflows can be brought about by two mechanisms. The first is mechanical mixing caused by the shear stresses as air moves over rough terrain. The second is via thermal convective mixing, which has the potential to occur significantly only during daytime. The occurrence of unstable and strong-wind neutral air flows generally provide the conditions for the highest ground level concentrations due to emissions to air from elevated stack sources, such as the coal-fired boiler exhaust stacks found at the factory.

A rose that illustrates the directional distribution of the predicted atmospheric stability is shown in Figure A7. During these stable periods, the regional scale cool air drainage flows down the river valley from the west to dominate the transport and dispersion of emissions to air from the factory and environmental farm. To a lesser extent, local slope drainage flows from the elevated terrain located to the north, west-north-west and west-south-west of the site would also generate these conditions for poor dispersion.

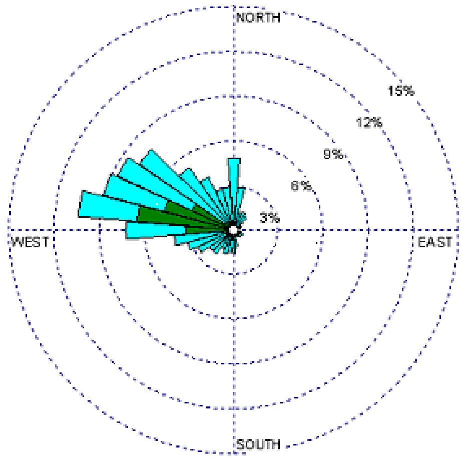
[16] Stability data in this table extracted from Factory meteorological data

All stability classes	E & F Stability classes (stable conditions only)



Legend
Stability Class

- F
- E
- D
- C
- B
- A



Legend
Stability Class

- F
- E
- D
- C
- B
- A

Figure A7 ***Factory Annual Stability Rose - Year 2008***

Appendix B

Complete odour emission inventory

Table B.1 Complete odour emission inventory (Mod 23)

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Combined Boiler Stack for No. 5 & 6 Boilers	35	BOILR5	tall wake free	54.0	2.05	10	413	70,708	Variable
Light phase recovery tank		DDG19	wake affected	11.0	0.10	3.3	362	74	170
Pellet Mill Silo (proposed)		PMFS	wake affected	23.0	0.16	7.0	320	173	398
Pellet Plant exhaust stack	46	PPES	tall wake free	49.2	1.50	10.9	323	70,900	Variable
Pellet silo (mill feed silo)		S12	wake affected	2.0	0.32	0.1	304	350	805
Stillage surge tank		SST	wake affected	2.0	0.20	3.3	360	173	397
Vent condenser drain		VCD	wake affected	24.1	0.30	0.3	300	4,419	10,163
Ethanol Recovery Scrubber Discharge	16	ERESC	wake affected	28.0	0.30	9.3	295	41,258	94,894
Fermenters (10-16)	44	FERM	tall wake free	21.0	0.28	3.1	303	2,000	4,600
Yeast propagators - tanks 4 & 5		YP45	wake affected	17.0	0.25	3.0	311	820	1,886
Cyclone and fabric filter		A4	wake affected	33.0	1.30	7.3	300	679	1,562
Cyclone and fabric filter		A5	wake affected	33.0	0.90	5.2	303	96	221
Cyclone and fabric filter		A6	wake affected	33.0	1.07	5.3	293	449	1,033
Cyclone and fabric filter		A7	wake affected	33.0	1.07	10.2	322	932	2,144
Drum vacuum receiver		C4	wake affected	21.0	0.20	11.0	320	1,400	3,220

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Dry gluten roof bin		S07	wake affected	25.0	0.65	0.1	328	4,500	10,350
Enzyme Tanks		B7	wake affected	6.0	0.46	0.3	327	2,042	4,696
Feed transfer to distillery		E22	wake affected	15.0	0.30	0.1	300	83	191
Flash Vessel Jet Cooker		C1	wake affected	21.0	0.10	0.1	350	970	2,231
Flour bin aspirator		S13A	wake affected	2.5	0.41	0.1	306	500	1,150
Flour bin aspirator		S13B	wake affected	2.5	0.41	0.1	306	500	1,150
Flour bin motor drive		S06	wake affected	24.0	0.27	0.1	307	283	651
Flour mill stack proposed and approved 1		FMP2	wake affected	31.8	0.68	4.4	322	266	612
Flour mill stack proposed and approved 2		FMP1	wake affected	33.4	0.90	4.2	300	205	472
Retention - tank 2 (now located in adjacent tank)		GRT	wake affected	21.0	0.20	18.0	360	4,535	10,430
High protein dust collector		S08	wake affected	24.5	0.39	0.1	316	600	1,380
Incondensable gases vent		D6	wake affected	13.0	0.20	0.6	309	558	1,284
Ion exchange effluent tank		C18	wake affected	2.5	0.46	0.1	307	250	575
Jet cooker 1 - retention tank		E13	wake affected	10.0	0.27	0.1	362	1,067	2,454
Jet cooker 2 & 4 - Retention		E7	wake affected	9.0	0.10	3.1	373	851	1,956
Molecular Sieve - Vacuum drum		D2	wake affected	10.0	0.08	13.0	337	1,350	3,105

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
No. 1 Gluten Dryer baghouse	8	S02	wake affected	25.5	3.20	0.1	344	9,800	22,540
No. 1 Starch Dryer	12	S01	wake affected	26.0	1.30	6.8	309	3,200	7,360
No. 2 Gluten Dryer baghouse (aka. No 2 Starch Dryer)	9	S04	wake affected	27.0	3.20	0.1	336	6,000	13,800
No. 3 Gluten Dryer baghouse	10	S03	wake affected	21.0	2.50	11.6	343	32,000	73,600
No. 3 Starch Dryer	13	S18	wake affected	20.0	1.20	20.0	307	6,800	15,640
No. 4 Gluten Dryer baghouse	11	S05	wake affected	30.0	2.70	16.0	347	20,000	46,000
No. 4 Starch Dryer	14	S19	wake affected	20.0	1.20	21.2	310	2,500	5,750
No. 5 Ring Dryer Starch		SDR5	wake affected	25.0	1.20	0.1	320	4,625	10,638
No. 5 Starch Dryer (existing)	47	SD5C	wake affected	33.5	2.35	2.9	340	2,123	4,882
No. 5 Starch Dryer (new)		SD5N	wake affected	30.0	2.35	14.7	340	10,877	25,018
No. 6 Gluten Dryer		GD6	wake affected	35.0	1.70	19.1	346	12,568	28,906
No. 7 Gluten Dryer		GD7	wake affected	29.0	1.80	19.3	341	9,553	21,972
Spray dryer		S20	wake affected	19.0	1.35	0.1	335	738	1,697
Starch factory rejects collection tank		E10	wake affected	8.0	0.10	0.1	308	183	421
Large Starch Silo 1		PPL1	wake affected	26.5	0.16	6.8	323	86	199
Large Starch Silo 2		PPL2	wake affected	26.5	0.16	6.8	323	86	199

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Medium Gluten Silo 1		PPM1	wake affected	20.7	0.16	6.8	323	173	398
Medium Gluten Silo 2		PPM2	wake affected	20.7	0.16	6.8	323	173	398
Medium Gluten Silo 3		PPM3	wake affected	20.7	0.16	6.8	323	173	398
Small Gluten Silo		PPS1	wake affected	34.3	0.20	18.6	323	92	211
Small Starch Silo		PPS2	wake affected	34.3	0.20	18.6	318	35	81
Biofilter A	40	BIO1	area					1,307	Variable
Biofilter B	41	BIO2	area					1,208	Variable
Biofilter C		BIO3	area					1,089	Variable
Biofilter D		BIO4	area					1,281	Variable
Effluent storage dam 1	19	PO1	area					948	Variable
Effluent storage dam 2	20	PO2	area					687	Variable
Effluent storage dam 3	21	PO3	area					1,626	Variable
Effluent storage dam 5	23	PO5	area					1,248	Variable
Effluent storage dam 6	24	PO6	area					1,435	Variable
Sulphur Oxidisation Basin	25	SOBAS	area					489	Variable
Membrane bio-reactor		MBR	wake affected					54	Variable
DDG load out shed - awning		DDG35	volume					923	2,123
DDG product storage sheds		DDG34	volume					1,023	2,353
DDG tent storage area		DDG36	volume					1,929	4,437
Pellet plant fugitives (discharged direct to atmosphere)		PPF	wake affected					5,771	13,273
Farm tank		F18	volume					3,833	8,817

Source	EPA ID	ID	Source type	Height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	OER after control (OUm^3/s)	Peak to mean adjusted total OER (OUm^3/s)
Column washing vent		CWV	wake affected	48.0	0.07	8.8	312	1,218	2,801
Flour Mill B		FMBA	wake affected	39.5	0.65	12.2	322	687	1,581
Flour Mill B		FMBB	wake affected	39.5	1.00	2.8	322	214	492
Flour Mill B		FMBC	wake affected	39.5	1.00	4.9	322	659	1,516
Flour Mill B		FMBD	wake affected	39.5	0.65	29.1	300	748	1,720
Flour Mill B		FMBE	wake affected	39.5	1.10	10.2	300	748	1,720
Flour Mill B		FMBF	wake affected	39.5	1.10	3.5	300	566	1,301
Flour Mill C		FMC1	wake affected	37.6	0.65	12.2	322	687	1,581
Flour Mill C		FMC2	wake affected	37.6	0.65	6.5	293	214	492
Flour Mill C		FMC3	wake affected	37.6	0.65	11.7	322	659	1,516
Gluten dryer no. 8		GD8	wake affected	29.0	1.90	19.1	346	12,568	28,906
Product dryer no. 9		PD9	wake affected	35.6	0.85	15.3	346	9,800	22,540
Beverage Ethanol D500 Vent (Column washing vent 2)		CWV2	wake affected	55.0	0.07	8.8	312	1,218	2,801

Appendix C

Site sampling reports

Appendix C contains the following sampling reports:

- Stephenson Environmental Management Australia. (2020) EPL Odour Emission Survey Quarter 2, 2020-2021
- Stephenson Environmental Management Australia. (2020a) EPL Odour Emission Survey Quarter 3, 2020-2021
- Preliminary Report REF: R012021p

Stephenson

Environmental Management Australia

EPL Odour Emission Survey Quarter 2, 2020-2021

Shoalhaven Starches Pty Ltd

Bomaderry, NSW

Project No.:	7095/S25548A/20
Dates of Survey:	5 & 12 August and 8 & 28 October, 2020
Date of Interim Report Issue:	28 August, 2020
Date of Final Report Issue:	4 January, 2021

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Environmental Management Australia

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EPL ODOUR EMISSION SURVEY QUARTER 2, 2020-2021

SHOALHAVEN STARCHES PTY LTD

BOMADERRY, NSW

PROJECT NO.: 7095/S25548A/20

DATES OF SURVEY: 5 & 12 AUGUST AND 8 & 28 OCTOBER, 2020

DATE OF INTERIM REPORT ISSUE: 28 AUGUST, 2020

DATE OF FINAL REPORT ISSUE: 4 JANUARY, 2021

P W STEPHENSON

J WEBER

M KIMBER

TABLE OF CONTENTS

1 INTRODUCTION 3

2 MONITORING REQUIREMENTS 4

2.1 ENVIRONMENT PROTECTION LICENCE 883 (ISSUED 18 DECEMBER 2015) 4

2.1.1 CONDITION P1 LOCATION OF MONITORING/DISCHARGE POINTS AND AREAS 4

2.1.2 CONDITION M2 – MONITORING CONCENTRATION OF DISCHARGED POLLUTANTS 5

3 PRODUCTION CONDITIONS 7

4 ODOUR EMISSION TEST RESULTS 8

5 CONCLUSIONS 10

6 TEST METHODS 21

6.1 ODOUR MEASUREMENT/DYNAMIC OLFACTOMETRY 21

6.1.1 ODOUR PANEL SELECTION 22

6.1.2 ODOUR TERMINOLOGY 22

6.2 EXHAUST GAS VELOCITY 22

6.3 EXHAUST GAS TEMPERATURE 23

6.4 OXYGEN (O_2) 23

6.5 MOISTURE 23

6.6 ACCURACY 23

APPENDIX A – EMISSION TEST RESULTS I

APPENDIX B – CERTIFICATES OF ANALYSIS I

APPENDIX C – DETAILS OF INSTRUMENT CALIBRATION I

APPENDIX D – SAMPLE LOCATIONS I

TABLE OF TABLES

TABLE 2-1 LOCATION OF ODOUR MONITORING/DISCHARGE POINTS AND AREAS 4
TABLE 2-2 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 8, 9, 10, 11, 12, 13, 14, 16 & 47) 5
TABLE 2-3 SAMPLING AND ANALYSIS OF DIFFUSE SOURCES (POINTS 19, 20, 21 & 23, 24 & 25) 5
TABLE 2-4 SAMPLING AND ANALYSIS OF SOURCES (POINTS 39, 40, 41, 44 & 46) 5
TABLE 2-5 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 35, 42 & 45) 6
TABLE 4-1 MEASURED EMISSION CONCENTRATION TEST RESULTS POINT SOURCES, QUARTER 2, 2020 8
TABLE 4-2 MEASURED EMISSION CONCENTRATION TEST RESULTS DIFFUSE SOURCES, QUARTER 2, 2020 9
TABLE 6-1 ESTIMATION OF MEASUREMENT UNCERTAINTY 23

TABLE OF FIGURES

FIGURE 5-1 ODOUR EMISSION CONCENTRATIONS, GLUTEN DRYERS NO.1, 2, 3 & 4 (EPA 8, 9, 10 & 11) .. 11
FIGURE 5-2 ODOUR EMISSION CONCENTRATIONS, STARCH DRYERS NO.1, 3 & 4 (EPA 12, 13 &14) 12
FIGURE 5-3 ODOUR EMISSION CONCENTRATIONS, STARCH DRYER 5 (EPA 47) 12
FIGURE 5-4 ODOUR EMISSION CONCENTRATIONS, FERMENTERS (EPA 44) 14
FIGURE 5-5 ODOUR EMISSION CONCENTRATIONS, CARBON DIOXIDE SCRUBBER OUTLET (EPA 16) 15
FIGURE 5-6 ODOUR EMISSION CONCENTRATIONS, COMBINED BOILER 5 & 6 STACK (EPA 35) 16
FIGURE 5-7 ODOUR EMISSION CONCENTRATIONS, BOILER 4 STACK (EPA 42) 17
FIGURE 5-8 ODOUR EMISSION CONCENTRATIONS, BOILER 2 STACK (EPA 45) 18

FIGURE 5-9 ODOUR EMISSION CONCENTRATIONS, BIOFILTERS (EPA 39, 40, 41) 19
FIGURE 5-10 ODOUR EMISSION CONCENTRATIONS, DDG PELLET PLANT (EPA 46) 20

TABLE OF TABLES – APPENDICES

TABLE A-1 EMISSION TEST RESULTS – GLUTEN DRYERS NO. 1, 2, 3 & 4 II
TABLE A-2 EMISSION TEST RESULTS – STARCH DRYERS NO.1, 3, 4 & 5 III
TABLE A- 3 EMISSION TEST RESULTS – BOILERS NO. 5&6, 4 & 2..IV
TABLE A-4 EMISSION TEST RESULTS – FERMENTER 13 & CO_2 SCRUBBER OUTLET..V
TABLE A- 5 EMISSION TEST RESULTS – INLET TO BIOFILTERS, DDG EVAPORATORS 1, 2, 3 & 4.........................VI
TABLE A- 6 EMISSION TEST RESULTS DDG PELLET PLANT..VII
TABLE A- 7 EMISSION TEST RESULTS – BIOFILTER OUTLETS VIII

TABLE C- 1 INSTRUMENT CALIBRATION DETAILS DAY 1...II
TABLE C- 2 INSTRUMENT CALIBRATION DETAILS DAY 2...III
TABLE C- 3 INSTRUMENT CALIBRATION DETAILS DAY 3...IV
TABLE C-4 INSTRUMENT CALIBRATION DETAILS DAY 4 V

TABLE OF FIGURES – APPENDICES

FIGURE D-1 GLUTEN DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC II
FIGURE D-2 GLUTEN DRYER NO. 1 – SAMPLE LOCATION III
FIGURE D-3 GLUTEN DRYER NO. 2 –SAMPLE LOCATION SCHEMATIC..IV
FIGURE D-4 GLUTEN DRYER NO. 2 – ODOUR SAMPLE LOCATION AT DUCT EXIT V
FIGURE D-5 GLUTEN DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC VI
FIGURE D-6 GLUTEN DRYER NO. 3 – SAMPLE LOCATION VII
FIGURE D-7 GLUTEN DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC VIII
FIGURE D-8 GLUTEN DRYER NO. 4 – SAMPLE LOCATION IX
FIGURE D-9 STARCH DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC X
FIGURE D-10 STARCH DRYER NO. 1 – SAMPLE LOCATION XI
FIGURE D-11 STARCH DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC XII
FIGURE D-12 STARCH DRYER NO. 3 – SAMPLE LOCATION XIII
FIGURE D-13 STARCH DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC XIV
FIGURE D-14 STARCH DRYER NO. 4 – SAMPLE LOCATION XV
FIGURE D-15 STARCH DRYER NO. 5 – SAMPLE LOCATION SCHEMATIC XVI
FIGURE D-16 STARCH DRYER NO. 5 – SAMPLE LOCATION XVII
FIGURE D-17 FERMENTERS – SAMPLE LOCATION SCHEMATIC XVIII
FIGURE D-18 FERMENTERS – SAMPLE LOCATION...XIX
FIGURE D-19 CO_2 SCRUBBER OUTLET – SAMPLE LOCATION SCHEMATIC XX
FIGURE D-20 BOILER NOS. 5 & 6 – SAMPLE LOCATION SCHEMATIC XXI
FIGURE D-21 BOILER NOS. 5 & 6 – SAMPLE LOCATION XXII
FIGURE D-22 BOILER NO. 4– SAMPLE LOCATION SCHEMATIC XXIII
FIGURE D-23 BOILER NO 4 – SAMPLE LOCATION...XXIV
FIGURE D-24 BOILER NO 2 – SAMPLE LOCATION SCHEMATIC XXV
FIGURE D-25 BIOFILTER INLET – SAMPLE LOCATION SCHEMATIC...XXVI
FIGURE D-26 BIOFILTER OUTLET EAST EPL ID 40 & 41 – SAMPLE LOCATION XXVII
FIGURE D-27 BIOFILTER OUTLET WEST EPL ID 41 – SAMPLE LOCATION XXVII
FIGURE D-28 DDG PELLET PLANT STACK – SAMPLE LOCATION SCHEMATIC...XXVIII
FIGURE D-29 DDG PELLET PLANT STACK – SAMPLE LOCATION PHOTOGRAPH...XXIX

1 INTRODUCTION

Stephenson Environmental Management Australia (SEMA) was requested by Shoalhaven Starches Pty Limited to conduct an odour emission survey at their manufacturing complex in Bomaderry, New South Wales (NSW).

The objective of the survey is to comply with Condition M2.1 of the Environment Protection Licence (EPL) No. 883 issued by the Environment Protection Authority (EPA). The EPA is now part of the Office of Environment and Heritage (OEH).

Section 2 of this report outlines Conditions P1 and M2 which identify the potential point and diffuse odour sources and the sampling and analysis methods respectively required by the OEH. This survey monitored the quarterly odour concentrations as required in section M2.2 of EPL 883.

In addition, the Carbon Dioxide (CO_2) Scrubber Inlet sampling point, which currently is not listed in EPL 883 and therefore does not have an EPA Identification No., was also sampled.

The DDG Pellet Plant Stack sampling port was inaccessible so measurements were taken from the DDG Cooler Silo and DDG Pellet Cooler East stack. They have a partial contribution to EPA Identification No. 46.

The quarters are defined as below:

- Quarter 1 May to July inclusive
- Quarter 2 August to October inclusive
- Quarter 3 November to January inclusive
- Quarter 4 February to April inclusive

Quarter 2, 2020-2021 odour test results are presented in this report. These tests were conducted on the 5th and 12th August and the 8th and 28th October, 2020.

2 MONITORING REQUIREMENTS

2.1 ENVIRONMENT PROTECTION LICENCE 883 (ISSUED 18 DECEMBER 2015)

2.1.1 CONDITION P1 LOCATION OF MONITORING/DISCHARGE POINTS AND AREAS

Table 2-1 identifies the point and diffuse sources as defined by the OEH that relate to this survey as per most recent version of EPL No. 883 dated 20 June 2018.

TABLE 2-1 LOCATION OF ODOUR MONITORING/DISCHARGE POINTS AND AREAS

EPL ID. No.	Location	Odour Samples TM OM-7/8	Frequency as per M2.2 EPL 883
8	No. 1 Gluten Dryer	1	Quarterly
9	No. 2 Gluten/Starch Dryer*	1	Quarterly
10	No. 3 Gluten Dryer	1	Quarterly
11	No. 4 Gluten Dryer	1	Quarterly
12	No. 1 Starch Dryer	1	Quarterly
13	No. 3 Starch Dryer	1	Quarterly
14	No. 4 Starch Dryer	1	Quarterly
16	CO_2 Scrubber outlet	1	Quarterly
Not specified	CO_2 Scrubber inlet	1	--
19	Effluent Storage Dam 1	1	Yearly
20	Effluent Storage Dam 2	1	Yearly
21	Effluent Storage Dam 3	1	Yearly
23	Effluent Storage Dam 5	1	Yearly
24	Effluent Storage Dam 6	1	Yearly
25	Sulphur Oxidisation Pond	1	Yearly
35	Combined Stack Boilers No.5 & 6	1	Quarterly
39	Inlet Pipe to Biofilters A & B (DDG Evaporators 1, 2 & 3)	1	Quarterly
39A	Inlet Pipe to Biofilters A & B (DDG Evaporator 4)	1	Quarterly
40	Outlet of Biofilter A	2	Quarterly
41	Outlet of Biofilter B	2	Quarterly
42	Boiler No.4	1	Quarterly
44	Fermenter	1	Quarterly
45	Boiler No.2	1	Quarterly
46	DDG Pellet Plant Stack	1	Quarterly
47	No. 5 Starch Dryer	1	Quarterly

2.1.2 CONDITION M2 – MONITORING CONCENTRATION OF DISCHARGED POLLUTANTS

Condition M2.1 states: *For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency specified in the opposite columns.*

Key to Tables 2.2 to 2.5:

%	=	percent
^oC	=	degrees Celsius
g/g.mole	=	grams per gram mole
kg/m^3	=	kilograms per cubic metre
m/s	=	metres per second
m^3/s	=	cubic metres per second
mg/m^3	=	milligrams per cubic metre
OM	=	Other Method
ou	=	odour units
TM	=	Test Method

TABLE 2-2 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 8, 9, 10, 11, 12, 13, 14, 16 & 47)

Pollutant	Units	Frequency	Approved Method
Dry Gas Density	kg/m^3	Quarterly	TM-23
Flow	m^3/s	Quarterly	TM-2
Moisture	%	Quarterly	TM-22
Molecular Weight of stack gases	g/g-mole	Quarterly	TM-23
Odour	ou	Quarterly	OM-7
Oxygen	%	Quarterly	TM-25
Temperature	^oC	Quarterly	TM-2
Velocity	m/s	Quarterly	TM-2

TABLE 2-3 SAMPLING AND ANALYSIS OF DIFFUSE SOURCES (POINTS 19, 20, 21 & 23, 24 & 25)

Pollutant	Units	Frequency	Approved Method
Odour	ou	Annual	OM-7

TABLE 2-4 SAMPLING AND ANALYSIS OF SOURCES (POINTS 39, 40, 41, 44 & 46)

Pollutant	Units	Frequency	Approved Method
Odour	ou	Quarterly	OM-7

TABLE 2-5 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 35, 42 & 45)

Pollutant	Units	Frequency	Approved Method
Cadmium	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Mercury	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Moisture	%	Quarterly	TM-22
Molecular weight of stack gases	g/g.mole	Quarterly	TM-23
Nitrogen Oxides	mg/m^3	Quarterly	TM-11
Odour	ou	Quarterly	OM-7
Opacity	%	Quarterly	CEM-1
Oxygen	%	Quarterly	TM-25
Sulphur Dioxide	mg/m^3	Annual	TM-4
Temperature	^oC	Quarterly	TM-2
Total Solid Particles	mg/m^3	Quarterly	TM-15
Type 1 & Type 2 substances in aggregate	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Velocity	m/s	Quarterly	TM-2
Volatile Organic Compounds as n-propane equivalent	mg/m^3	Quarterly	TM-34
Volumetric Flowrate	m^3/s	Quarterly	TM-2

3 PRODUCTION CONDITIONS

Shoalhaven Starches personnel considered the factory and the ethanol distillery were operating under typical conditions on the days of testing.

One exception is that Gluten Dryer No.1 (EPA ID 8) has had a new silencer and supporting ductwork installed to replace the previous unit. However, the sampling ports have not been re-installed in this new ductwork. Therefore, access to the inside of the duct is no longer available. Thus, exhaust gas flow measurements were unable to be taken.

However, odour measurements were taken from the duct outlet to atmosphere. To enable calculation of the Mass Odour Emission Rate (MOER), exhaust gas flow measurements have been based on the most recent previous quarterly monitoring results; that is, Quarter 1, 2020 results.

Access to the DDG Pellet Plant Stack (EPA 46) was inaccessible, so measurements were taken from the DDG Pellet Cooler East and the DDG Pellet Silo, which have a partial contribution to EPA 46.

4 ODOUR EMISSION TEST RESULTS

SEMA performed the sampling and the odour analysis was performed by Odour Research Laboratories Australia (ORLA). SEMA and ORLA are both NATA accredited (No.15043) facilities to ISO 17025 for this.

The NATA accredited ORLA Olfactometry Test Reports 7095/ORLA/01 and 7095/ORLA/02 are presented in Appendix B.

Exhaust gas flow and emission tests results from measured sources are detailed in Tables A-1 to A-7, Appendix A.

Appendix C details calibration of instruments used to take measurements.

Appendix D shows sample locations.

Tables 4-1 summarise the odour emission concentrations for the point sources measured in Quarter 2, 2020.

TABLE 4-1 MEASURED EMISSION CONCENTRATION TEST RESULTS POINT SOURCES, QUARTER 2, 2020

EPA ID No.	Description	Date	Odour Concentration (ou)
8	No.1 Gluten Dryer	12.08.2020	660
9	No.2 Gluten Dryer	05.08.2020	430
10	No.3 Gluten Dryer	05.08.2020	850
11	No.4 Gluten Dryer	05.08.2020	720
12	No.1 Starch Dryer	05.08.2020	250
13	No.3 Starch Dryer	12.08.2020	400
14	No.4 Starch Dryer	12.08.2020	140
16	Carbon Dioxide Scrubber Outlet	05.08.2020	17,500
--	Carbon Dioxide Scrubber Inlet	05.08.2020	11,300
35	Combined Stack No.5 & 6 Boilers	12.08.2020	2,000
42	Boiler No.4 Outlet	12.08.2020	2,180
44	Fermenter (No. 13)	05.08.2020	10,300
45	Boiler No.2 Outlet	12.08.2020	1,100
47	No.5 Starch Dryer	12.08.2020	250
Part 46*	DDG Pellet Cooler East	28.10.2020	6200
Part 46*	DDG Pellet Silo	28.10.2020	8800

Key:

ou	=	odour units
--	=	Not listed in EPL 883, no EPL ID number
Part 46*	=	Partial contribution to EPA ID 46, as EPA ID 46 stack was inaccessible

TABLE 4-2 MEASURED EMISSION CONCENTRATION TEST RESULTS DIFFUSE SOURCES, QUARTER 2, 2020

EPA ID No.	Description	Date	Odour Concentration (ou)
39	Inlet to Biofilters A & B DDG Evaporators 1, 2 & 3	8.10.2020	15,600
39A	Inlet to Biofilters A & B DDG Evaporators 4	8.10.2020	41,900
40	Outlet of Biofilter A (east)	8.10.2020	1,200
40	Outlet of Biofilter A (west)	8.10.2020	1,400
41	Outlet of Biofilter B (east)	8.10.2020	4,000
41	Outlet of Biofilter B (west)	8.10.2020	6,200

5 CONCLUSIONS

The comparative results of the odour sampling and analysis, over time, that have been undertaken by SEMA at Shoalhaven Starches manufacturing facility at Bomaderry are graphically presented in Figures 5-1 to 5-8.

Figure 5-1 presents graphical representations of odour concentrations recorded for Gluten Dryers No.1, 2, 3 and 4 since autumn 2005.

Figure 5-2 presents graphical representations of odour concentrations recorded for Starch Dryers No.1, 3 and 4 since autumn 2005.

Figure 5-3 graphically shows the Starch Dryer No. 5 emission concentrations since spring 2017.

Figure 5-4 graphically shows the Fermenter emission concentrations since summer 2007-2008.

Figure 5-5 illustrates odour emission concentrations from the Carbon Dioxide Scrubber since autumn 2013.

Figures 5-6 and 5-7 graphically show the Combined Boiler 5 and 6 stack and the Boiler No.4 stack emission concentrations since summer 2013-2014 respectively.

Figure 5-8 shows the Boiler 2 stack emission concentrations since winter 2019.

Figure 5-9 graphically shows the Bio-filter inlet and outlet emission concentrations since autumn 2010.

Figure 5-10 graphically shows the DDG Pellet plant stack emission concentrations since spring 2016.

FIGURE 5-1 ODOUR EMISSION CONCENTRATIONS, GLUTEN DRYERS NO.1, 2, 3 & 4 (EPA 8, 9, 10 & 11)

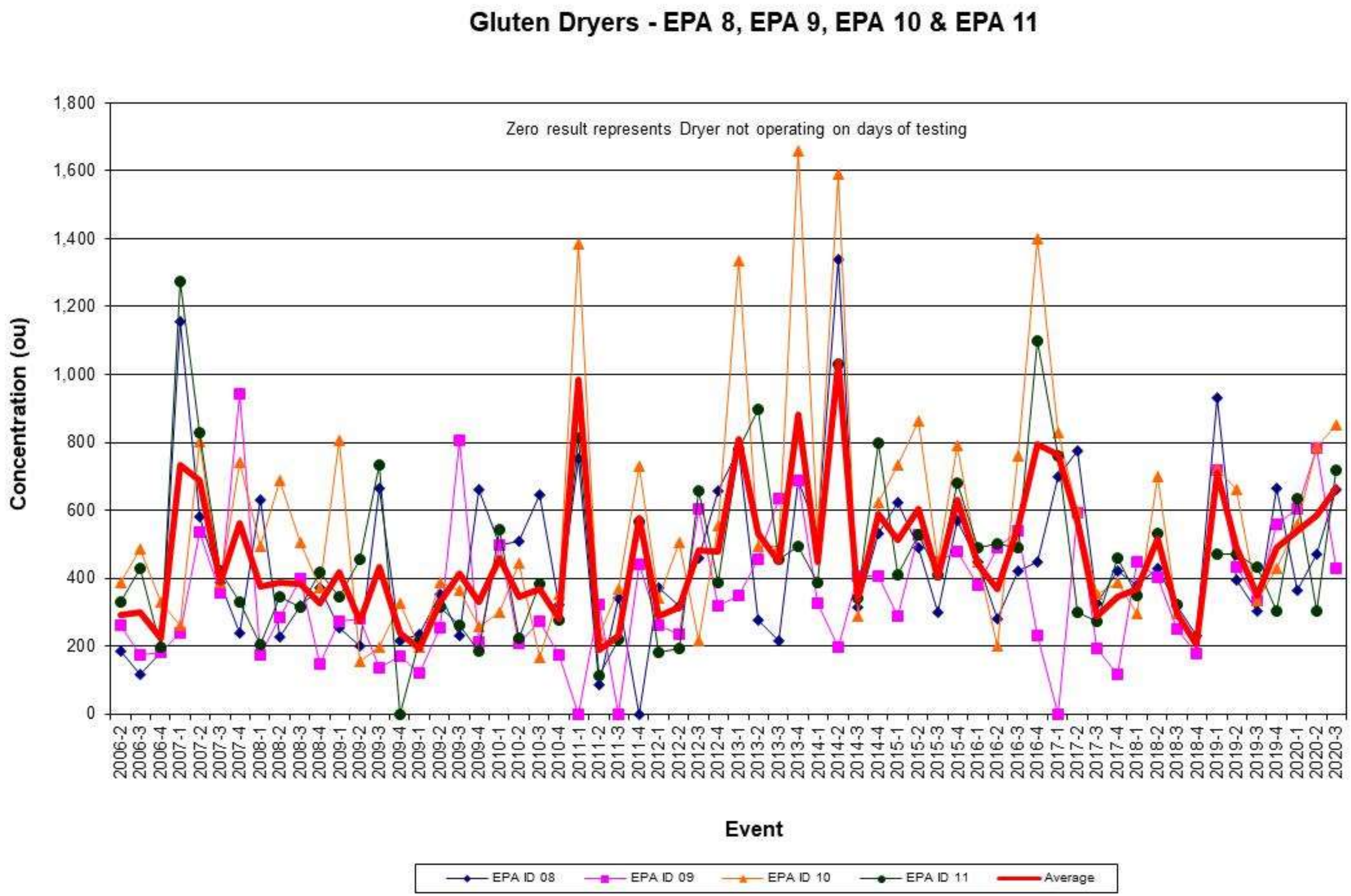


FIGURE 5-2 ODOUR EMISSION CONCENTRATIONS, STARCH DRYERS NO.1, 3 & 4 (EPA 12, 13 &14)

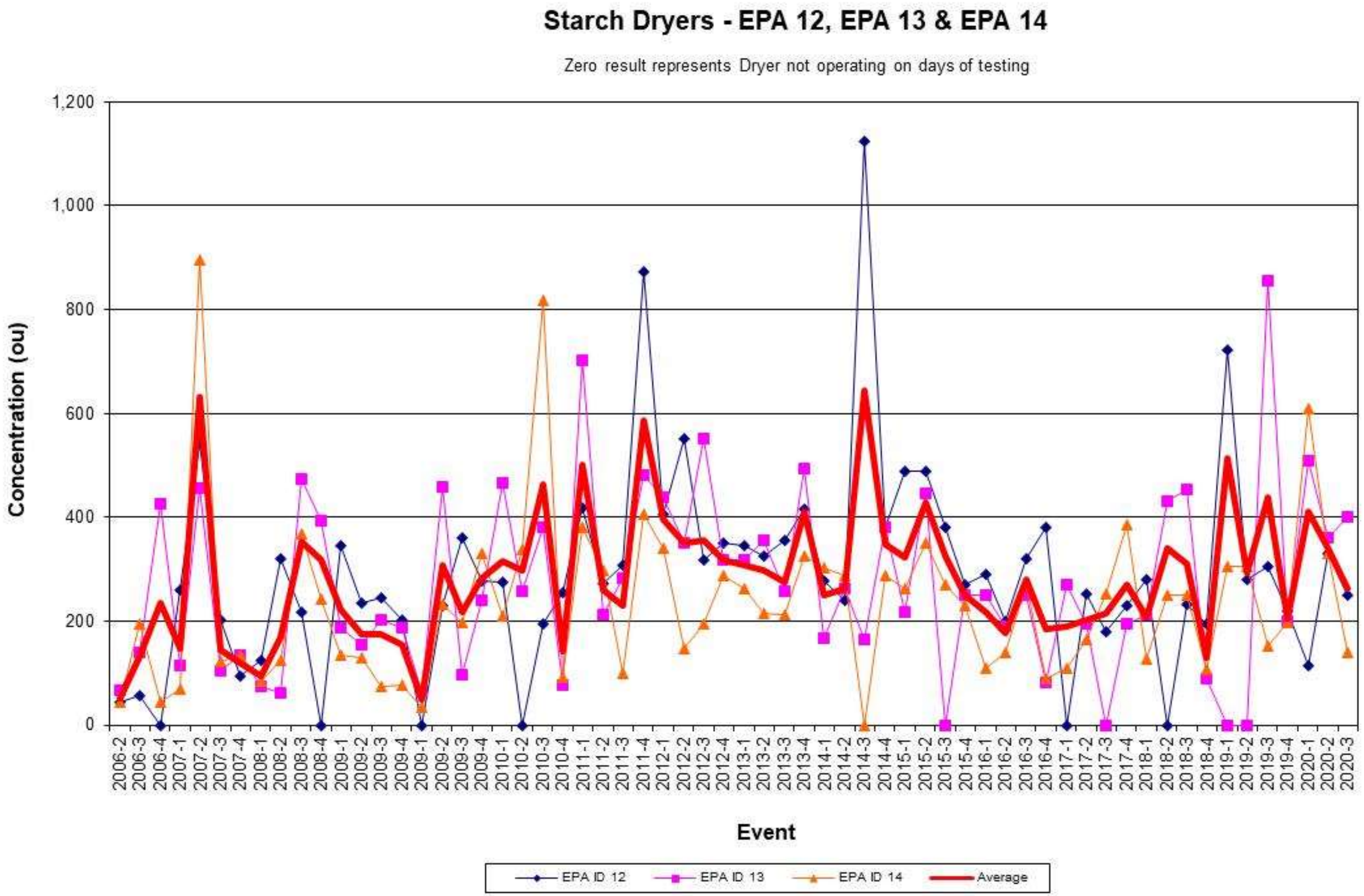


FIGURE 5-3 ODOUR EMISSION CONCENTRATIONS, STARCH DRYER 5 (EPA 47)

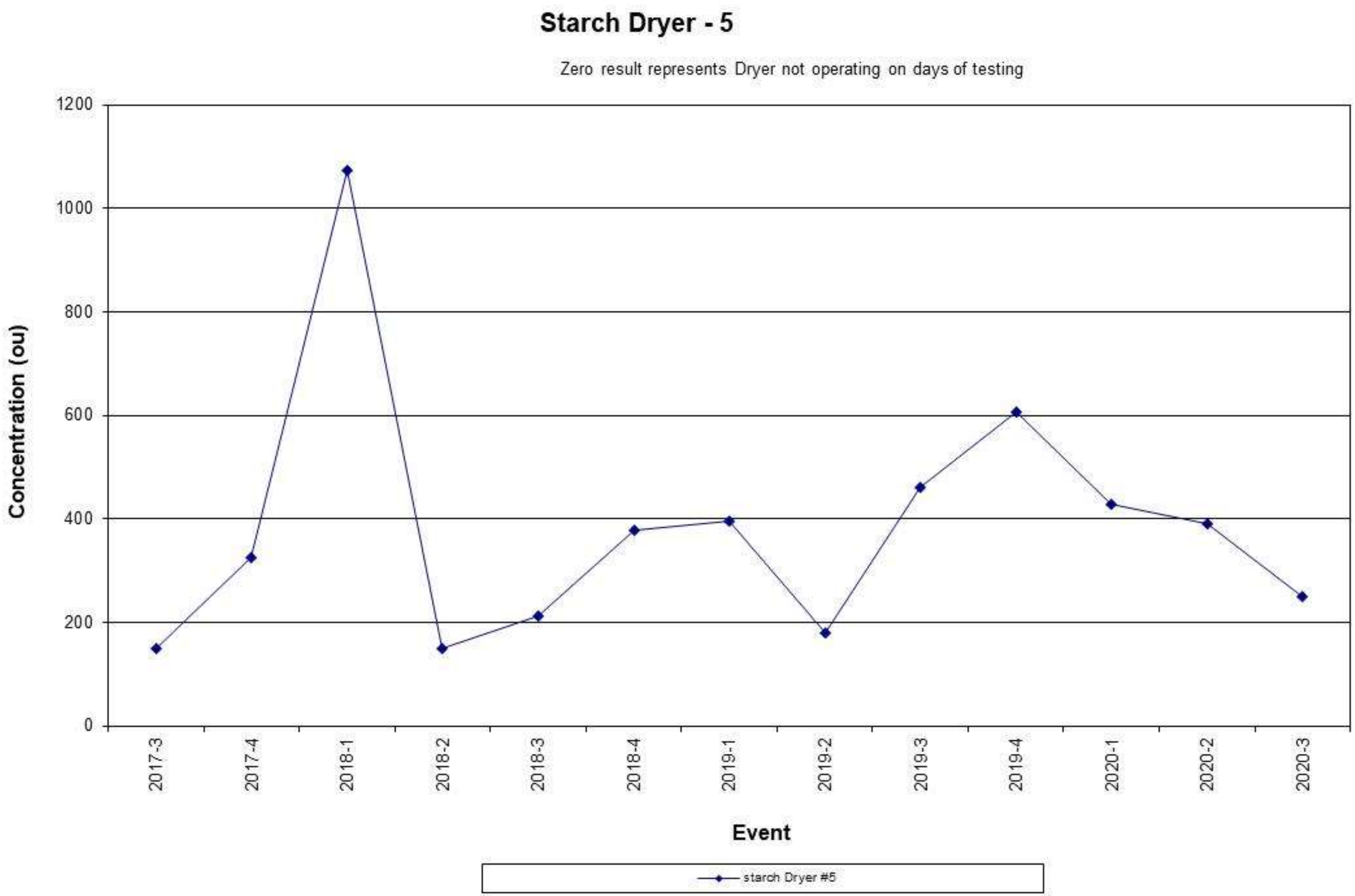


FIGURE 5-4 ODOUR EMISSION CONCENTRATIONS, FERMENTERS (EPA 44)

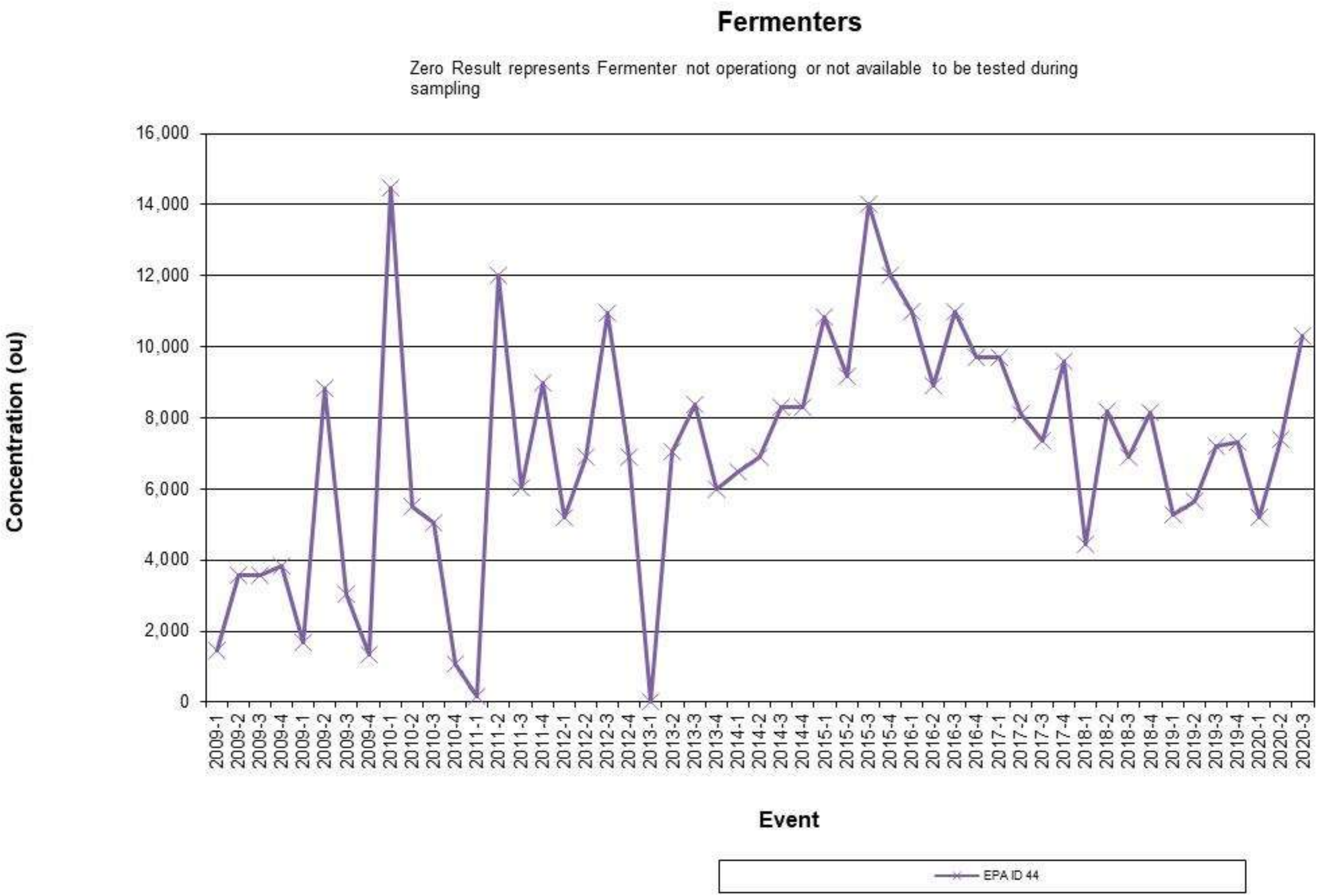


FIGURE 5-5 ODOUR EMISSION CONCENTRATIONS, CARBON DIOXIDE SCRUBBER OUTLET (EPA 16)

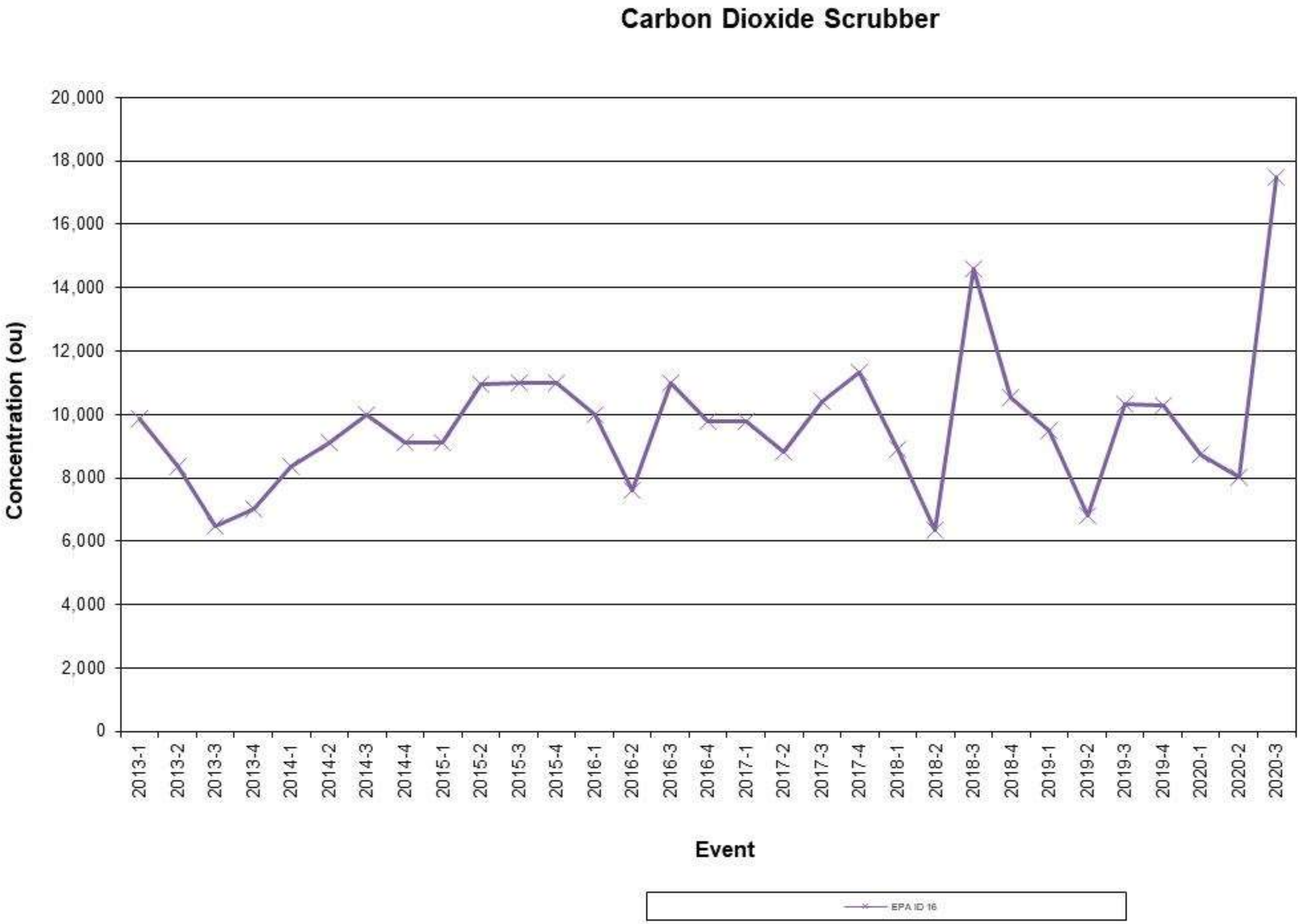


FIGURE 5-6 ODOUR EMISSION CONCENTRATIONS, COMBINED BOILER 5 & 6 STACK (EPA 35)

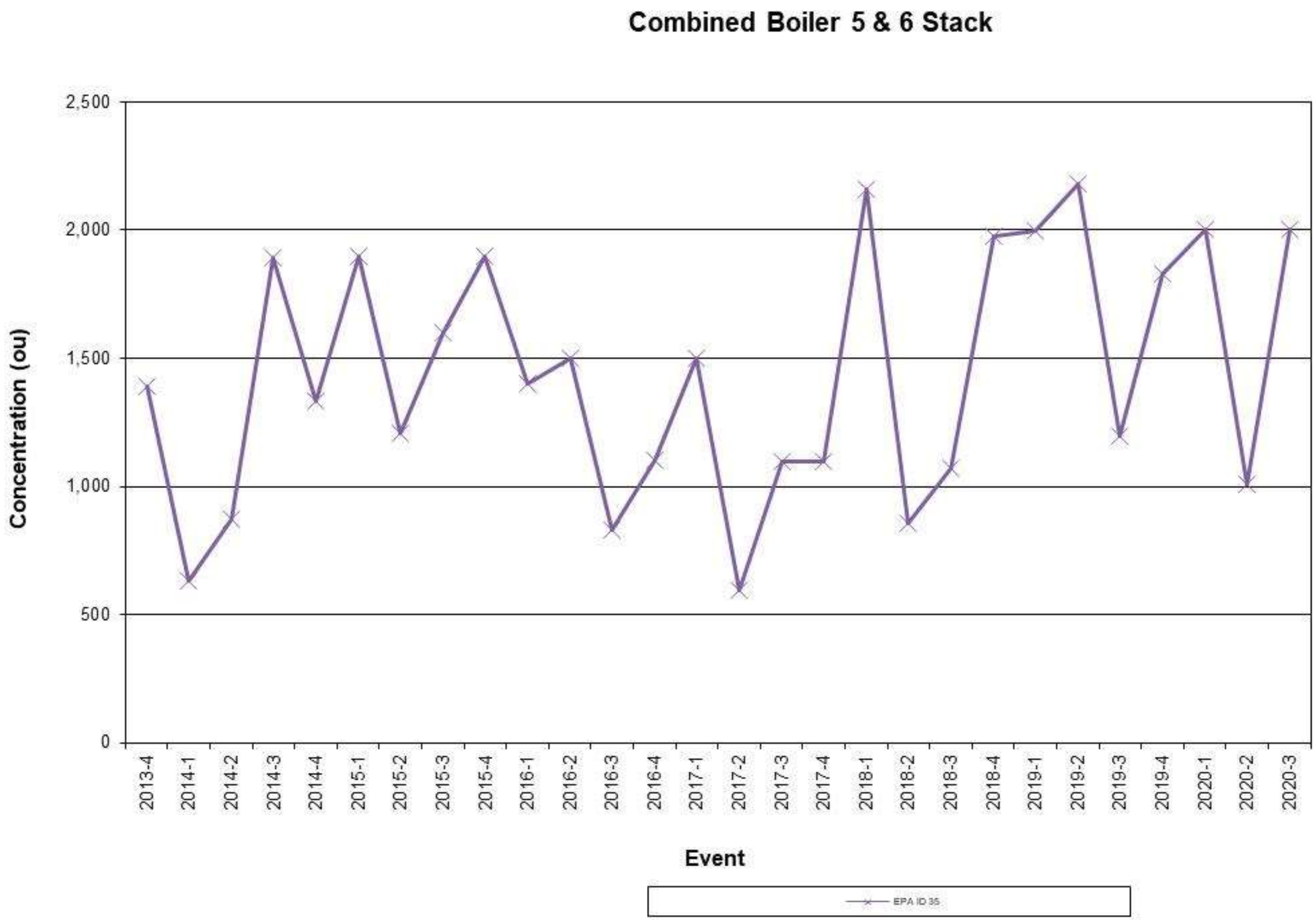


FIGURE 5-7 ODOUR EMISSION CONCENTRATIONS, BOILER 4 STACK (EPA 42)

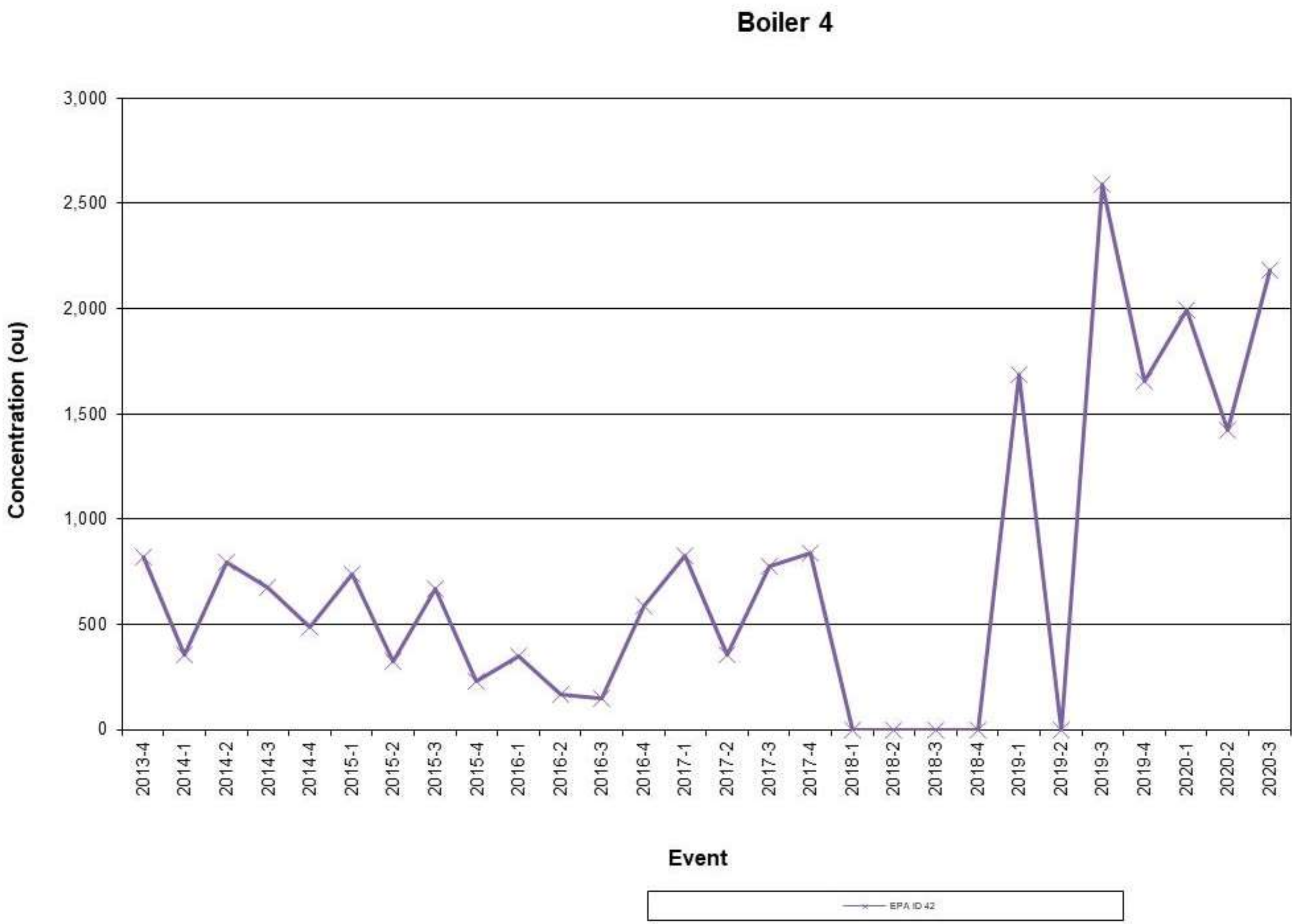


FIGURE 5-8 ODOUR EMISSION CONCENTRATIONS, BOILER 2 STACK (EPA 45)

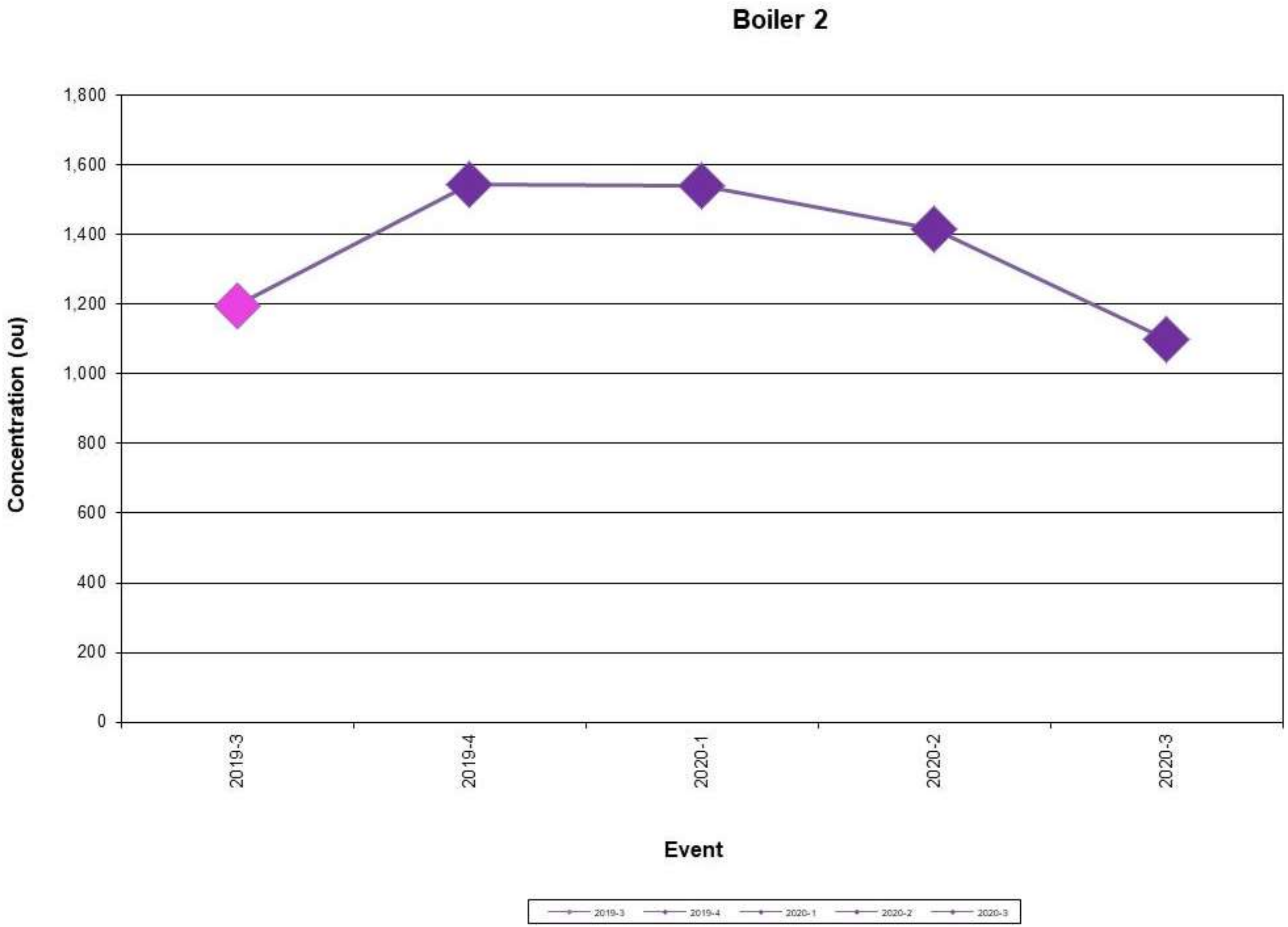


FIGURE 5-9 ODOUR EMISSION CONCENTRATIONS, BIOFILTERS (EPA 39, 40, 41)

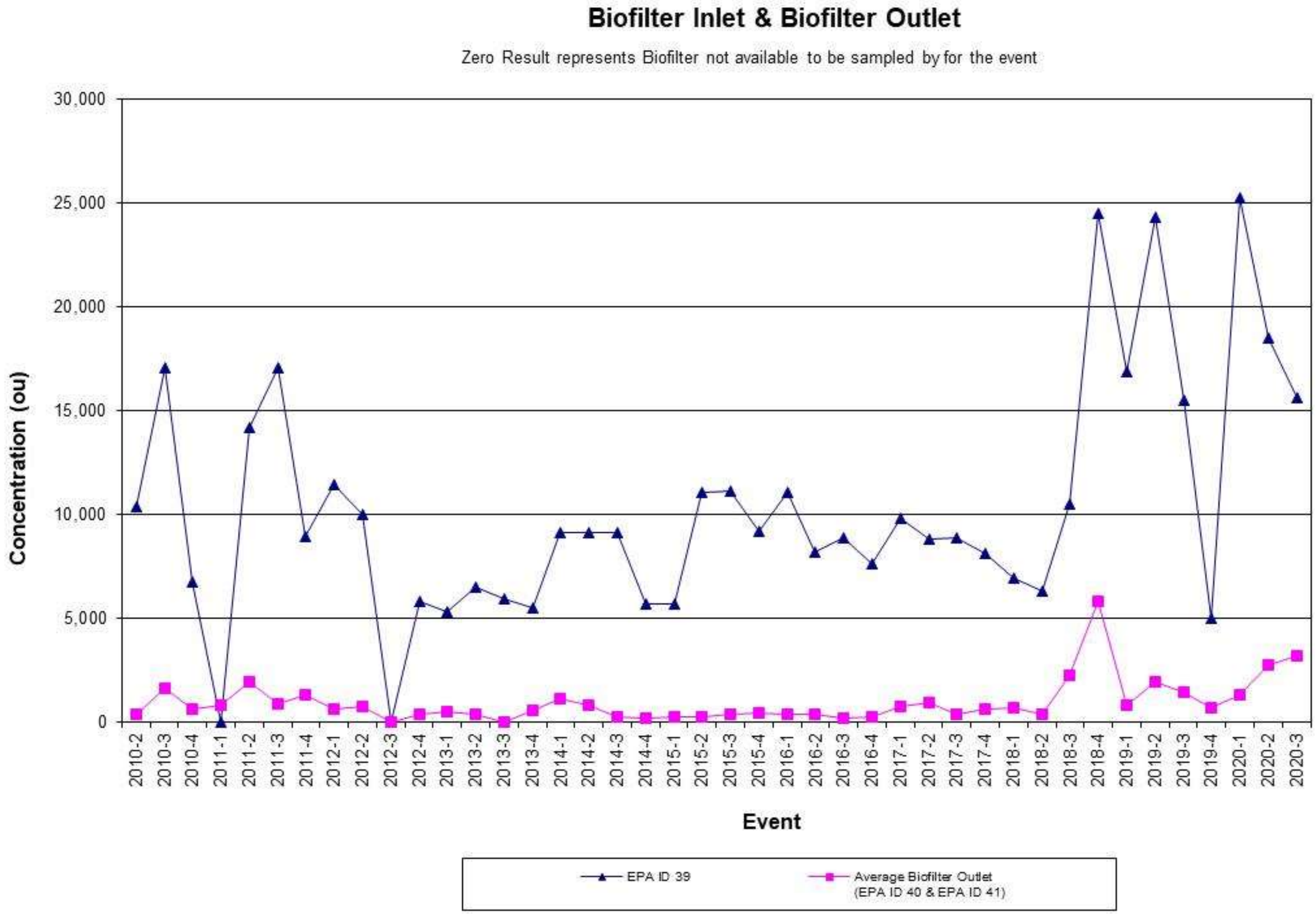
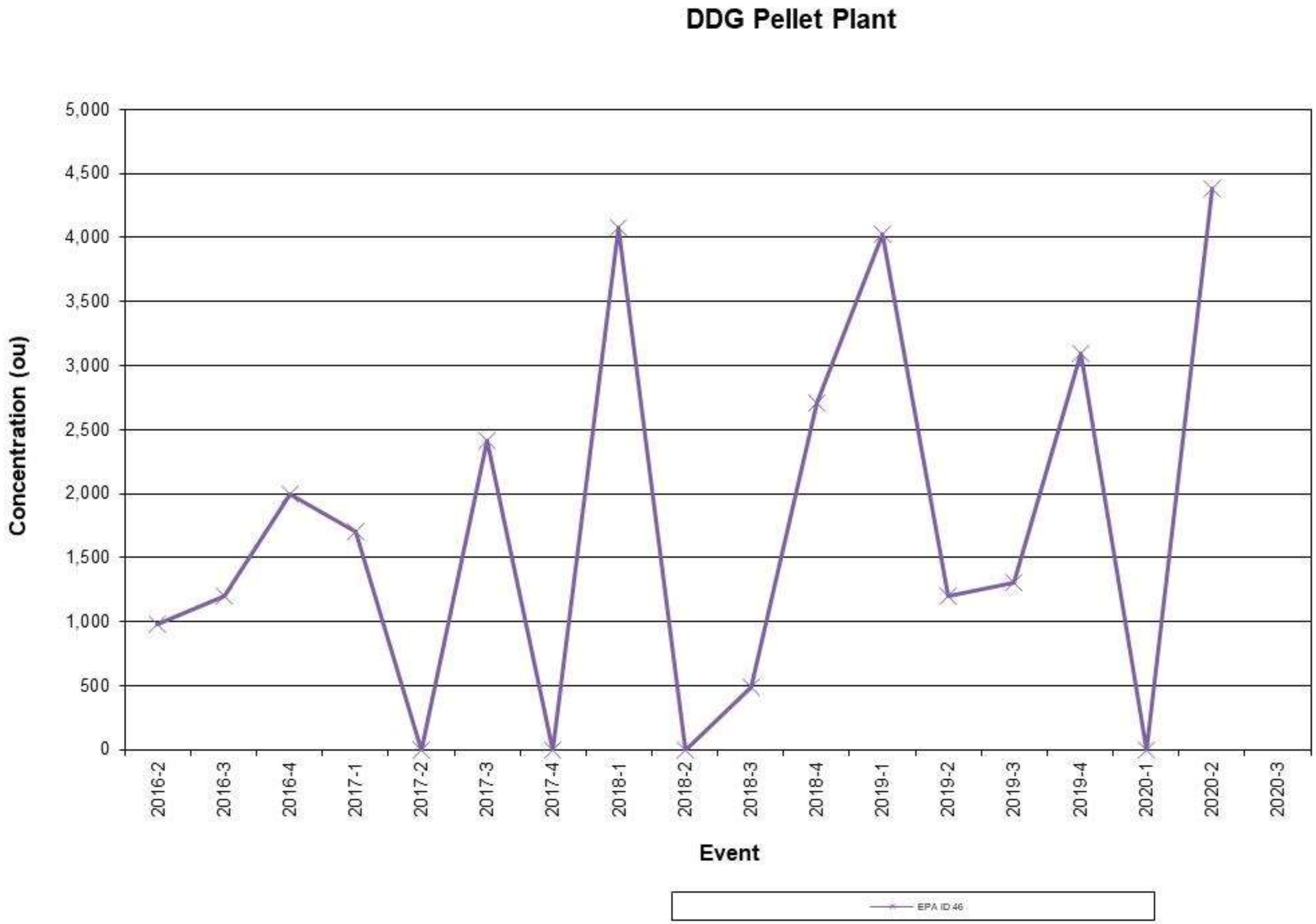


FIGURE 5-10 ODOUR EMISSION CONCENTRATIONS, DDG PELLET PLANT (EPA 46)



6 TEST METHODS

6.1 ODOUR MEASUREMENT/DYNAMIC OLFACTOMETRY

(AS 4323.3 & AS 4323.4 and OM-7 and OM-8)

Samples were collected in 30L Nalophane sampling bags which are enclosed in airtight plastic containers. Surface samples were collected utilising an equilibrium flux hood or witches hat flux hood.

Odorous gas for analysis was drawn through a Teflon (PTFE) sample probe. The gas then passes through a Teflon (PTFE) tube connected to the Nalophane sampling bag. The sampling pump is connected to the airtight plastic container to provide a sample gas flow-rate of approximately 0.5 – 1.5 litres per minute. After the required volume has been sampled, the pump is stopped and the bag sealed with a stainless steel valve. Two samples were collected from each site.

Using a triangular forced choice olfactometer, the Nalophane bag of odour sample was dynamically diluted to various concentrations with dry odour free air.

The diluted sample was then presented to a panel of screened panellists as one of these airflows. The panellists then recorded if they could detect any odour and from which flow. The other two flows were discharging odour free air.

The odour is always presented to the panellists in ascending concentration; that is, from lower to higher concentration. The panellists are required at each dilution level to give a response as to what they are smelling from the flows (forced choice methodology). The response options for the panellists are:

'Guess'	Unable to determine which air flow contains the diluted odours
'Inkle'	Thinks that one of the flows could be different from the other two flows
'Detect' or 'Certain'	Is confident that one of the airflows smells different from the other two flows. Not necessarily able to say what the smell is.
'Recognise'	Thinks that one of the flows could be different from the other two flows and is able to: ▪ Assign a 'hedonic tone' (pleasantness scale number) to the odour ranging from –10 to 10 and/or ▪ Able to assign a character to the colour, as in 'it smells like …' *Note: that the Recognise level concentration and Hedonic Tone and Odour descriptors are obtained with the diluted odour, panellists are not exposed to the full strength odour.*

The percentage panel response and dilution levels used were then entered into a computer programme to determine the 50% panel response. This dilution level corresponds to the odour concentration of the sample.

Sampling and dilution lines are constructed from teflon, stainless or glass to prevent contamination of the sample.

The sampling and the dilution procedures used were in accordance with OEH NSW Method OM-7 and OM-8, which are based on Standards Association of Australia, AS4323.3 and AS4323.4.

6.1.1 ODOUR PANEL SELECTION

Odour panellists must meet certain criteria to qualify as and remain panellists. Their average sensitivity to n-Butanol must be between 20 and 80 parts per billion (ppb) and their variability in response to n-Butanol must be within a certain range.

Panellists are screened against n-Butanol before every panel session to ensure they are in compliance.

Panellists should not suffer from respiratory complaints, nor should they eat or smoke or drink anything but water during the half hour preceding or during the test period and their person and clothing should be odour free and have not been exposed to an odorous environment before testing.

6.1.2 ODOUR TERMINOLOGY

The odour level is expressed in odour units and for mixed odours is analogous to concentration expressed in parts per billion. The odour detection level is defined as the ratio of *the volume that a sample of odorous gas would occupy when diluted to the threshold of detection of that odour* to *the volume of the sample*. In simpler terms, the ratio indicated the number of dilutions necessary to reduce the odour to its threshold of detection or odour detection threshold. This ratio is expressed in odour units or number of dilutions to detection threshold. For example, a value of 2,000 odour units would mean the volume of the initial sample of odorous gas would need to be diluted 2,000 times before the odour would just be detectable to the average human nose, that is, at the odour detection threshold.

6.2 EXHAUST GAS VELOCITY

(OEH NSW TM-2 and USEPA Method 12)

Velocity profiles were obtained across the stack utilising an Airflow Developments Ltd. S-type pitot tube and digital manometer.

6.3 EXHAUST GAS TEMPERATURE

(OEH NSW TM- 2, 3 & 4 and USEPA Methods 2, 3 & 4)

The exhaust gas temperature was measured using a Digital thermometer (0-1200^{o}C) connected to a chromel/alumel (K-type) thermocouple probe.

6.4 OXYGEN (O_2)

(OEH NSW TM-24 and USEPA Method 3A)

O_2 was analysed by a Testo 350 analyser.

6.5 MOISTURE

(OEH NSW TM-22 and USEPA Method 4)

Moisture from the stack was determined in accordance with OEH NSW TM-22 and USEPA Method 4. In particular, M4 Section 2.2.1 which nominates a moisture approximation method used to enable calculation of isokinetic sampling rates and where isokinetic sampling is not required such as odour sampling.

6.6 ACCURACY

All results are quoted on a dry basis. SEMA has adopted the following (Table 6-1) uncertainties for various stack testing methods.

TABLE 6-1 ESTIMATION OF MEASUREMENT UNCERTAINTY

Pollutant	Methods	Uncertainty
Moisture	AS4323.2, TM-22, USEPA 4	25%
Odour	AS4323.3, AS4323.4	3 times
Oxygen and Carbon Dioxide	TM-24, TM-25, USEPA 3A	1% actual
Velocity	AS4323.1, TM-2, USEPA 2A & 2C	5%

Key:

Unless otherwise indicated the uncertainties quoted have been determined @ 95% level of Confidence level (i.e. by multiplying the repeatability standard deviation by a co-efficient equal to 1.96) (Source – Measurement Uncertainty)

Sources: *Measurement Uncertainty – implications for the enforcement of emission limits by Maciek Lewandowski (Environment Agency) & Michael Woodfield (AEAT) UK*

Technical Guidance Note (Monitoring) M2 Monitoring of stack emissions to air Environment Agency Version 3.1 June 2005.

APPENDIX A – EMISSION TEST RESULTS

Glossary:

%	=	percent
^oC	=	degrees celsius
am^3/min	=	cubic metre of gas at actual conditions per minute
Normal Volume (m^3)	=	cubic metre at 0°C and 760 mm pressure and 1 atmosphere
am^3	=	cubic metre of gas at actual conditions
g/g mole	=	grams per gram mole
g/s	=	grams per second
hrs	=	hours
kg/m^3	=	kilograms per cubic metre
kPa	=	kilo Pascals
m^2	=	square metre
m/s	=	metre per second
m^3/sec	=	cubic metre per second at 0^0C and 1 atmosphere
mg	=	milligrams
mg/ m^3	=	milligrams per cubic metre at 0^oC and 1 atmosphere
O_2	=	oxygen

Abbreviations for names of SEMA staff who completed either Sampling or Analysis or QA Checking

PWS	=	Peter W Stephenson
JW	=	Jay Weber

TABLE A-1 EMISSION TEST RESULTS – GLUTEN DRYERS NO. 1, 2, 3 & 4

Emission Test Results				
Project Number	**7095**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 8 Gluten Dryer 1***	**EPA ID 9 Gluten Dryer 2**	**EPA ID 10 Gluten Dryer 3**	**EPA ID 11 Gluten Dryer 4**
Date	05-Aug-20	05-Aug-20	05-Aug-20	05-Aug-20
	Dry			
Run	1			
Method	TM-1, TM-2 & TM-22			
Flow Start Time (hrs)	12:07	10:30	12:00	11:32
Flow Stop Time (hrs)	12:24	10:40	12:21	11:53
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	71.4	63	70.1	73.5
Stack Cross-Sectional area (m^2)	1.431	1.094	4.410	2.310
Average Stack Gas Velocity (m/s)	14.0	18.1	11.6	16.0
Actual Gas Flow Volume (am^3/min)	1,201	1,190	3,080	2,222
Total Normal Gas Flow Volume (m^3/min)	887	837	2,253	1,651
Total Normal Gas Flow Volume (m^3/s)	14.8	14.0	37.6	27.5
Total Stack Pressure (kPa)	101.4	92.1	101.4	101.1
Moisture Content (% by volume)	6.9	4.8	8.1	5.5
Molecular Weight Dry Stack Gas (g/gmole)	28.8	28.8	28.8	28.8
Dry Gas Density (kg/m^3)	1.29	1.29	1.29	1.29
Oxygen (%)	20.9	20.90	20.9	20.9
Analysis	**Odour**	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5417	5407	5408	5409
SEMA Number	728041	728032	728033	728034
Sample Start Time (hrs)	12:14	10:35	12:11	11:43
Sample Finish Time (hrs)	12:24	10:40	12:21	11:53
Odour Concentration (As Received) (ou)	660	430	850	720
Odour Concentration (Final) (ou)	**660**	**430**	**850**	**720**
Normal MOER (As Received) (ou m^3/s)	9,800	6,000	32,000	20,000
Normal MOER (Final) (ou m^3/s)	9,800	6,000	32,000	20,000
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit	No Limit
Sample storage period prior to disposal	2 days	2 days	2 days	2 days
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

* Re. Gluten Dryer No.1 (EPA ID 8), odour measurements were taken. However, new silencer and ductwork no longer enable access to the duct. Thus, flow measurements were unable to be taken. To enable calculation of the MOER, flow measurements have been based on previous Quarter 1, 2020 results.

TABLE A-2 EMISSION TEST RESULTS – STARCH DRYERS NO.1, 3, 4 & 5

Emission Test Results				
Project Number	**7095**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 12 Starch Dryer 1**	**EPA ID 13 Starch Dryer 3**	**EPA ID 14 Starch Dryer 4**	**EPA ID 47 Starch Dryer 5**
Date	05-Aug-20	12-Aug-20	12-Aug-20	12-Aug-20
	Dry			
Run	1			
Method	TM-1, TM-2 & TM-22			
Flow Start Time (hrs)	11:10	11:21	11:22	10:29
Flow Stop Time (hrs)	11:31	11:43	11:43	10:30
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	36.1	34.2	36.8	67.3
Stack Cross-Sectional area (m^2)	2.250	1.000	1.000	4.524
Average Stack Gas Velocity (m/s)	6.8	20.0	21.2	15.3
Actual Gas Flow Volume (am^3/min)	920	1,200	1,273	4,156
Total Normal Gas Flow Volume (m^3/min)	773	1,018	1,064	3,173
Total Normal Gas Flow Volume (m^3/s)	12.9	17.0	17.7	52.9
Total Stack Pressure (kPa)	101.05	101.44	101.42	101.42
Moisture Content (% by volume)	4.6	4.6	5.3	5.0
Molecular Weight Dry Stack Gas (g/gmole)	28.8	28.8	28.8	28.8
Dry Gas Density (kg/m^3)	1.29	1.29	1.29	1.29
Oxygen (%)	20.9	20.9	20.9	20.9
Analysis	**Odour**	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5406	5415	5416	5413A
SEMA Number	728031	728039	728040	728038
Sample Start Time (hrs)	11:21	11:33	11:33	10:40
Sample Finish Time (hrs)	11:31	11:43	11:43	10:50
Odour Concentration (As Received) (ou)	250	400	140	250
Odour Concentration (Final) (ou)	**250**	**400**	**140**	**250**
Normal MOER (As Received) (ou m^3/s)	3,200	6,800	2,500	13,000
Normal MOER (Final) (ou m^3/s)	3,200	6,800	2,500	13,000
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days	2 days	2 days
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

TABLE A- 3 EMISSION TEST RESULTS – BOILERS NO. 5&6, 4 & 2

Emission Test Results			
Project Number	**7095**		
Project Name	**Shoalhaven Starches**		
Test Location	**EPA ID 35 Boilers 5&6**	**EPA ID 42 Boiler 4**	**EPA ID 45 Boiler 2**
Date	12-Aug-20	12-Aug-20	12-Aug-20
	Dry		
Run	1		
Method	TM-1, TM-2 & TM-22		
Flow Start Time (hrs)	12:32	13:12	13:58
Flow Stop Time (hrs)	12:53	13:32	14:20
Inlet/Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	139.5	164.6	216.0
Stack Cross-Sectional area (m^2)	3.142	1.057	0.950
Average Stack Gas Velocity (m/s)	16.7	18.8	10.4
Actual Gas Flow Volume (am^3/min)	3,143.1	1,194.9	592.4
Total Normal Gas Flow Volume (m^3/min)	1,978.0	708.3	316.9
Total Normal Gas Flow Volume (m^3/s)	32.966	11.805	5.282
Total Stack Pressure (kPa)	101.36	101.64	101.52
Moisture Content (% by volume)	5.0	5.3	4.4
Molecular Weight Dry Stack Gas (g/gmole)	30.1	29.8	30.080
Dry Gas Density (kg/m^3)	1.34	1.33	1.34
Oxygen (%)	8.4	10.0	8.4
Analysis	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5418	5419	5420
SEMA Number	728042	728043	728044
Sample Start Time (hrs)	12:43	13:22	14:10
Sample Finish Time (hrs)	12:53	13:32	14:20
Odour Concentration (As Received) (ou)	2,000	2,180	1,100
Odour Concentration (Final) (ou)	**2,000**	**2,180**	**1,100**
Normal MOER (As Received) (ou m^3/s)	66,000	26,000	5,800
Normal MOER (Final) (ou m^3/s)	66,000	26,000	5,800
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days	2 days
Calculations entered by	JW	JW	JW
Calculations checked by	PWS	PWS	PWS

TABLE A-4 EMISSION TEST RESULTS – FERMENTER 13 & CO_2 SCRUBBER OUTLET

Emission Test Results		
Project Number	**7095**	
Project Name	**Shoalhaven Starches**	
Test Location	**EPA ID 44 Fermenter 13**	**EPA ID 16 CO_2 Scrubber outlet**
Date	05-Aug-20	05-Aug-20
	Dry	
Run	1	
Method	TM-1,TM-2 & TM-22	
Flow Start Time (hrs)	12:54	13:04
Flow Stop Time (hrs)	13:15	13:25
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	29.7	22.4
Stack Cross-Sectional area (m^2)	0.071	0.196
Average Stack Gas Velocity (m/s)	3.1	9.3
Actual Gas Flow Volume (am^3/min)	13.1	110
Total Normal Gas Flow Volume (m^3/min)	11.4	99
Total Normal Gas Flow Volume (m^3/s)	0.190	1.645
Total Stack Pressure (kPa)	101.11	101.07
Moisture Content (% by volume)	3.30	2.56
Molecular Weight Dry Stack Gas (g/gmole)	29.6	31.2
Dry Gas Density (kg/m^3)	1.32	1.39
Oxygen (%)	0.5	0.1
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5410	5412
SEMA Number	728035	728037
Sample Start Time (hrs)	13:05	13:15
Sample Finish Time (hrs)	13:15	13:25
Odour Concentration (As Received) (ou)	10,300	17,500
Odour Concentration (Final) (ou)	**10,300**	**17,500**
Normal MOER (As Received) (ou m^3/s)	2,000	28,800
Normal MOER (Final) (ou m^3/s)	2,000	28,800
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

TABLE A- 5 EMISSION TEST RESULTS – INLET TO BIOFILTERS, DDG EVAPORATORS 1, 2, 3 & 4

Emission Test Results		
Project Number	**7095**	
Project Name	**Shoalhaven Starches**	
Test Location	**EPA ID 39 Biofilter Inlet DDG Evaporators 1, 2 & 3**	**EPA ID 39A Biofilter Inlet DDG Evaporator 4**
Date	8-Oct-20	8-Oct-20
	Dry	
Run	1	
Method	TM-1,TM-2 & TM-22	
Flow Start Time (hrs)	12:18	12:22
Flow Stop Time (hrs)	12:46	12:43
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	39.8	31.1
Stack Cross-Sectional area (m^2)	0.283	0.049
Average Stack Gas Velocity (m/s)	14.3	7.5
Actual Gas Flow Volume (am^3/min)	243	22
Total Normal Gas Flow Volume (m^3/min)	189	19
Total Normal Gas Flow Volume (m^3/s)	3.1	0.3
Total Stack Pressure (kPa)	96.25	101.06
Moisture Content (% by volume)	6.23	4.12
Molecular Weight Dry Stack Gas (g/gmole)	28.836	28.836
Dry Gas Density (kg/m^3)	1.287	1.287
Oxygen (%)	20.9	20.9
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5434	5435
SEMA Number	728098	728099
Sample Start Time (hrs)	12:32	13:09
Sample Finish Time (hrs)	12:46	13:19
Odour Concentration (As Received) (ou)	15,600	41,900
Odour Concentration (Final) (ou)	**15,600**	**41,900**
Normal MOER (As Received) (ou m^3/s)	49,100	13,200
Normal MOER (Final) (ou m^3/s)	49,100	13,200
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

TABLE A- 6 EMISSION TEST RESULTS DDG PELLET PLANT

Emission Test Results		
Project Number	**7095**	
Project Name	**Shoalhaven Starches**	
Test Location	**Part EPA ID 46* DDG Pellet Cooler East Stack**	**Part EPA ID 46* DDG Pellet Silo**
Date	28-Oct-20	28-Oct-20
	Dry	
Run	1	
Method	TM-1,TM-2 & TM-22	
Flow Start Time (hrs)	16:25	15:54
Flow Stop Time (hrs)	16:48	16:06
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	69.0	56.0
Stack Cross-Sectional area (m^2)	0.665	0.126
Average Stack Gas Velocity (m/s)	14	12
Actual Gas Flow Volume (am^3/min)	571	87
Total Normal Gas Flow Volume (m^3/min)	434	70
Total Normal Gas Flow Volume (m^3/s)	7.2	1.2
Total Stack Pressure (kPa)	99.70	102.11
Moisture Content (% by volume)	3.21	3.57
Molecular Weight Dry Stack Gas (g/gmole)	28.836	28.836
Dry Gas Density (kg/m^3)	1.29	1.29
Oxygen (%)	20.9	20.9
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5438	5437
SEMA Number	728112	728111
Sample Start Time (hrs)	16:38	16:08
Sample Finish Time (hrs)	16:48	16:18
Odour Concentration (As Received) (ou)	8,800	6,200
Odour Concentration (Final) (ou)	**8,800**	**6,200**
Normal MOER (As Received) (ou m^3/s)	63,600	7,300
Normal MOER (Final) (ou m^3/s)	63,600	7,300
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample Storage Period prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

Key:

Part 46* = partial contribution to EPA ID 46 stack which was not accessible

TABLE A- 7 EMISSION TEST RESULTS – BIOFILTER OUTLETS

Emission Test Results				
Project Number	**7095**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 40 Biofilter A East**	**EPA ID 40 Biofilter A West**	**EPA ID 41 Biofilter B East**	**EPA ID 41 Biofilter B West**
Date	8-Oct-20	8-Oct-20	8-Oct-20	8-Oct-20
Run	1			
Method	TM-2 & TM-22			
Sample & Flow Start Time (hrs)	13:10	13:41	13:06	13:32
Sample & Flow Stop Time (hrs)	13:20	13:51	13:16	13:43
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^{o}C)	37.6	38.4	30.6	27.8
Proportion of Inlet air flow (%)	**26**	**25**	**26**	**23**
Analysis	Odour	Odour	Odour	Odour
Method	AS4323.3	AS4323.3	AS4323.3	AS4323.3
ORLA Number	728094	728096	728095	728097
SEMA Number	5430	5432	5431	5433
Odour Concentration (As Received) (ou)	1,200	1,400	4,000	6,200
Odour Concentration (Final) (ou)	**1,200**	**1,400**	**4,000**	**6,200**
Normal MOER (As Received) (ou m^3/s)	1,100	1,200	3,700	4,900
Normal MOER (Final) (ou m^3/s)	1,100	1,200	3,700	4,900
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

APPENDIX B – CERTIFICATES OF ANALYSIS

Odour Research Laboratories Australia

A Division of Peter W. Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

52A Hampstead Road
Auburn NSW 2144 Australia
Tel: (02) 9737 9991
E-Mail: pstephenson@orla.com.au

Olfactometry Test Report

The measurement was commissioned by SEMA on behalf of:

Client	Organisation:	Shoalhaven Starches
	Address:	Bolong Road, Bomaderry NSW 2541
	Contact:	John Studdert
	Sampling Sites:	Starch Dryers 1, 3, 4 and 5 Gluten Dryers 1, 2, 3 and 4 Fermenter 13 CO_2 Scrubber inlet and outlet Boilers 2, 4 and 5&6
	Telephone:	02 4423 8254
	Email:	John.studdert@manildra.com.au
Project	ORLA Report Number:	7095/ORLA/01
	Project Manager:	Margot Kimber
	Testing operator:	Peter Stephenson
	ORLA Sample number(s):	5405 - 5420
	SEMA Sample number(s):	728031 - 728044
Order	Analysis Requested:	Odour Analysis
	Order requested by:	SEMA on behalf of Shoalhaven Starches
	Date of order:	31 July 2020
	Order number:	5147
	Telephone:	02 9737 9991
	Signed by:	Margot Kimber
	Order accepted by:	Peter Stephenson
Report	Date of issue:	14 August 2020

NATA accredited laboratory number 15043.

Accredited for Compliance with ISO/IEC 17025 - Testing

ODOUR CONCENTRATION MEASUREMENTS RESULTS 7095/ORLA/01

Investigated Item	Odour concentration in odour units 'ou' determined by Sensory odour concentration measurements, of an odour sample supplied in a sampling bag. All samples were received in good condition.
Analysis Method	The samples were analysed in accordance with AS/NZS4323.3:2001.
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 n-butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Instrument Used	The Olfactometer used during this testing session was: AC'SCENT International Olfactometer
Measuring Range	The measuring range of the AC'SCENT International olfactometer is $12 \leq \chi \leq 92{,}102$ ou. . If the measuring range was insufficient the odour samples will have been pre-diluted.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between $\pm 3^{o}C$.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.05$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $r = 0.0020$ (February 2020) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.20$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $A = 0.020$ (February 2020) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the AC'SCENT International Olfactometer has been determined to be 12 ou.
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 every session to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

14 August, 2020

Peter Stephenson
Managing Director

Odour Research Laboratories Australia

Odour Olfactometry Results – 7095/ORLA/01

Sample				Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Starch Dryer 1	728031	05.08.20 11:21	5406	06.08.20 10:50	4	8	Nil	250	250	Hessian, earthy, floral mould, flour, musty, yeasty-then plastic, paint (-1)^
Sample ID: Gluten Dryer 2	728032	05.08.20 10:35	5407	06.08.20 11:19	4	8	Nil	430	430	Musty, dirty feet, wheat, plastic, paint, hessian, bag of dirty potatoes, earthy, grains (-2)^
Sample ID: Gluten Dryer 3	728033	05.08.20 12:11	5408	06.08.20 11:49	4	8	Nil	850	850	Dirty feet, hessian, wet cardboard, fried vegetables, first sharp/sour vomit – then musty, wheat, plastic (-2)^
Sample ID: Gluten Dryer 4	728034	05.08.20 11:43	5409	06.08.20 12:18	4	8	Nil	720	720	Musty, hessian, earthy, wheat, plastic, dirty feet, metallic drain water (-2)^
Sample ID: Fermenter #13	728035	05.08.20 13:05	5410	06.08.20 12:47	4	8	Nil	10300	10300	Flowery, sweet, perfume, vinegar, ink, alcohol, caramel liqueur, fruit yoghurt (-1)^
Sample ID: CO2 scrubber Inlet	728036	05.08.20 13:16	5411	06.08.20 14:10	4	8	Nil	11300	11300	Ethanol, sickly sweet, alcohol, sweet vinegar, ink, caramel liqueur, syrup, mango yoghurt (0)^
Sample ID: CO2 scrubber Outlet	728037	05.08.20 13:15	5412	06.08.20 14:39	4	8	Nil	17500	17500	Perfume, citrus, sweet vinegar, ink, alcohol, caramel liqueur, syrup, fruit, sour – but not sharp (-2)^

Odour Research Laboratories Australia

Odour Olfactometry Results – 7095/ORLA/01

Sample				Analysis Date/Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1 *	(ou) 2 *	
Sample ID: Starch Dryer 5	728038	12.08.20 10:40	5413	13.08.20 10:46	4	8	Nil	250	250	Dirty feet, gas, musty, hessian, grain, wheat, fermentation (hops?), firstly earth & garbage/septic then plastic (-2)^
Sample ID: Starch Dryer 3	728039	12.08.20 11:33	5415	13.08.20 11:14	4	8	Nil	400	400	Yeasty, sweet, organic, hessian, wheat, grains, slight soapy, later plastic artificial fruit (0)^
Sample ID: Starch Dryer 4	728040	12.08.20 11:33	5416	13.08.20 11:43	4	8	Nil	140	140	Starch, musty, sweet, plastic toys, slight chlorine, dank pipe water (metallic), hessian, wheat, compost, dirty & earthy at end (-1)^
Sample ID: Gluten Dryer 1	728041	12.08.20 12:14	5417	13.08.20 12:12	4	8	Nil	660	660	Dirty feet, musty, rotting stone fruit, corn, garlic, potato, earth, vinyl, wood (-2)^
Sample ID: Boiler 5&6	728042	12.08.20 12:43	5418	13.08.20 12:42	4	8	Nil	2000	2000	Damp, musty, car exhaust, sweet coal/steam train exhaust, septic, earth, wood, grain, plastic (-2)^
Sample ID: Boiler 4	728043	12.08.20 13:24	5419	13.08.20 13:10	4	8	Nil	2180	2180	Car exhaust fumes, coke-not coal, slightly metallic, musty, acid, sweet, slight mild & sweet vinegar, plastic (-1)^
Sample ID: Boiler 2	728044	12.08.20 14:10	5420	13.08.20 13:39	4	8	Nil	1100	1100	Exhaust fumes, coke, musty, sulfur, solvent, plastic, sweet mild vinegar (-1)^

Odour Research Laboratories Australia

Odour Panel Calibration Results – 7095/ORLA/01

Reference Odorant	ORLA Sample No.	Date	Concentration of Reference Gas (ppm)	Reference Gas Measured Concentration (ou)	Panel Average Measured Concentration (ppb) [3]	Does panel calibration measurement comply with AS/NZS4323.3:P2001 (Yes/No) [4]
n-butanol	5405	06.08.20	62.0	1413	43.9	Yes
n-butanol	5414	13.08.20	62.0	1679	36.9	Yes

Comments: All samples were collected by Stephenson Environmental Management Australia and analysed by Odour Research Laboratories Australia at their Sydney Laboratory.

Notes from Odour Olfactometry Results:

[1] Sample Odour Concentration: as received in the bag

[2] Sample Odour Concentration: allowing for pre-dilution

[3] Panel Average Measured Concentration: indicates the sensitivity of the panel for the session completed

[4] Target Range for reference gas n-butanol is $20 \leq \chi \leq 80$ ppb and compliance with AS/NZ4323.3:2001 is based on the individuals rolling average and not on the panel average measured concentration.

Panellist Rolling Average:

06/08/2020: SR =46.9, PR = 61.3, TL = 32.2, JW= 42.4

13/08/2020: SR =46.9, PR = 61.3, TL = 31.1, JW= 42.4

^ denotes the Average Hedonic Tone: describes the pleasantness of the odour being presented where (+5) represents Very Pleasant, (0) represents Neutral and (-5) represents Very Unpleasant and has been derived from the panellist responses at the recognition threshold.

+ This value is not part of our NATA Scope of Accreditation and AS4323.3

---END OF TEST REPORT---

Odour Research Laboratories Australia

A Division of Peter W. Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

52A Hampstead Road
Auburn NSW 2144 Australia
Tel: (02) 9737 9991
E-Mail: pstephenson@orla.com.au

Olfactometry Test Report

The measurement was commissioned by SEMA on behalf of:

Client	Organisation:	Shoalhaven Starches
	Address:	Bolong Road, Bomaderry NSW 2541
	Contact:	John Studdert
	Sampling Sites:	Biofilter Outlets A & B East, Biofilter Outlets A & B West, Biofilter Inlet from DDG Evaporators 1, 2, 3 & 4, DDG Pellet Silo and DDG Pellet Cooler East Stack
	Telephone:	02 4423 8254
	Email:	John.studdert@manildra.com.au
Project	ORLA Report Number:	7095/ORLA/02
	Project Manager:	Margot Kimber
	Testing operator:	Peter Stephenson
	ORLA Sample number(s):	5429 - 5438
	SEMA Sample number(s):	728094 - 728099 and 728111 - 728112
Order	Analysis Requested:	Odour Analysis
	Order requested by:	SEMA on behalf of Shoalhaven Starches
	Date of order:	8-Oct-2020
	Order number:	5167
	Telephone:	02 9737 9991
	Signed by:	Margot Kimber
	Order accepted by:	Peter Stephenson
Report	Date of issue:	04 January, 2021

NATA accredited laboratory number 15043.

Accredited for Compliance with ISO/IEC 17025 - Testing

Investigated Item	Odour concentration in odour units 'ou' determined by Sensory odour concentration measurements, of an odour sample supplied in a sampling bag. All samples were received in good condition.
Analysis Method	The samples were analysed in accordance with AS/NZS4323.3:2001.
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 n-butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Instrument Used	The Olfactometer used during this testing session was: AC'SCENT International Olfactometer
Measuring Range	The measuring range of the AC'SCENT International olfactometer is $12 \leq \chi \leq 92{,}102$ ou. . If the measuring range was insufficient the odour samples will have been pre-diluted.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between ± 3°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.05$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $r = 0.0020$ (February 2020) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.20$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $A = 0.020$ (February 2020) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the AC'SCENT International Olfactometer has been determined to be 12 ou.
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 every session to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

04 January, 2021

Peter Stephenson
Managing Director

Odour Research Laboratories Australia

Odour Olfactometry Results – 7095/ORLA/02

Sample				Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour concentration		Odour Character & Hedonic Tone^ +
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Bio outlet A East	728094	08.10.20 13:10	5430	09.10.20 09:54	4	8	Nil	1200	1200	Manure, caffeine, sour, fertiliser, bitter, mould, earth, yeast, cocoa, coffee (-3)^
Sample ID: Bio outlet B East	728095	08.10.20 13:06	5431	09.10.20 10:24	4	8	Nil	4000	4000	Vegemite, slight sewer, earth, grain, hessian, sweet, cocoa, fruit yoghurt, sour vegetables, chocolate (-2)^
Sample ID: Bio outlet A West	728096	08.10.20 13:41	5432	09.10.20 10:53	4	8	Nil	1400	1400	Manure, fertiliser, smoky, burnt, earth, sulfur, grain, vegemite, swamp, cocoa (-2)^
Sample ID: Bio outlet B West	728097	08.10.20 13:32	5433	09.10.20 11:22	4	8	Nil	6200	6200	Sour, sour vegetable soup, hessian, mould, peat, cocoa, chocolate, sweet (-1)^
Sample ID: Bio inlet DDG Evaporators 1,2 & 3	728098	08.10.20 12:32	5434	09.10.20 12:55	4	8	Nil	15600	15600	Hessian, vegemite, grain, cocoa, sweet, dusty vacuum cleaner, plastic (-1)^
Sample ID: Bio inlet DDG Evaporator 4	728099	08.10.20 13:09	5435	09.10.20 13:27	4	8	Nil	42000	42000	Almond oil, sickly oil, cooking potatoes, tar, molasses, grain, sweet, chocolate, caramel liqueur (-3)^
Sample ID: DDG Pellet Silo	728111	28.10.20 16:08	5437	29.10.20 17:22	4	8	Nil	6200	6200	Malt, milkshake, wheat, cereal, slight yoghurt odour, old cooking oil, bitter (+1)^
Sample ID: DDG Pellet Cooler East	728112	28.10.20 16:38	5438	29.10.20 17:50	4	8	Nil	8800	8800	Sweet, sugar, malt, milkshake, cereal, wheat, dirty (+1)^

ODOUR RESEARCH LABORATORIES AUSTRALIA VERSION: 4.4 PAGE 3 OF 4

Odour Research Laboratories Australia

Odour Panel Calibration Results – 7095/ORLA/02

Reference Odorant	ORLA Sample No.	Date	Concentration of Reference Gas (ppm)	Reference Gas Measured Concentration (ou)	Panel Average Measured Concentration (ppb) [3]	Does panel calibration measurement comply with AS/NZS4323.3:P2001 (Yes/No) [4]
n-butanol	5429	09.10.20	62.0	1413	43.8	Yes
n-butanol	5436	29.10.20	62.0	1421	43.6	Yes

Comments: All samples were collected by Stephenson Environmental Management Australia and analysed by Odour Research Laboratories Australia at their Sydney Laboratory.

Notes from Odour Olfactometry Results:

[1] Sample Odour Concentration: as received in the bag

[2] Sample Odour Concentration: allowing for pre-dilution

[3] Panel Average Measured Concentration: indicates the sensitivity of the panel for the session completed

[4] Target Range for reference gas n-butanol is $20 \le \chi \le 80$ ppb and compliance with AS/NZ4323.3:2001 is based on the individuals rolling average and not on the panel average measured concentration.

Panellist Rolling Average:

09/10/2020: SR = 48.5, PR = 57.3, TL = 32.2, JW= 45.3

29/10/2020: SR = 46.9, PR = 61.3, TL = 31.1, PRP= 39.5

^ denotes the Average Hedonic Tone: describes the pleasantness of the odour being presented where (+5) represents Very Pleasant, (0) represents Neutral and (-5) represents Very Unpleasant and has been derived from the panellist responses at the recognition threshold.

+ This value is not part of our NATA Scope of Accreditation and AS4323.3

--END OF TEST REPORT--

APPENDIX C – DETAILS OF INSTRUMENT CALIBRATION

TABLE C- 1 INSTRUMENT CALIBRATION DETAILS DAY 1

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	07-May-20	07-Nov-20
775	Thermocouple	07-May-20	07-Nov-20
893	Thermocouple	07-May-20	07-Nov-20
815	Digital Manometer	06-Dec-19	06-Dec-20
726	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	Combustion Analyzer	16-Mar-20	16-Sep-20
675	Personal Sampler	12-Mar-20	12-Mar-21
832	Personal Sampler	26-Feb-20	26-Feb-21
678	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	05-Dec-19	05-Dec-20
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C- 2 INSTRUMENT CALIBRATION DETAILS DAY 2

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	07-May-20	07-Nov-20
920	Thermocouple	07-May-20	07-Nov-20
769	Thermocouple	07-May-20	07-Nov-20
815	Digital Manometer	06-Dec-19	06-Dec-20
726	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	Combustion Analyzer	16-Mar-20	16-Sep-20
675	Personal Sampler	12-Mar-20	12-Mar-21
832	Personal Sampler	26-Feb-20	26-Feb-21
678	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	05-Dec-19	05-Dec-20
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C- 3 INSTRUMENT CALIBRATION DETAILS DAY 3

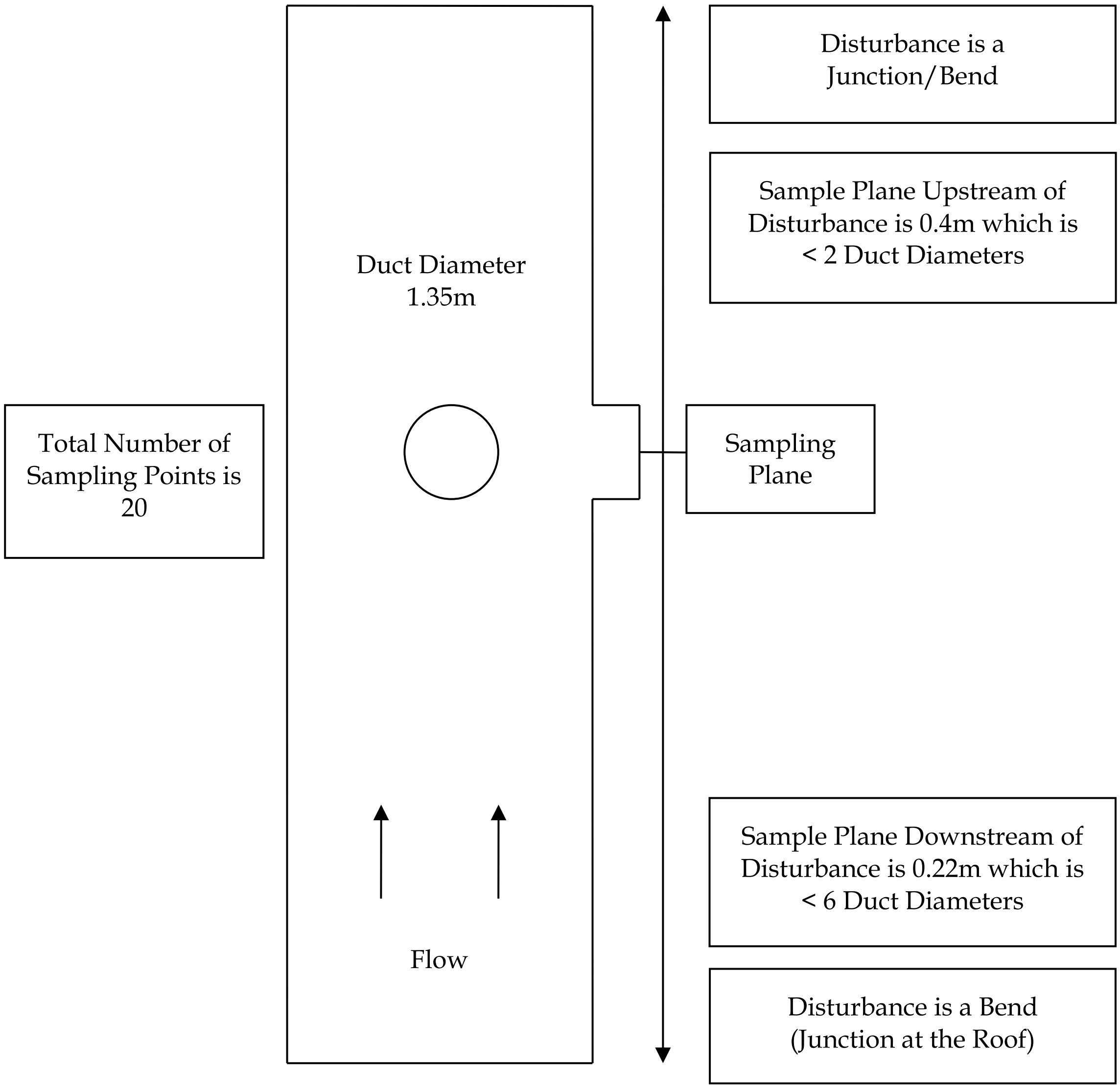
SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	07-May-20	07-Nov-20
919	Thermocouple	07-May-20	07-Nov-20
775	Thermocouple	07-May-20	07-Nov-20
815	Digital Manometer	06-Dec-19	06-Dec-20
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	Combustion Analyzer	02-Sep-20	02-Mar-21
832	Personal Sampler	26-Feb-20	26-Feb-21
753	Personal Sampler	12-Mar-20	12-Mar-21
678	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	05-Dec-19	05-Dec-20
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C-4 INSTRUMENT CALIBRATION DETAILS DAY 4

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	19-Oct-20	19-Apr-21
920	Thermocouple	19-Oct-20	19-Apr-21
805	Thermocouple	19-Oct-20	19-Apr-21
815	Digital Manometer	06-Dec-19	06-Dec-20
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	Combustion Analyzer	02-Sep-20	02-Mar-21
676	Personal Sampler	26-Feb-20	26-Feb-21
613	Barometer	05-Dec-19	05-Dec-20
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

APPENDIX D – SAMPLE LOCATIONS

FIGURE D-1 GLUTEN DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC



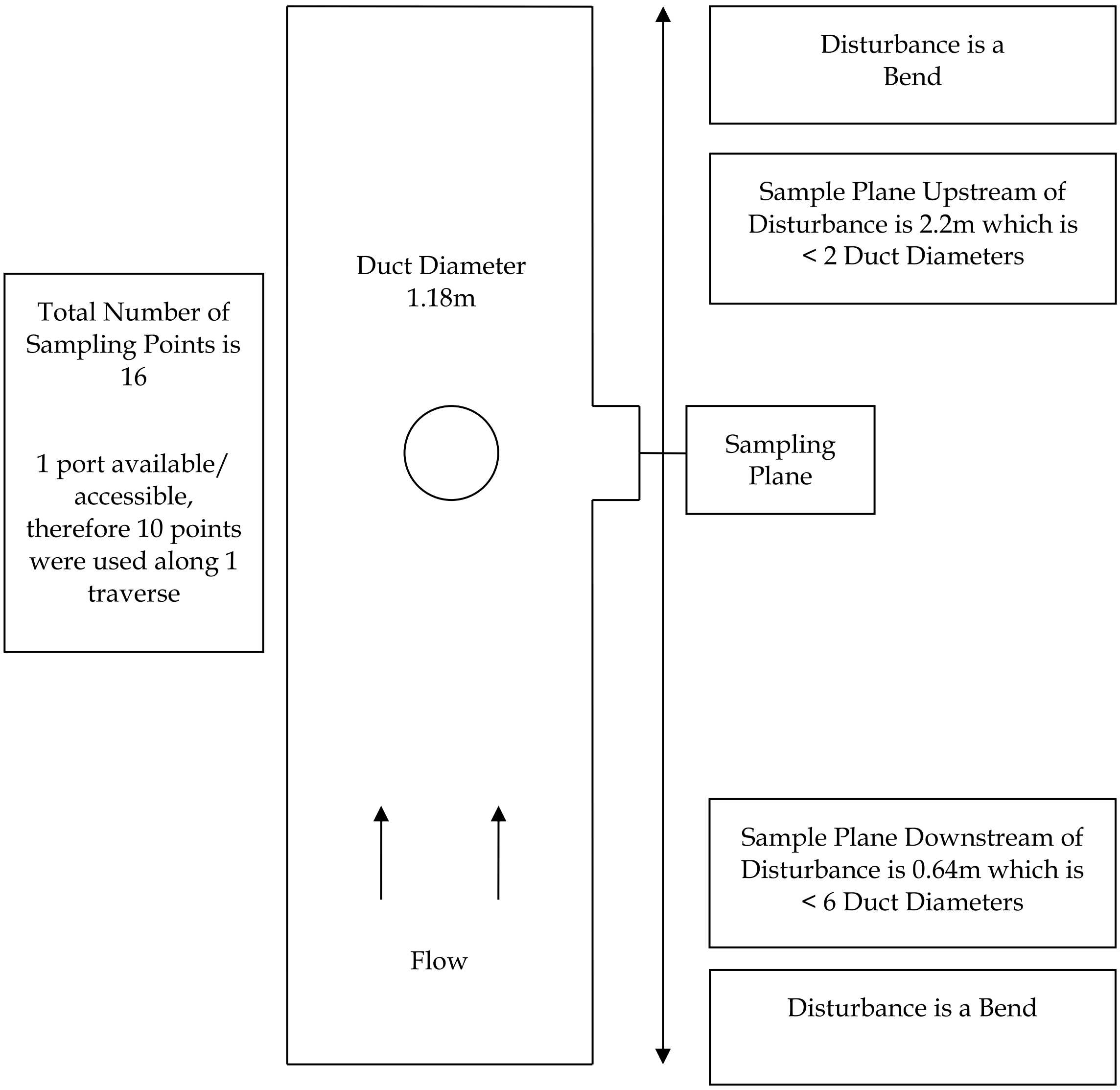
In the absence of cyclonic flow activity ideal sampling plane positions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-2 GLUTEN DRYER NO. 1 – SAMPLE LOCATION

FIGURE D-3 GLUTEN DRYER NO. 2 –SAMPLE LOCATION SCHEMATIC



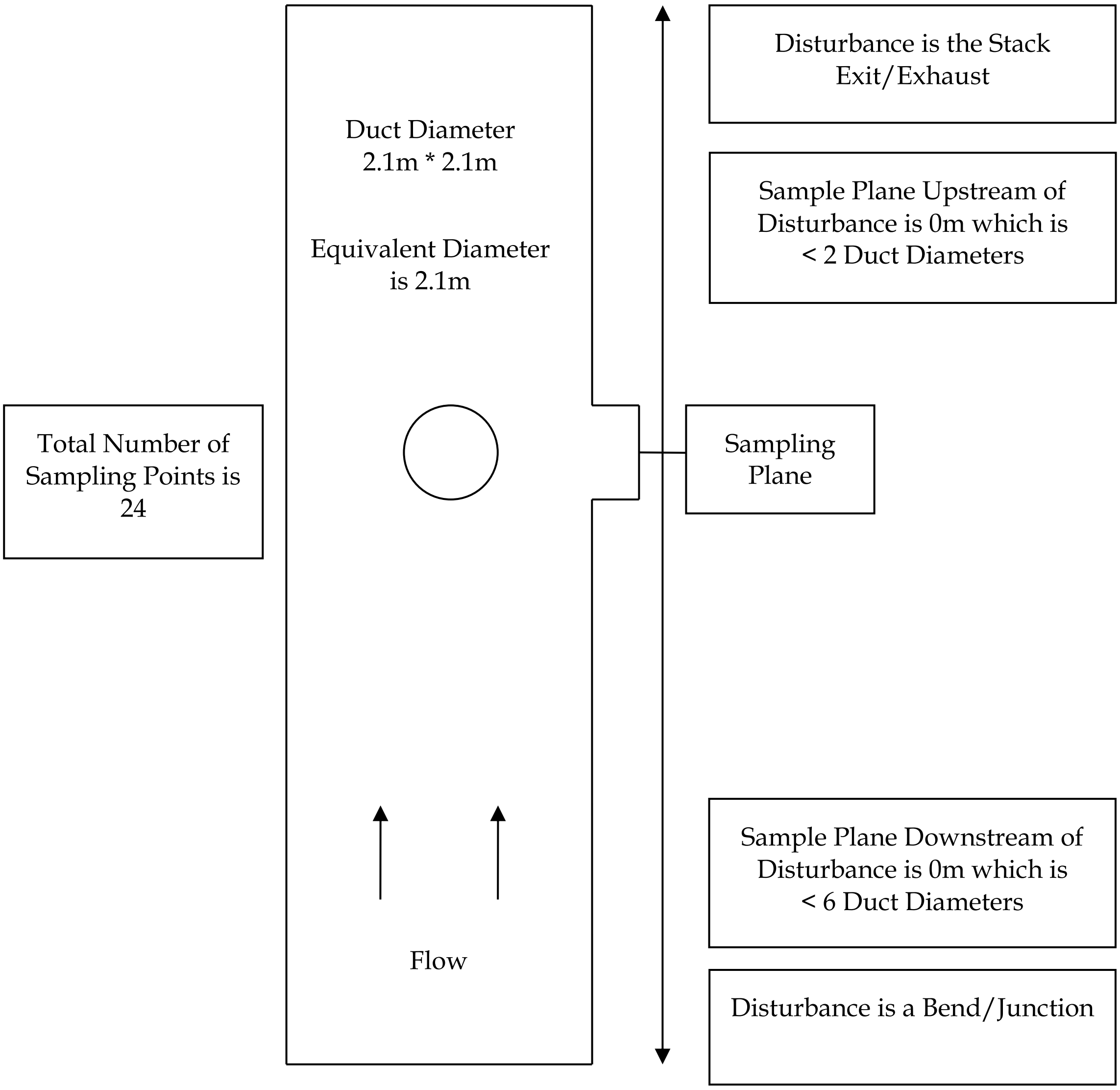
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the interim exit sampling plane complies with AS4323.1 temperature and AS4323.3 odour criteria for sampling.

FIGURE D-4 GLUTEN DRYER NO. 2 – ODOUR SAMPLE LOCATION AT DUCT EXIT

FIGURE D-5 GLUTEN DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC



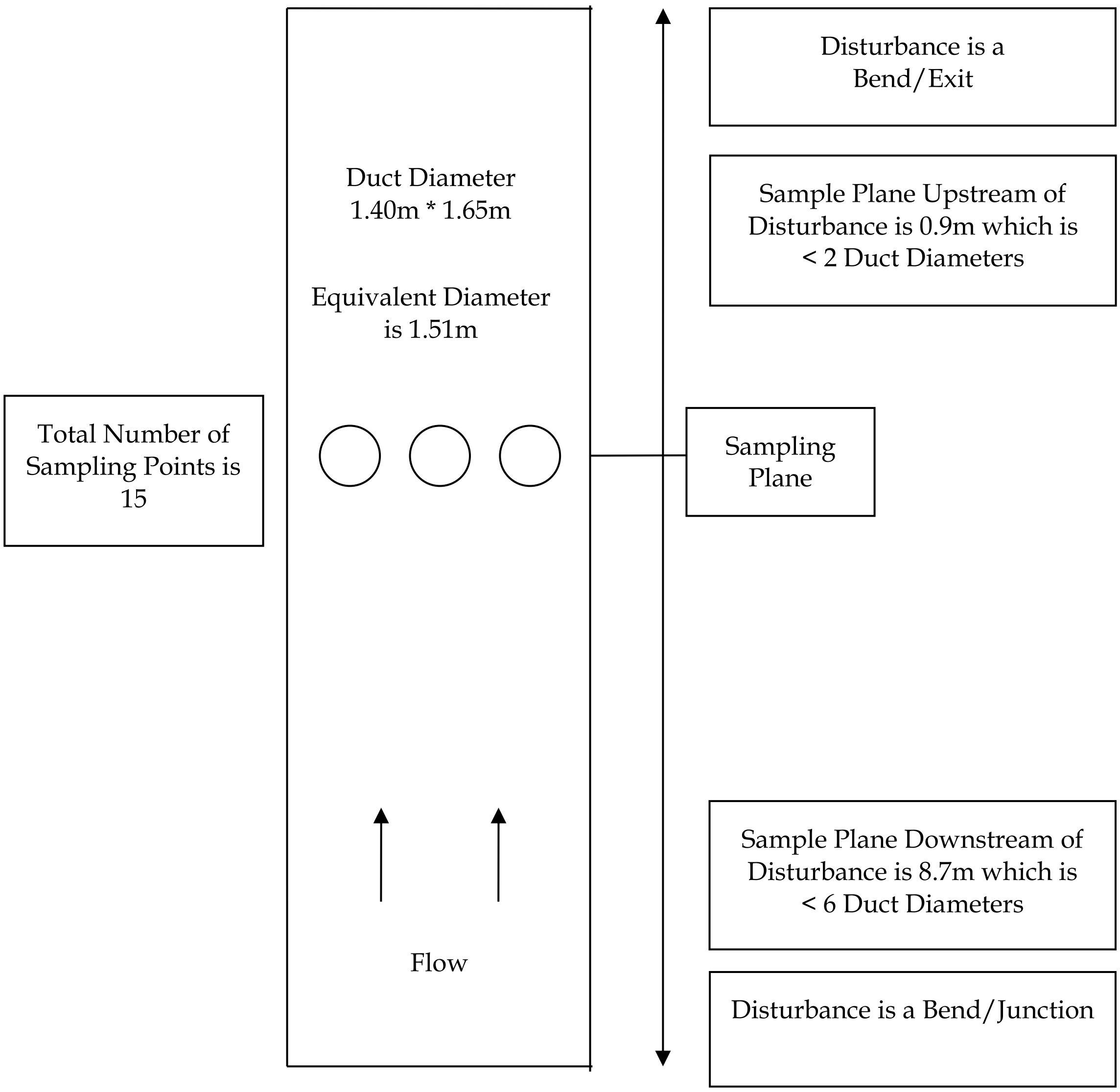
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of minimum velocity profile not meeting the minimum 3 metres per second (m/s) at every sampling point. Previous Minimum (0.8 m/s), Current Minimum (0 m/s).

FIGURE D-6 GLUTEN DRYER NO. 3 – SAMPLE LOCATION

FIGURE D-7 GLUTEN DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC



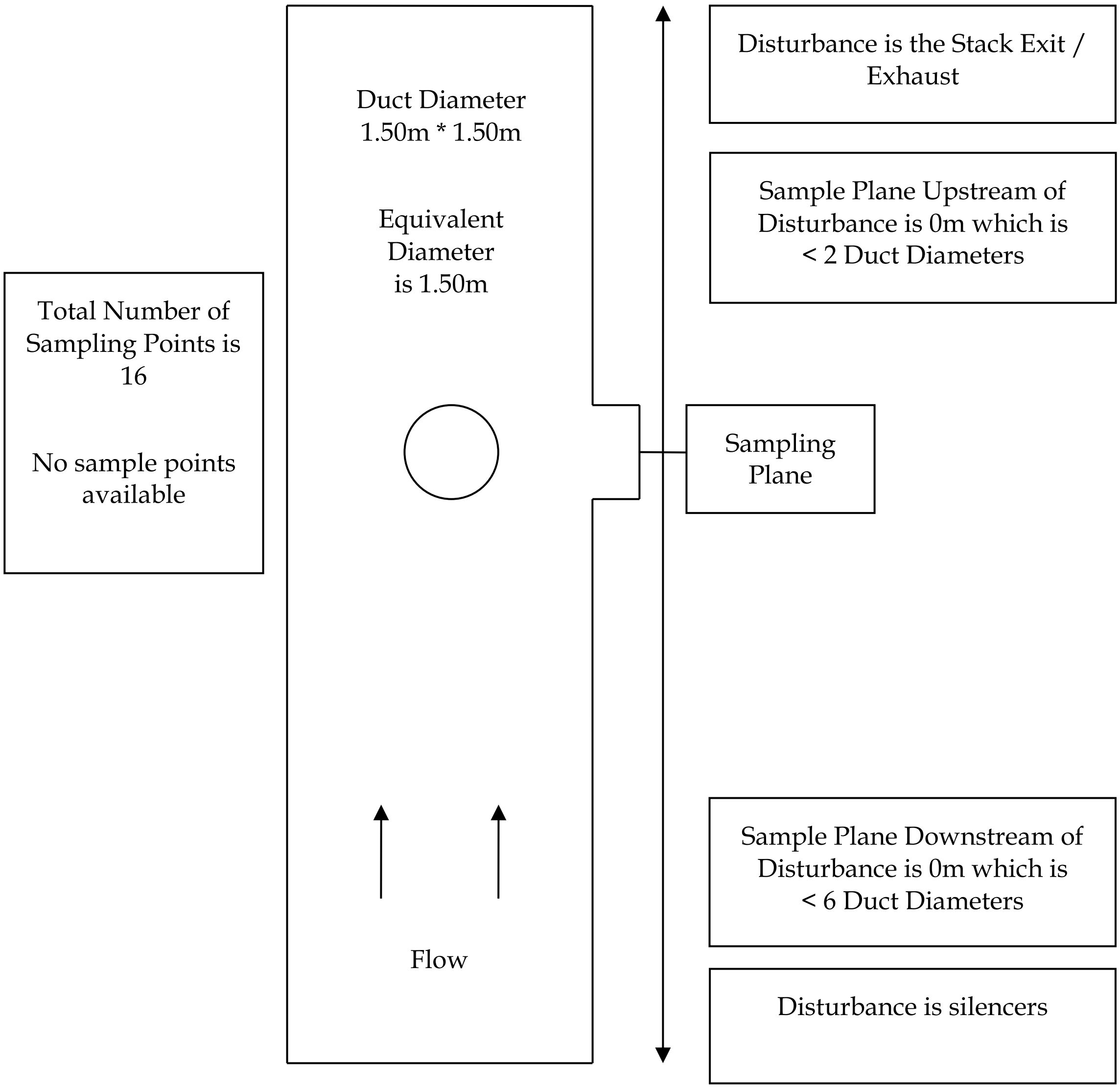
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane does meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-8 GLUTEN DRYER NO. 4 – SAMPLE LOCATION

FIGURE D-9 STARCH DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC



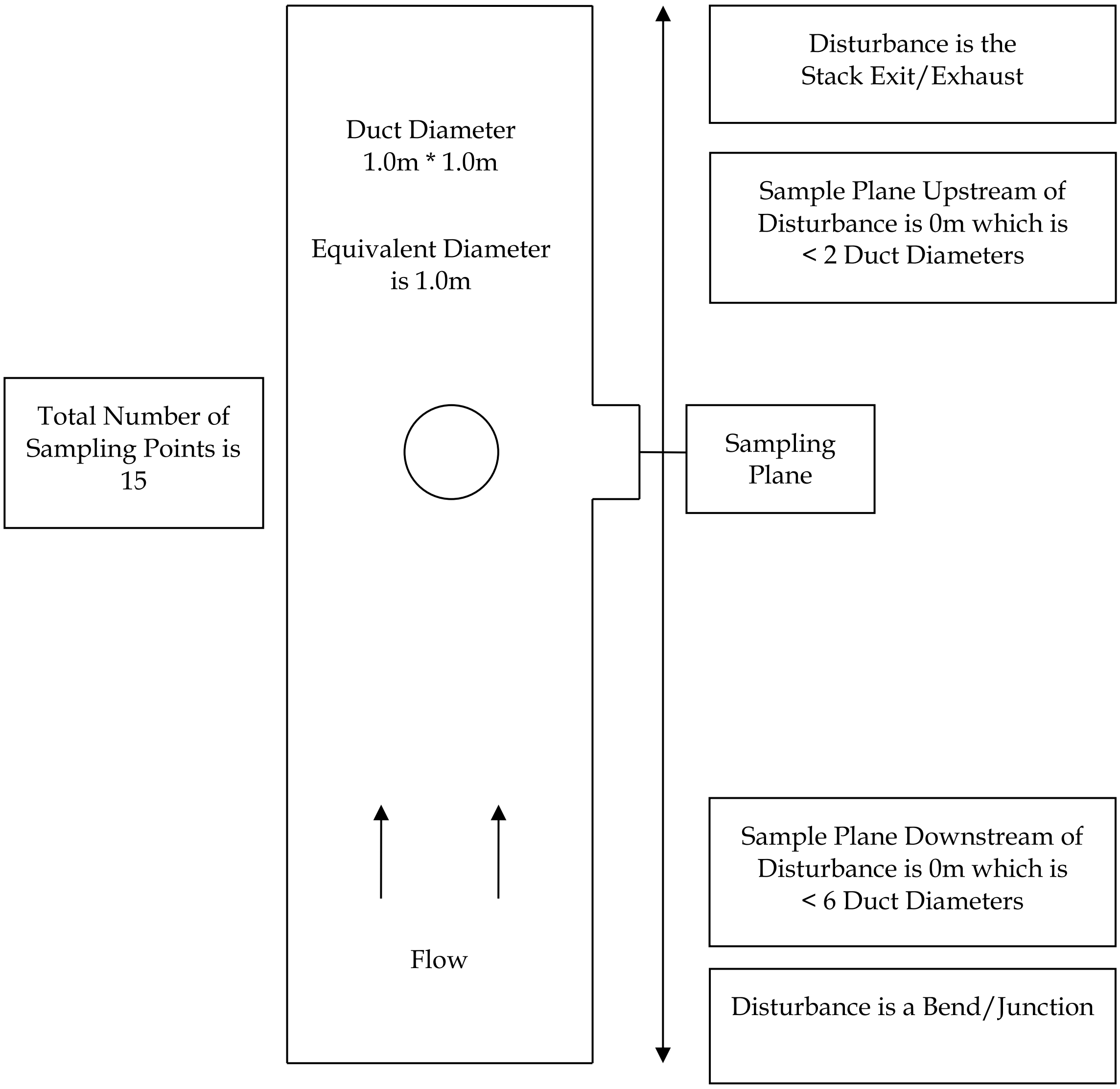
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-10 STARCH DRYER NO. 1 – SAMPLE LOCATION

FIGURE D-11 STARCH DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC



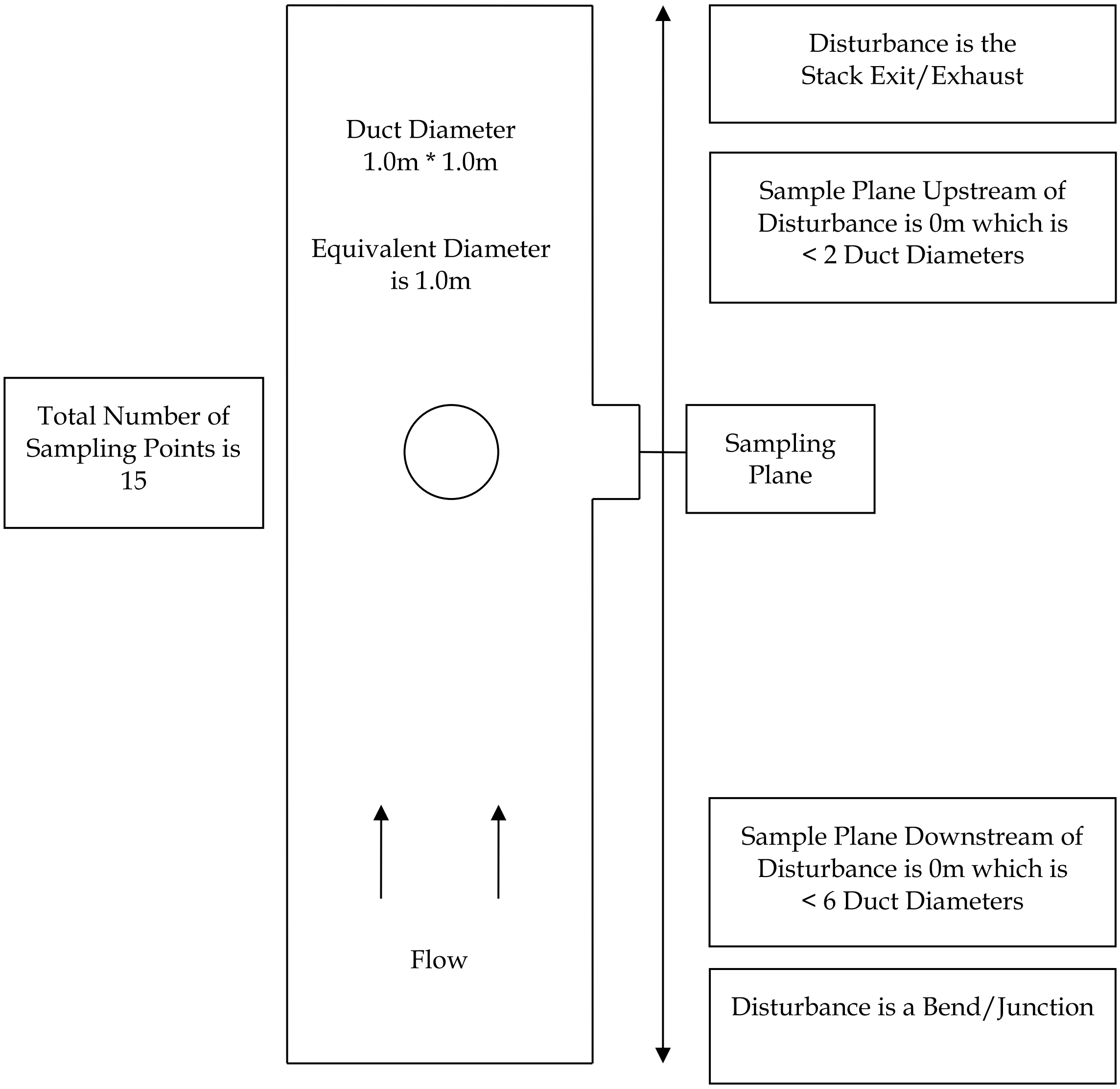
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-12 STARCH DRYER NO. 3 – SAMPLE LOCATION

FIGURE D-13 STARCH DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC



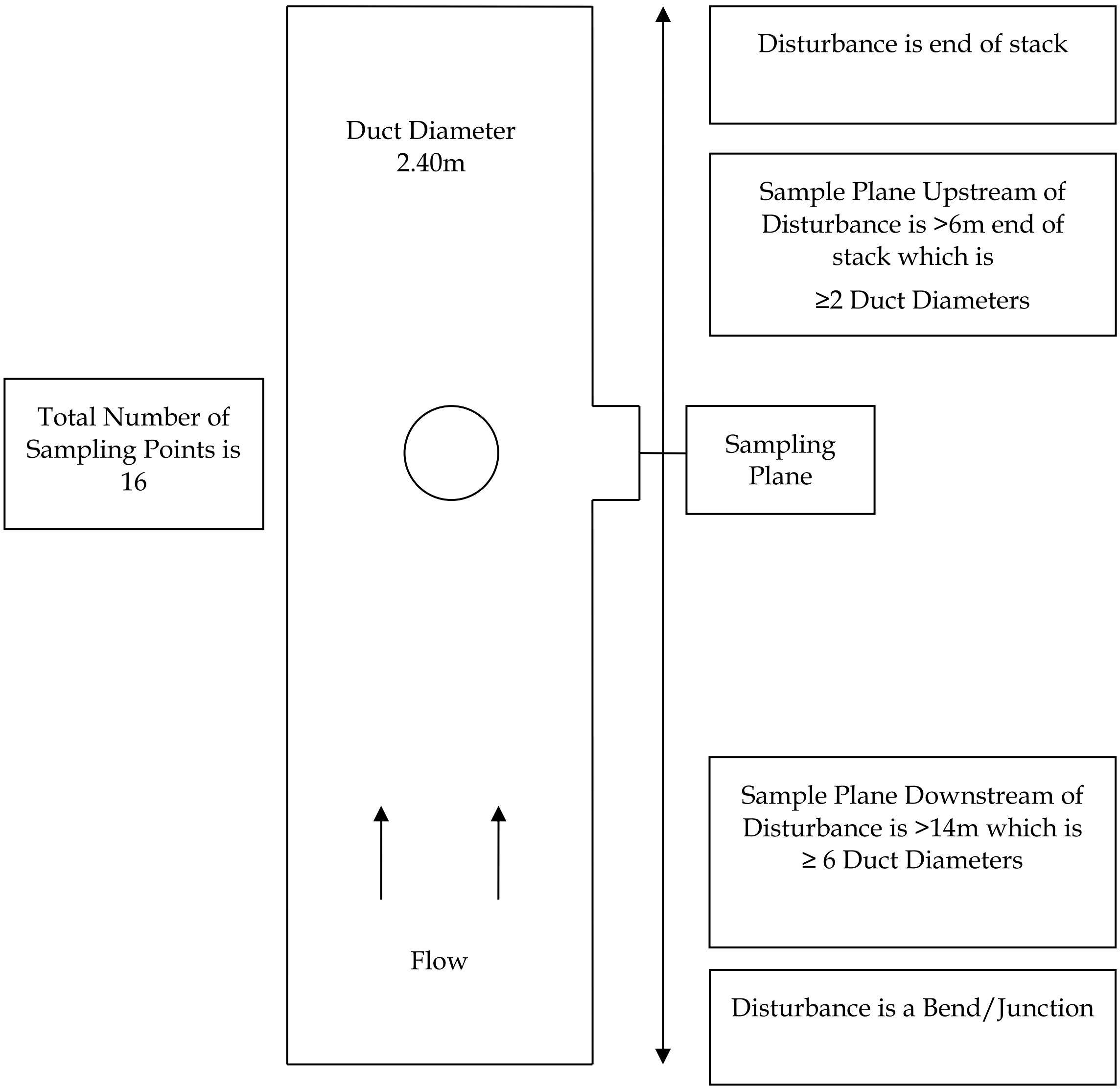
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-14 STARCH DRYER NO. 4 – SAMPLE LOCATION

FIGURE D-15 STARCH DRYER NO. 5 – SAMPLE LOCATION SCHEMATIC

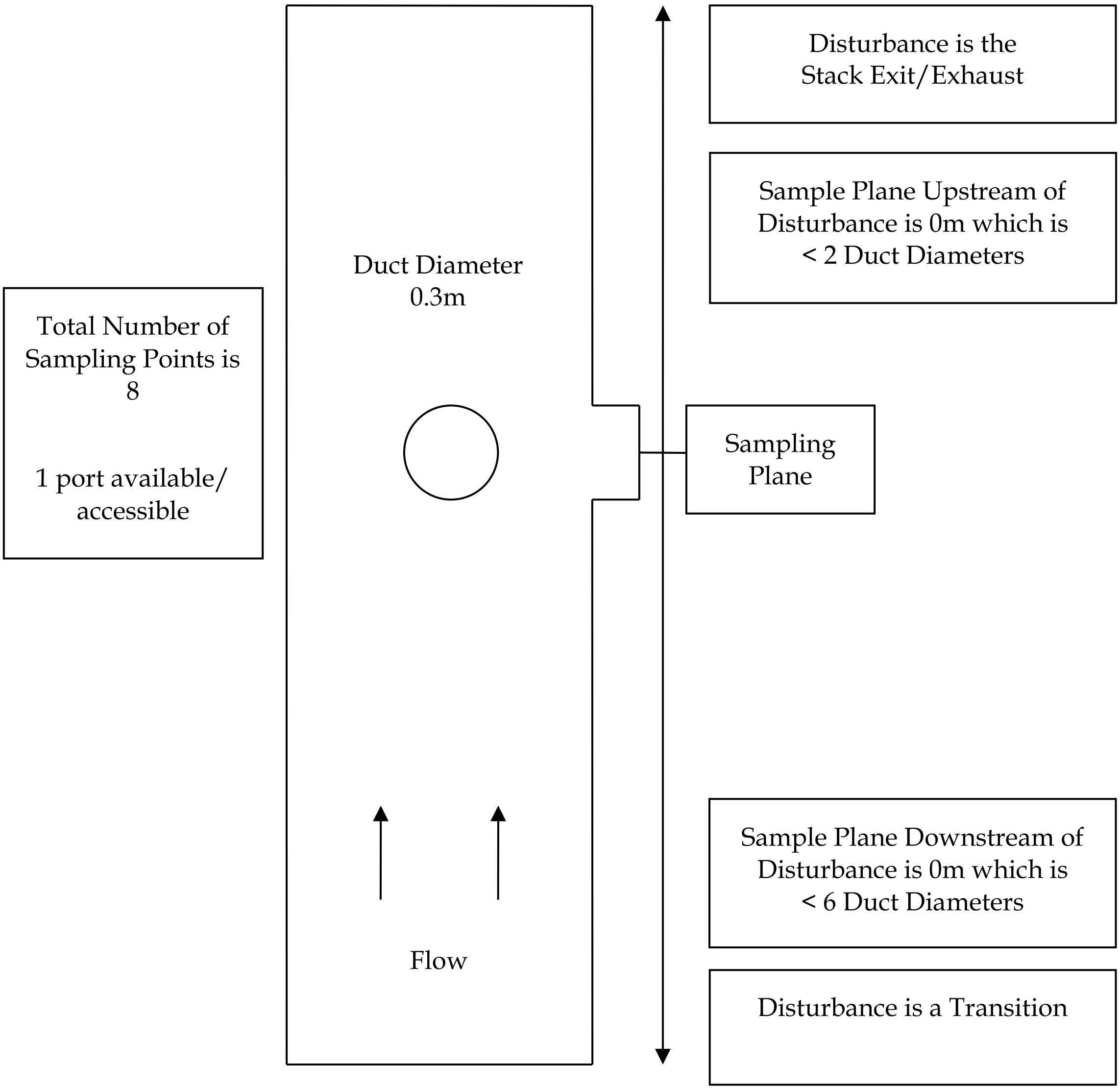


In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does meet this criterion. .

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-16 STARCH DRYER NO. 5 – SAMPLE LOCATION

FIGURE D-17 FERMENTERS – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

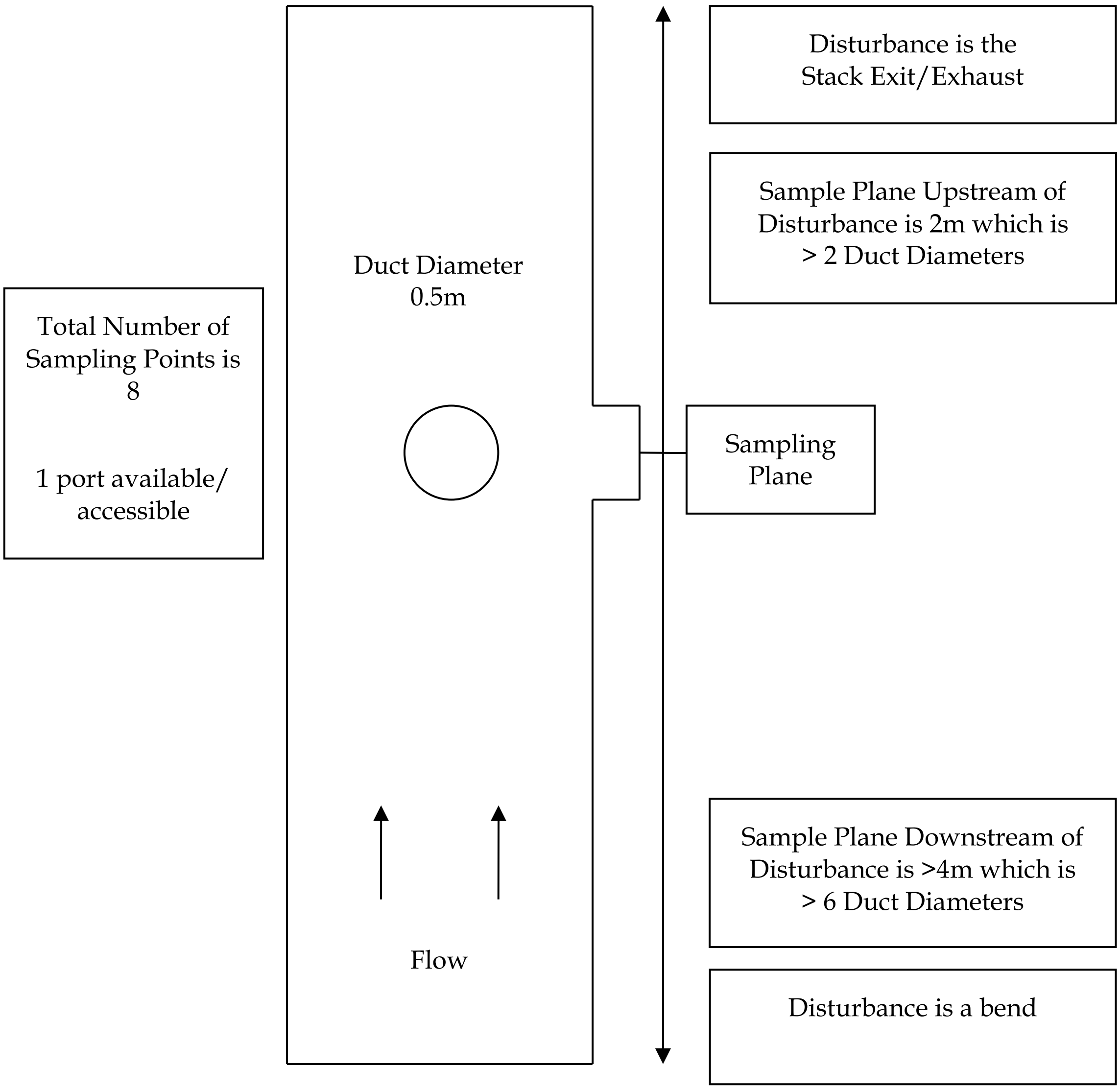
However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The sample location also does not meet the minimum number of access holes available.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of the velocity profile not meeting the minimum 3 metres per second (m/s) at any sampling point. Previous measurements were Average (0.9 m/s), maximum (1.1 m/s) and minimum (0.8 m/s) velocity profile. Current measurements are Average (1.7 m/s), maximum (3.5 m/s) and minimum (0 m/s) velocity profile.

FIGURE D-18 FERMENTERS – SAMPLE LOCATION

FIGURE D-19 CO_2 SCRUBBER OUTLET – SAMPLE LOCATION SCHEMATIC

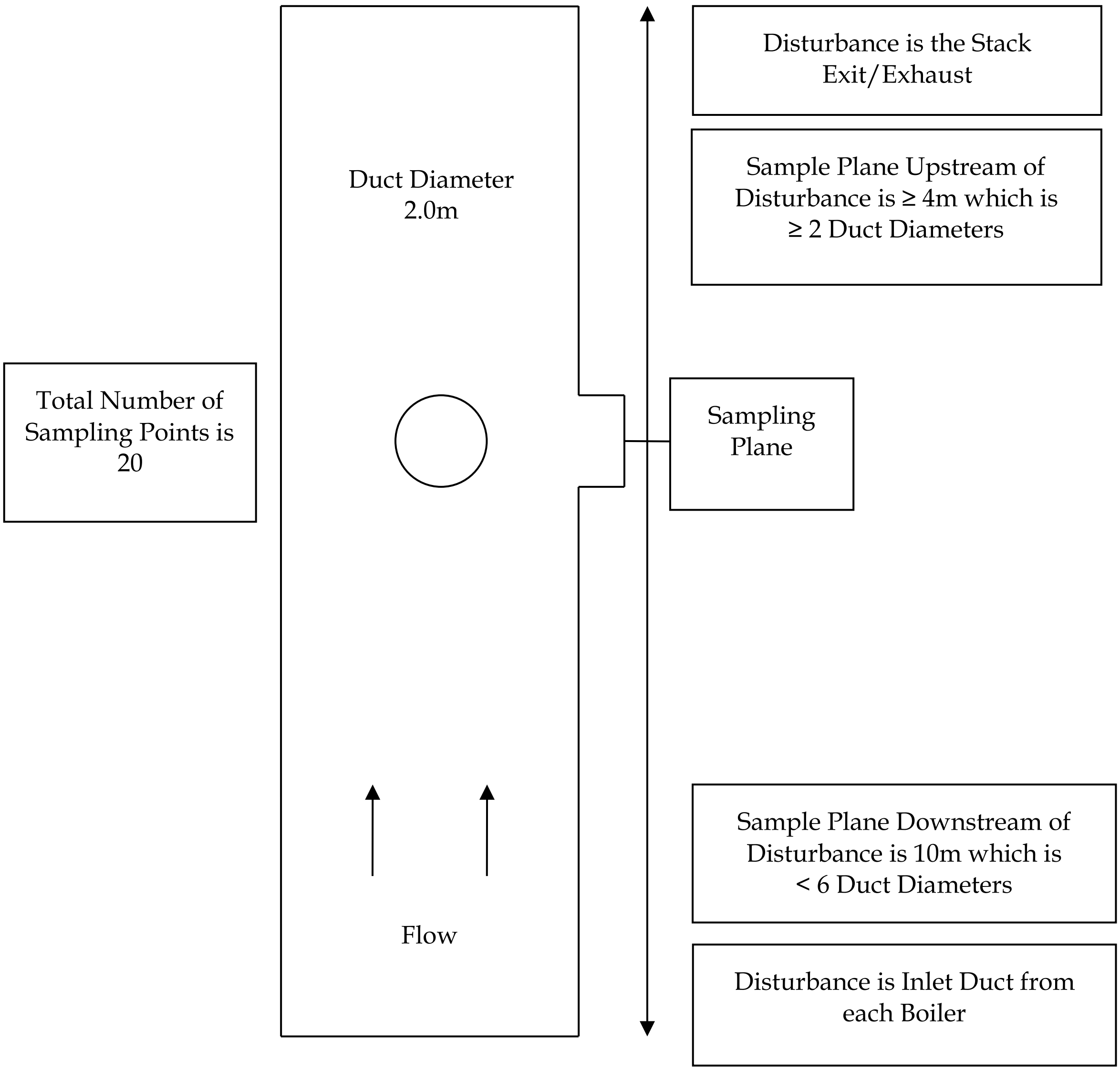


In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does meet this criterion.

The sample location does not meet the minimum number of access holes available.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-20 BOILER NOS. 5 & 6 – SAMPLE LOCATION SCHEMATIC



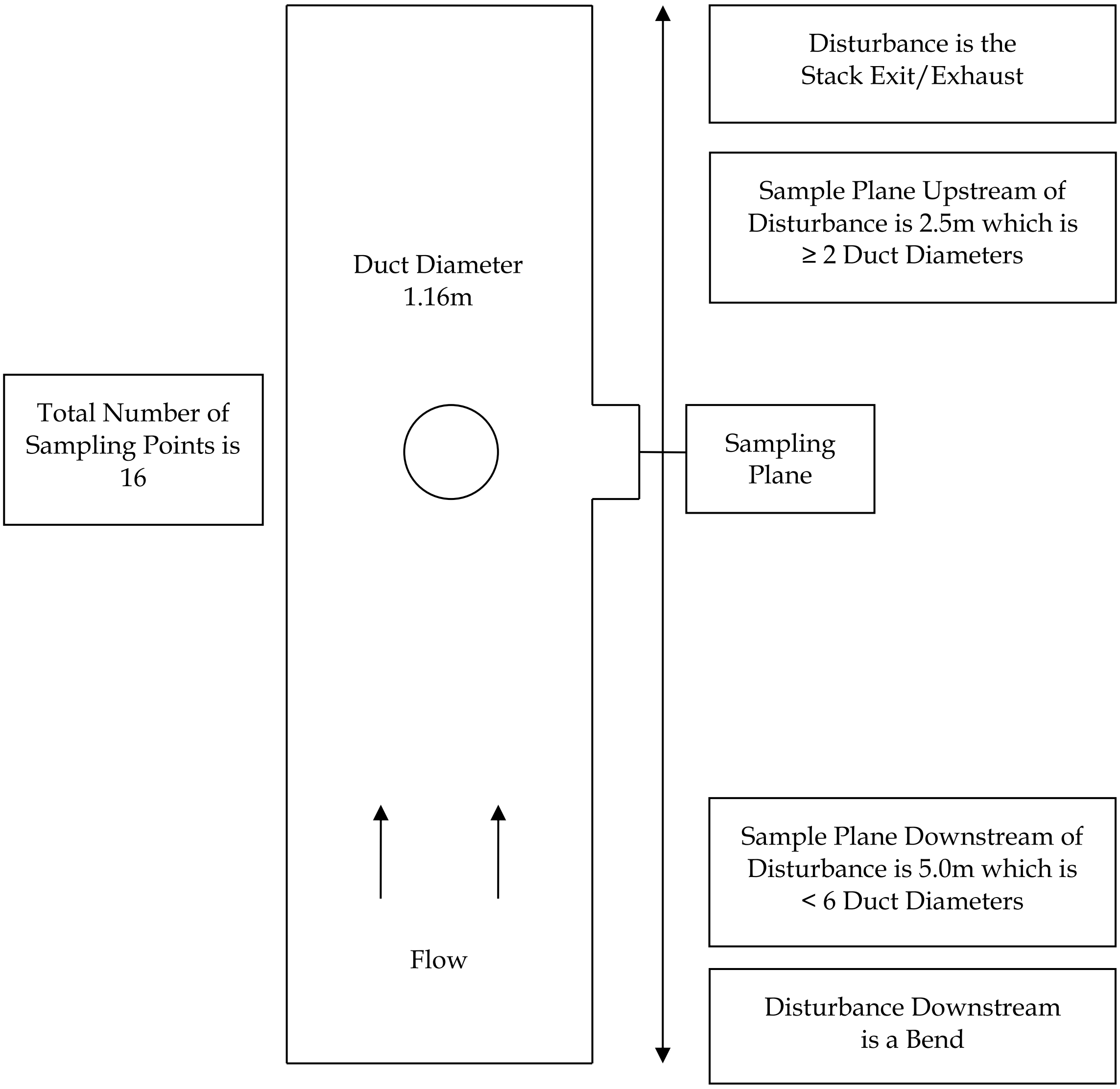
In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-21 BOILER NOS. 5 & 6 – SAMPLE LOCATION

FIGURE D-22 BOILER NO. 4– SAMPLE LOCATION SCHEMATIC



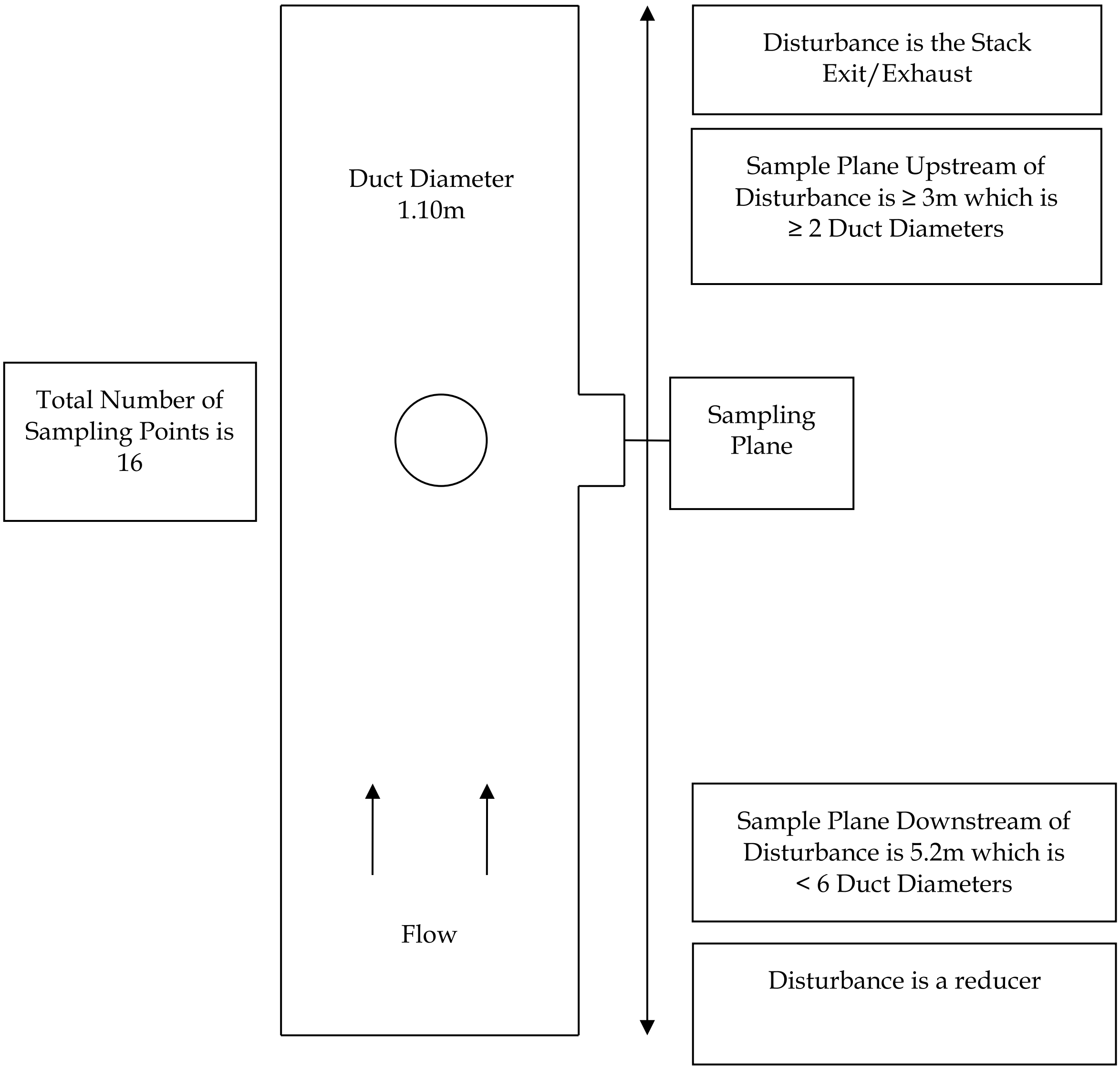
In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-23 BOILER NO 4 – SAMPLE LOCATION

FIGURE D-24 BOILER NO 2 – SAMPLE LOCATION SCHEMATIC

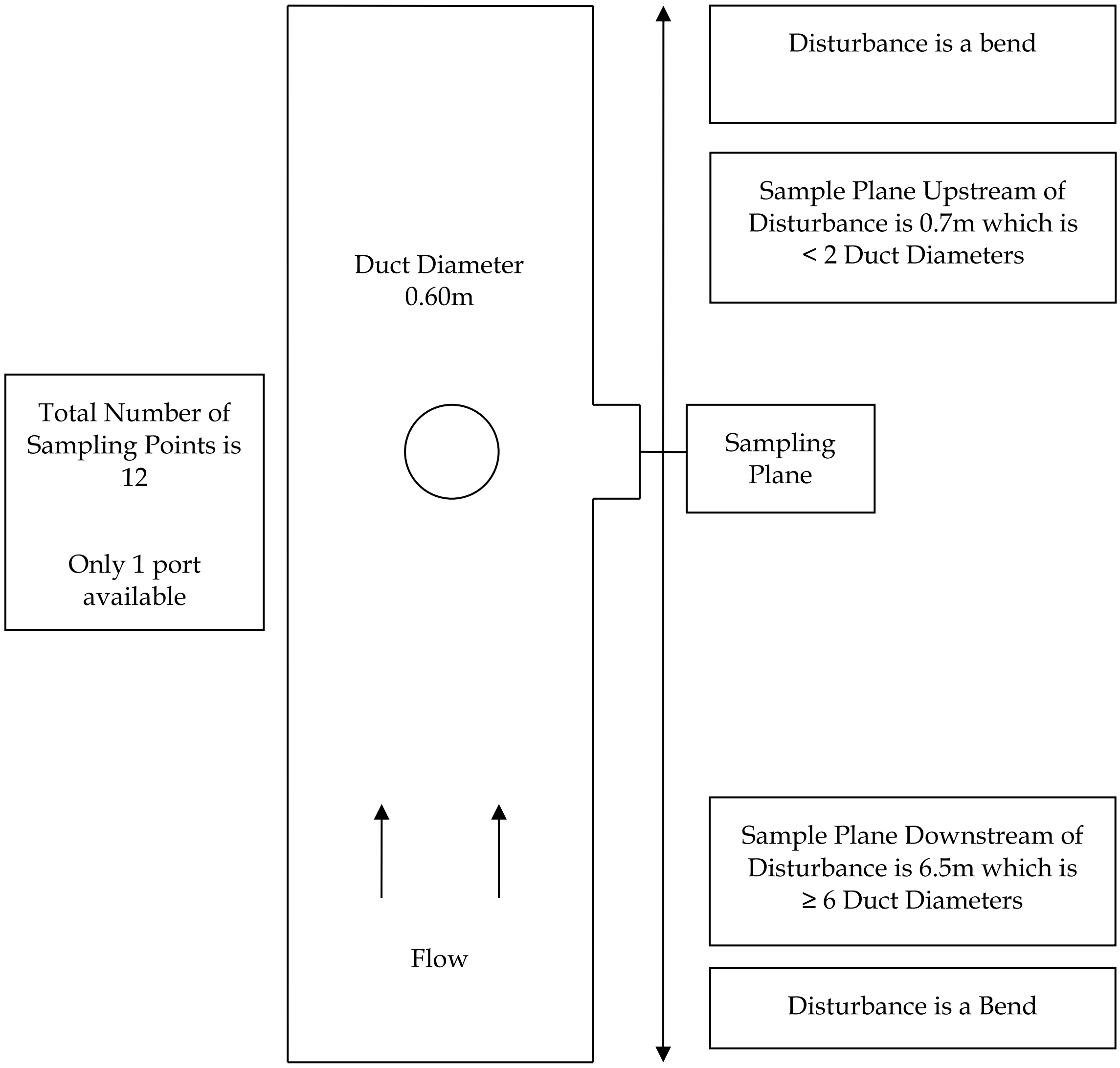


In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-25 BIOFILTER INLET – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

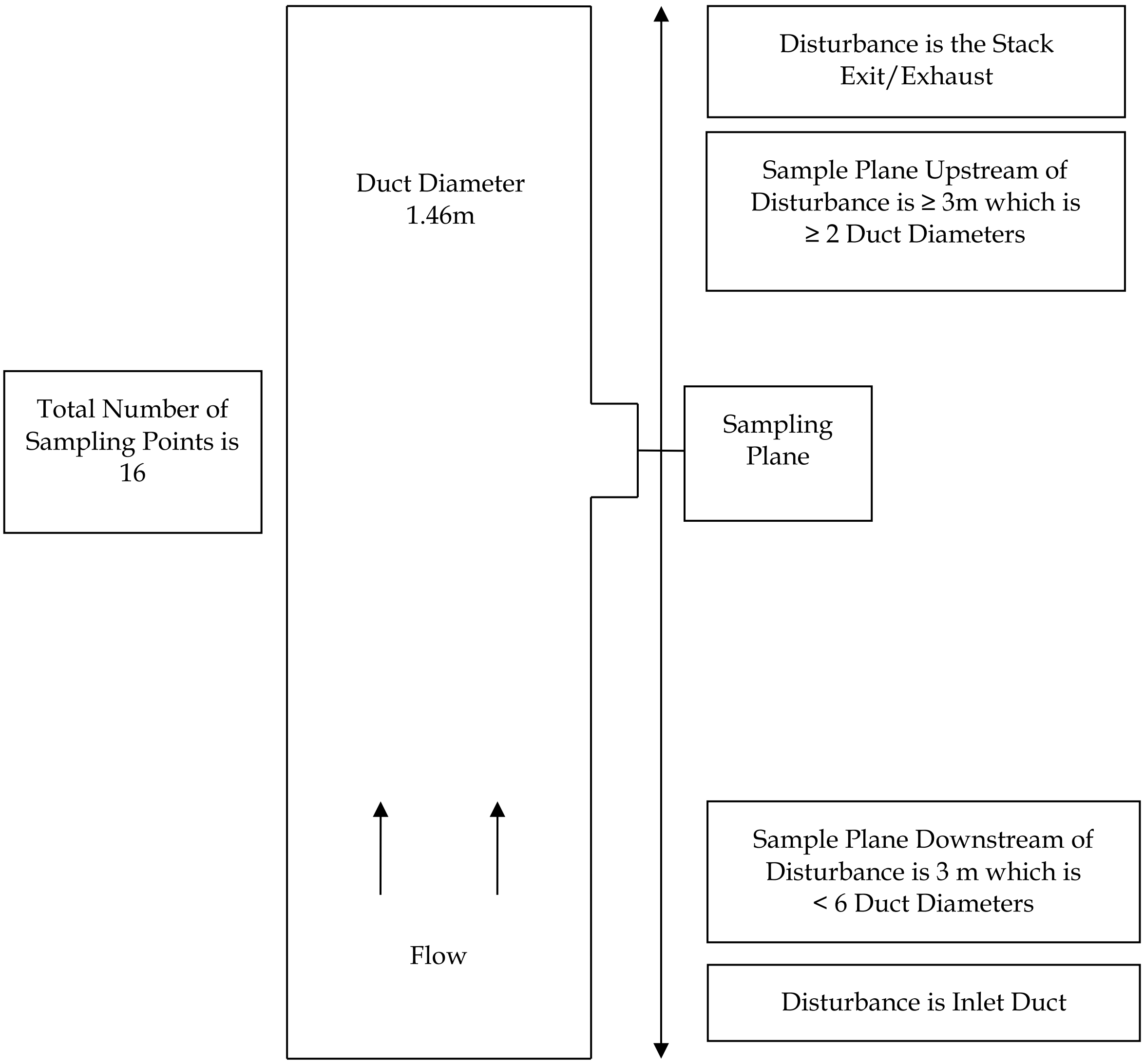
The sample plane also does not meet the minimum number of access points required. Additional sample points were used in compliance with AS4323.1.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of velocity meeting the minimum velocity of 3m/s at every sampling point. Maximum = 5.2 m/s, Average = 2.4 m/s, Minimum = 1.0 m/s.

FIGURE D-26 BIOFILTER OUTLET EAST EPL ID 40 & 41 – SAMPLE LOCATION

FIGURE D-27 BIOFILTER OUTLET WEST EPL ID 41 – SAMPLE LOCATION

FIGURE D-28 DDG PELLET PLANT STACK – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-29 DDG PELLET PLANT STACK – SAMPLE LOCATION PHOTOGRAPH

Stephenson

Environmental Management Australia

EPL ODOUR EMISSION SURVEY ANNUAL & QUARTER 3, 2020-2021

SHOALHAVEN STARCHES PTY LTD

BOMADERRY, NSW

PROJECT NO.: 7116/S25548B/20

DATES OF SURVEY: 18 & 24 NOVEMBER, AND 7 DECEMBER 2020

DATE OF REPORT ISSUE: 21 DECEMBER, 2020

Stephenson
Environmental Management Australia

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P W STEPHENSON

J WEBER

M KIMBER

TABLE OF CONTENTS

1 INTRODUCTION 4

2 MONITORING REQUIREMENTS 5

2.1 ENVIRONMENT PROTECTION LICENCE 883 (ISSUED 18 DECEMBER 2015) 5

2.1.1 CONDITION P1 LOCATION OF MONITORING/DISCHARGE POINTS AND AREAS 5

2.1.2 CONDITION M2 – MONITORING CONCENTRATION OF DISCHARGED POLLUTANTS 6

3 PRODUCTION CONDITIONS 8

4 ODOUR EMISSION TEST RESULTS 9

5 CONCLUSIONS 11

6 TEST METHODS 27

6.1 ODOUR MEASUREMENT/DYNAMIC OLFACTOMETRY 27

6.1.1 ODOUR PANEL SELECTION 28

6.1.2 ODOUR TERMINOLOGY 28

6.2 EXHAUST GAS VELOCITY 28

6.3 EXHAUST GAS TEMPERATURE 29

6.4 OXYGEN (O_2) 29

6.5 MOISTURE 29

6.6 ACCURACY 29

APPENDIX A – EMISSION TEST RESULTS I

APPENDIX B – CERTIFICATES OF ANALYSIS I

APPENDIX C – DETAILS OF INSTRUMENT CALIBRATION I

APPENDIX D – SAMPLE LOCATIONS I

TABLE OF TABLES

TABLE 2-1 LOCATION OF ODOUR MONITORING/DISCHARGE POINTS AND AREAS 5
TABLE 2-2 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 8, 9, 10, 11, 12, 13, 14, 16 & 47) 6
TABLE 2-3 SAMPLING AND ANALYSIS OF DIFFUSE SOURCES (POINTS 19, 20, 21 & 23, 24 & 25) 6
TABLE 2-4 SAMPLING AND ANALYSIS OF SOURCES (POINTS 39, 40, 41, 44 & 46) 6
TABLE 2-5 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 35, 42 & 45) 7
TABLE 4-1 MEASURED EMISSION CONCENTRATION TEST RESULTS POINT SOURCES, QUARTER 3, 2020 9
TABLE 4-2 MEASURED EMISSION CONCENTRATION TEST RESULTS DIFFUSE SOURCES, ANNUAL & Q3, 2020 10
TABLE 6-1 ESTIMATION OF MEASUREMENT UNCERTAINTY 29

TABLE OF FIGURES

FIGURE 5-1 ODOUR EMISSION CONCENTRATIONS, GLUTEN DRYERS NO.1, 2, 3 & 4 (EPA 8, 9, 10 & 11) . 12
FIGURE 5-2 ODOUR EMISSION CONCENTRATIONS, STARCH DRYERS NO.1, 3 & 4 (EPA 12, 13 &14) 13
FIGURE 5-3 ODOUR EMISSION CONCENTRATIONS, STARCH DRYER 5 (EPA 47) 14
FIGURE 5-4 ODOUR EMISSION CONCENTRATIONS, FERMENTERS (EPA 44) 15
FIGURE 5-5 ODOUR EMISSION CONCENTRATIONS, CARBON DIOXIDE SCRUBBER OUTLET (EPA 16) 16
FIGURE 5-6 ODOUR EMISSION CONCENTRATIONS, COMBINED BOILER 5 & 6 STACK (EPA 35) 17
FIGURE 5-7 ODOUR EMISSION CONCENTRATIONS, BOILER 4 STACK (EPA 42) 18
FIGURE 5-8 ODOUR EMISSION CONCENTRATIONS, BOILER 2 STACK (EPA 45) 19

FIGURE 5-9 ODOUR EMISSION CONCENTRATIONS, BIOFILTERS (EPA 39, 40, 41) 20
FIGURE 5-10 ODOUR EMISSION CONCENTRATIONS, DDG PELLET PLANT (EPA 46) 21
FIGURE 5-11 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 1 22
FIGURE 5-12 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 3 23
FIGURE 5-13 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 5 24
FIGURE 5-14 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 6 25
FIGURE 5-15 ODOUR EMISSION CONCENTRATIONS, SULPHUR OXIDATION POND 26

TABLE OF TABLES – APPENDICES

TABLE A-1 EMISSION TEST RESULTS – GLUTEN DRYERS NO. 1, 2, 3 & 4 II
TABLE A-2 EMISSION TEST RESULTS – STARCH DRYERS NO.1, 3, 4 & 5 III
TABLE A- 3 EMISSION TEST RESULTS – BOILERS NO. 5&6, 4 & 2 IV
TABLE A-4 EMISSION TEST RESULTS – FERMENTER 16 & CO_2 SCRUBBER OUTLET V
TABLE A- 5 EMISSION TEST RESULTS –INLET TO BIOFILTERS, DDG DRYERS 1,2,3 & 4 VI
TABLE A- 6 EMISSION TEST RESULTS DDG PELLET PLANT VII
TABLE A- 7 EMISSION TEST RESULTS – BIOFILTER OUTLETS VIII

TABLE C- 1 INSTRUMENT CALIBRATION DETAILS DAY 1 II
TABLE C- 2 INSTRUMENT CALIBRATION DETAILS DAY 2 III
TABLE C- 3 INSTRUMENT CALIBRATION DETAILS DAY 3 IV

TABLE OF FIGURES – APPENDICES

FIGURE D-1 GLUTEN DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC II
FIGURE D-2 GLUTEN DRYER NO. 1 – SAMPLE LOCATION III
FIGURE D-3 GLUTEN DRYER NO. 2 –SAMPLE LOCATION SCHEMATIC IV
FIGURE D-4 GLUTEN DRYER NO. 2 – ODOUR SAMPLE LOCATION AT DUCT EXIT V
FIGURE D-5 GLUTEN DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC VI
FIGURE D-6 GLUTEN DRYER NO. 3 – SAMPLE LOCATION VII
FIGURE D-7 GLUTEN DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC VIII
FIGURE D-8 GLUTEN DRYER NO. 4 – SAMPLE LOCATION IX
FIGURE D-9 STARCH DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC X
FIGURE D-10 STARCH DRYER NO. 1 – SAMPLE LOCATION XI
FIGURE D-11 STARCH DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC XII
FIGURE D-12 STARCH DRYER NO. 3 – SAMPLE LOCATION XIII
FIGURE D-13 STARCH DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC XIV
FIGURE D-14 STARCH DRYER NO. 4 – SAMPLE LOCATION XV
FIGURE D-15 STARCH DRYER NO. 5 – SAMPLE LOCATION SCHEMATIC XVI
FIGURE D-16 STARCH DRYER NO. 5 – SAMPLE LOCATION XVII
FIGURE D-17 FERMENTERS – SAMPLE LOCATION SCHEMATIC XVIII
FIGURE D-18 FERMENTERS – SAMPLE LOCATION XIX
FIGURE D-19 CO_2 SCRUBBER OUTLET – SAMPLE LOCATION SCHEMATIC XX
FIGURE D-20 BOILER NOS. 5 & 6 – SAMPLE LOCATION SCHEMATIC XXI
FIGURE D-21 BOILER NOS. 5 & 6 – SAMPLE LOCATION XXII
FIGURE D-22 BOILER NO. 4– SAMPLE LOCATION SCHEMATIC XXIII
FIGURE D-23 BOILER NO 4 – SAMPLE LOCATION XXIV
FIGURE D-24 BOILER NO 2 – SAMPLE LOCATION SCHEMATIC XXV
FIGURE D-25 BIOFILTER INLET – SAMPLE LOCATION SCHEMATIC XXVI
FIGURE D-26 BIOFILTER OUTLET EAST EPL ID 40 & 41 – SAMPLE LOCATION XXVII

FIGURE D-27 BIOFILTER OUTLET WEST EPL ID 41 – SAMPLE LOCATION XXVII
FIGURE D-28 DDG PELLET PLANT STACK – SAMPLE LOCATION SCHEMATIC....... XXVIII
FIGURE D-29 DDG PELLET PLANT STACK – SAMPLE LOCATION PHOTOGRAPH....... XXIX

1 INTRODUCTION

Stephenson Environmental Management Australia (SEMA) was requested by Shoalhaven Starches Pty Limited to conduct an odour emission survey at their manufacturing complex in Bomaderry, New South Wales (NSW).

The objective of the survey is to comply with Condition M2.1 of the Environment Protection Licence (EPL) No. 883 issued by the Environment Protection Authority (EPA). The EPA is now part of the Office of Environment and Heritage (OEH).

Section 2 of this report outlines Conditions P1 and M2 which identify the potential point and diffuse odour sources and the sampling and analysis methods respectively required by the OEH. This survey monitored the quarterly and annual odour concentrations as required in section M2.2 of EPL 883.

In addition, the Carbon Dioxide (CO_2) Scrubber Inlet sampling point, which currently is not listed in EPL 883 and therefore does not an have EPA Identification No., was also sampled.

The quarters are defined as below:

- Quarter 1 May to July inclusive
- Quarter 2 August to October inclusive
- Quarter 3 November to January inclusive
- Quarter 4 February to April inclusive

The annual and Quarter 3, 2020-2021 odour test results are presented in this report. These tests were conducted on the 18th and 24th November, and the 7th December 2020.

2 MONITORING REQUIREMENTS

2.1 ENVIRONMENT PROTECTION LICENCE 883 (ISSUED 18 DECEMBER 2015)

2.1.1 CONDITION P1 LOCATION OF MONITORING/DISCHARGE POINTS AND AREAS

Table 2-1 identifies the point and diffuse sources as defined by the OEH that relate to this survey as per most recent version of EPL No. 883 dated 20 June 2018.

TABLE 2-1 LOCATION OF ODOUR MONITORING/DISCHARGE POINTS AND AREAS

EPL ID. No.	Location	Odour Samples TM OM-7/8	Frequency as per M2.2 EPL 883
8	No. 1 Gluten Dryer	1	Quarterly
9	No. 2 Gluten/Starch Dryer*	1	Quarterly
10	No. 3 Gluten Dryer	1	Quarterly
11	No. 4 Gluten Dryer	1	Quarterly
12	No. 1 Starch Dryer	1	Quarterly
13	No. 3 Starch Dryer	1	Quarterly
14	No. 4 Starch Dryer	1	Quarterly
16	CO_2 Scrubber outlet	1	Quarterly
Not specified	CO_2 Scrubber inlet	1	--
19	Effluent Storage Dam 1	1	Yearly
20	Effluent Storage Dam 2	1	Yearly
21	Effluent Storage Dam 3	1	Yearly
23	Effluent Storage Dam 5	1	Yearly
24	Effluent Storage Dam 6	1	Yearly
25	Sulphur Oxidisation Pond	1	Yearly
35	Combined Stack Boilers No.5 & 6	1	Quarterly
39	Inlet Pipe to Biofilters A & B (DDG Evap #1,2&3)	1	Quarterly
39A	Inlet Pipe to Biofilters A & B (DDG Evap #4)	1	Quarterly
40	Outlet of Biofilter A	2	Quarterly
41	Outlet of Biofilter B	2	Quarterly
42	Boiler No.4	1	Quarterly
44	Fermenter	1	Quarterly
45	Boiler No.2	1	Quarterly
46	DDG Pellet Plant Stack	1	Quarterly
47	No. 5 Starch Dryer	1	Quarterly

2.1.2 CONDITION M2 – MONITORING CONCENTRATION OF DISCHARGED POLLUTANTS

Condition M2.1 states: *For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency specified in the opposite columns.*

Key to Tables 2.2 to 2.5:

%	=	percent
°C	=	degrees Celsius
g/g.mole	=	grams per gram mole
kg/m³	=	kilograms per cubic metre
m/s	=	metres per second
m³/s	=	cubic metres per second
mg/m³	=	milligrams per cubic metre
OM	=	Other Method
ou	=	odour units
TM	=	Test Method

TABLE 2-2 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 8, 9, 10, 11, 12, 13, 14, 16 & 47)

Pollutant	Units	Frequency	Approved Method
Dry Gas Density	kg/m³	Quarterly	TM-23
Flow	m³/s	Quarterly	TM-2
Moisture	%	Quarterly	TM-22
Molecular Weight of stack gases	g/g-mole	Quarterly	TM-23
Odour	ou	Quarterly	OM-7
Oxygen	%	Quarterly	TM-25
Temperature	°C	Quarterly	TM-2
Velocity	m/s	Quarterly	TM-2

TABLE 2-3 SAMPLING AND ANALYSIS OF DIFFUSE SOURCES (POINTS 19, 20, 21 & 23, 24 & 25)

Pollutant	Units	Frequency	Approved Method
Odour	ou	Annual	OM-7

TABLE 2-4 SAMPLING AND ANALYSIS OF SOURCES (POINTS 39, 40, 41, 44 & 46)

Pollutant	Units	Frequency	Approved Method
Odour	ou	Quarterly	OM-7

TABLE 2-5 SAMPLING AND ANALYSIS OF POINT SOURCES (POINTS 35, 42 & 45)

Pollutant	Units	Frequency	Approved Method
Cadmium	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Mercury	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Moisture	%	Quarterly	TM-22
Molecular weight of stack gases	g/g.mole	Quarterly	TM-23
Nitrogen Oxides	mg/m^3	Quarterly	TM-11
Odour	ou	Quarterly	OM-7
Opacity	%	Quarterly	CEM-1
Oxygen	%	Quarterly	TM-25
Sulphur Dioxide	mg/m^3	Annual	TM-4
Temperature	^oC	Quarterly	TM-2
Total Solid Particles	mg/m^3	Quarterly	TM-15
Type 1 & Type 2 substances in aggregate	mg/m^3	Quarterly	TM-12,TM-13 & TM-14
Velocity	m/s	Quarterly	TM-2
Volatile Organic Compounds as n-propane equivalent	mg/m^3	Quarterly	TM-34
Volumetric Flowrate	m^3/s	Quarterly	TM-2

3 PRODUCTION CONDITIONS

Shoalhaven Starches personnel considered the factory and the ethanol distillery were operating under typical conditions on the days of testing.

One exception is that Gluten Dryer No.1 (EPA ID 8) has had a new silencer and supporting ductwork installed to replace the previous unit. However, the sampling ports have not been re-installed in this new ductwork. Therefore, access to the inside of the duct is no longer available. Thus, exhaust gas flow measurements were unable to be taken.

However, odour measurements were taken from the duct outlet to atmosphere. To enable calculation of the Mass Odour Emission Rate (MOER), exhaust gas flow measurements have been based on the most recent previous quarterly monitoring results; that is, Quarter 1, 2020 results.

4 ODOUR EMISSION TEST RESULTS

SEMA performed the sampling, and the odour analysis was performed by Odour Research Laboratories Australia (ORLA). SEMA and ORLA are both NATA accredited (No.15043) facilities to ISO 17025 for this.

The NATA accredited ORLA Olfactometry Test Report 7116/ORLA is presented in Appendix B.

Exhaust gas flow and emission tests results from measured sources are detailed in Tables A-1 to A-7, Appendix A.

Appendix C details calibration of instruments used to take measurements.

Appendix D shows sample locations.

Tables 4-1 summarises the odour emission concentrations for the point sources measured in Quarter 3, 2020. Table 4-2 summarises the odour emission concentrations of the diffuse sources.

TABLE 4-1 MEASURED EMISSION CONCENTRATION TEST RESULTS POINT SOURCES, QUARTER 3, 2020

EPA ID No.	Description	Date	Odour Concentration (ou)
8	No.1 Gluten Dryer	18/11/2020	470
9	No.2 Gluten Dryer	18/11/2020	250
10	No.3 Gluten Dryer	18/11/2020	300
11	No.4 Gluten Dryer	18/11/2020	360
12	No.1 Starch Dryer	18/11/2020	470
13	No.3 Starch Dryer	18/11/2020	120
14	No.4 Starch Dryer	18/11/2020	110
16	Carbon Dioxide Scrubber Outlet	18/11/2020	8,000
--	Carbon Dioxide Scrubber Inlet	18/11/2020	10,600
35	Combined Stack No.5 & 6 Boilers	24/11/2020	2,200
42	Boiler No.4 Stack	24/11/2020	1,700
44	Fermenter (No. 16)	24/11/2020	7,500
45	Boiler No.2 Stack	24/11/2020	1,200
46	DDG Pellet Plant Stack	24/11/2020	2,300
47	No.5 Starch Dryer	24/11/2020	390

Key: ou = odour units

TABLE 4-2 MEASURED EMISSION CONCENTRATION TEST RESULTS DIFFUSE SOURCES, ANNUAL & Q3, 2020

EPA ID No.	Description	Date	Odour Concentration (ou)
39	Inlet to Biofilters A & B	24/11/2020	9,500
39A	Inlet to Biofilters A & B	24/11/2020	70,400
40	Outlet of Biofilter A (east)	24/11/2020	1,200
40	Outlet of Biofilter A (west)	24/11/2020	2,000
41	Outlet of Biofilter B (east)	24/11/2020	1,680
41	Outlet of Biofilter B (west)	24/11/2020	1,830
19	Effluent Storage Dam 1	7/12/2020	360
20	Effluent Storage Dam 2	Unsafe for sampling	---
21	Effluent Storage Dam 3	7/12/2020	280
23	Effluent Storage Dam 5	7/12/2020	63
24	Effluent Storage Dam 6	7/12/2020	38
25	Sulphur Oxidation Pond	7/12/2020	63

Key: ou = odour units

5 CONCLUSIONS

The comparative results of the odour sampling and analysis, over time, that have been undertaken by SEMA at Shoalhaven Starches manufacturing facility at Bomaderry are graphically presented in Figures 5-1 to 5-16.

Figure 5-1 presents graphical representations of odour concentrations recorded for Gluten Dryers No.1, 2, 3 and 4 since autumn 2005.

Figure 5-2 presents graphical representations of odour concentrations recorded for Starch Dryers No.1, 3 and 4 since autumn 2005.

Figure 5-3 graphically shows the Starch Dryer No. 5 emission concentrations since spring 2017.

Figure 5-4 graphically shows the Fermenter emission concentrations since summer 2007-2008.

Figure 5-5 illustrates odour emission concentrations from the Carbon Dioxide Scrubber since autumn 2013.

Figures 5-6 and 5-7 graphically show the Combined Boiler 5 and 6 stack and the Boiler No.4 stack emission concentrations since summer 2013-2014 respectively.

Figure 5-8 shows the Boiler 2 stack emission concentrations since winter 2019.

Figure 5-9 graphically shows the Bio-filter inlet (EPA ID#39) and outlet emission concentrations since autumn 2010.

Figure 5-10 graphically shows the DDG Pellet plant Stack emission concentrations since spring 2016.

Figures 5-11 to 5-15 show the Effluent Ponds 1, 3, 5 and 6 odour emission concentrations since summer 2003-2004.

Figure 5-16 shows Sulphur Oxidation Pond odour emission concentrations since winter 2010.

FIGURE 5-1 ODOUR EMISSION CONCENTRATIONS, GLUTEN DRYERS NO.1, 2, 3 & 4 (EPA 8, 9, 10 & 11)

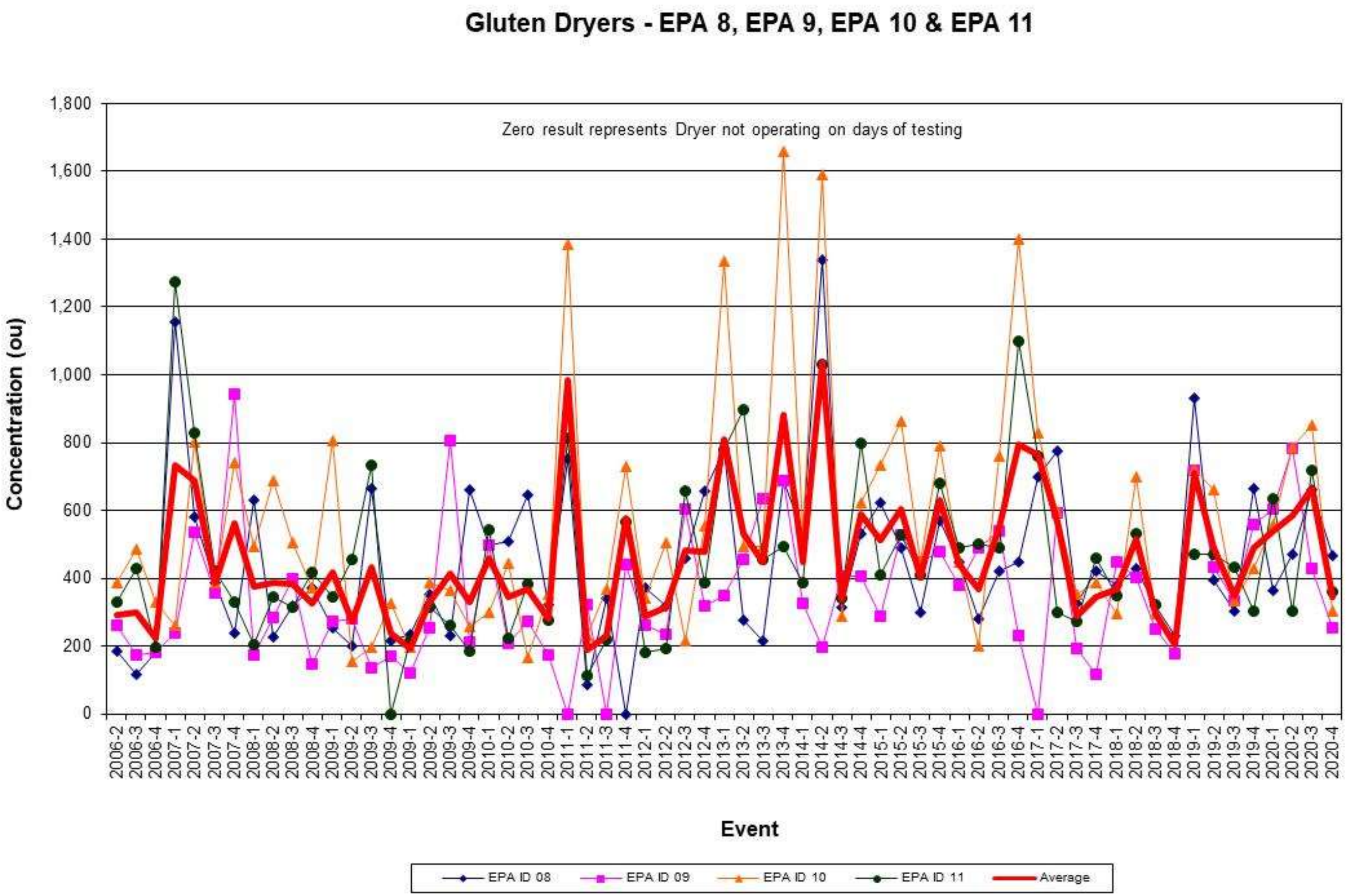


FIGURE 5-2 ODOUR EMISSION CONCENTRATIONS, STARCH DRYERS NO.1, 3 & 4 (EPA 12, 13 &14)

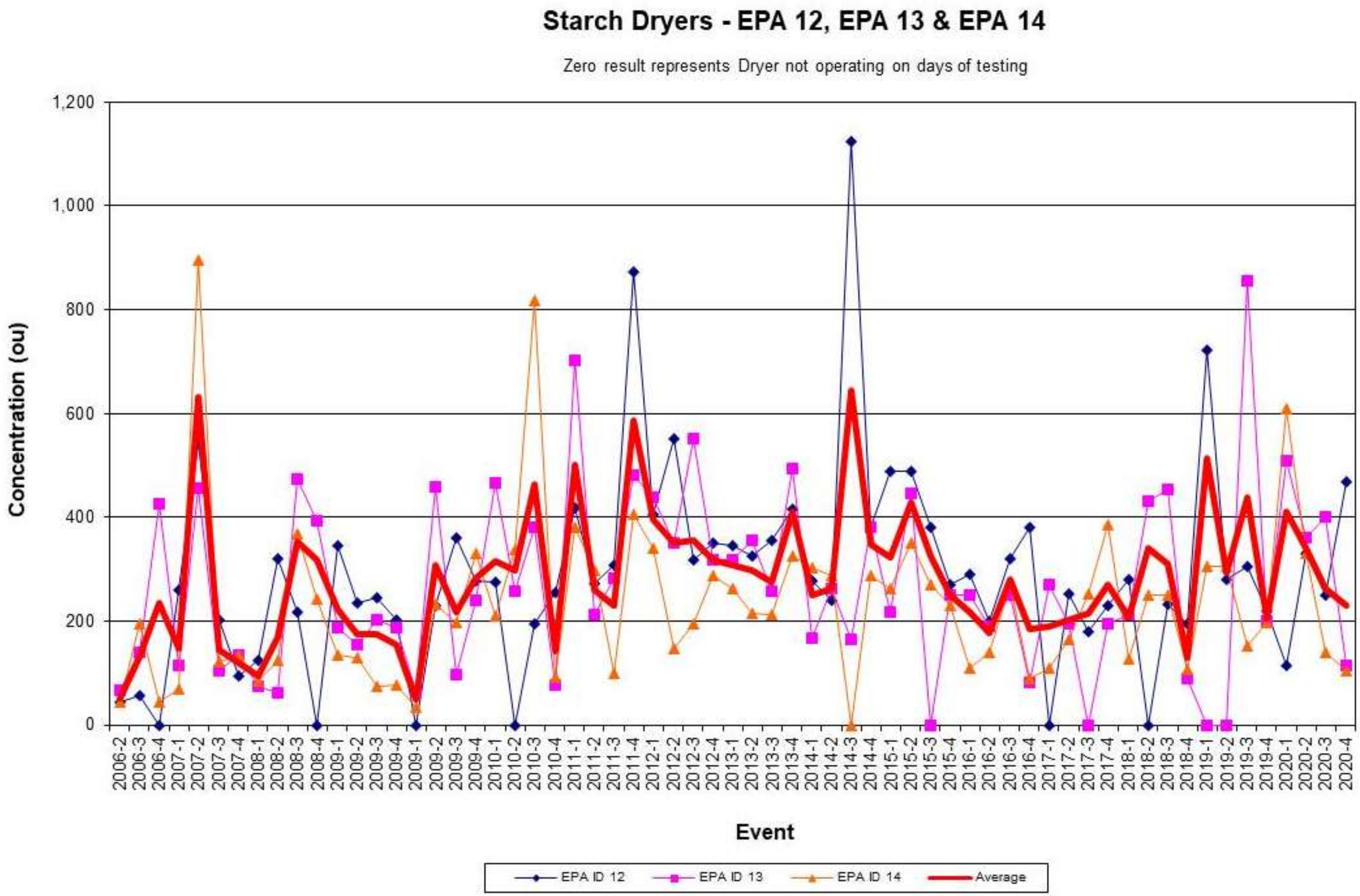


FIGURE 5-3 ODOUR EMISSION CONCENTRATIONS, STARCH DRYER 5 (EPA 47)

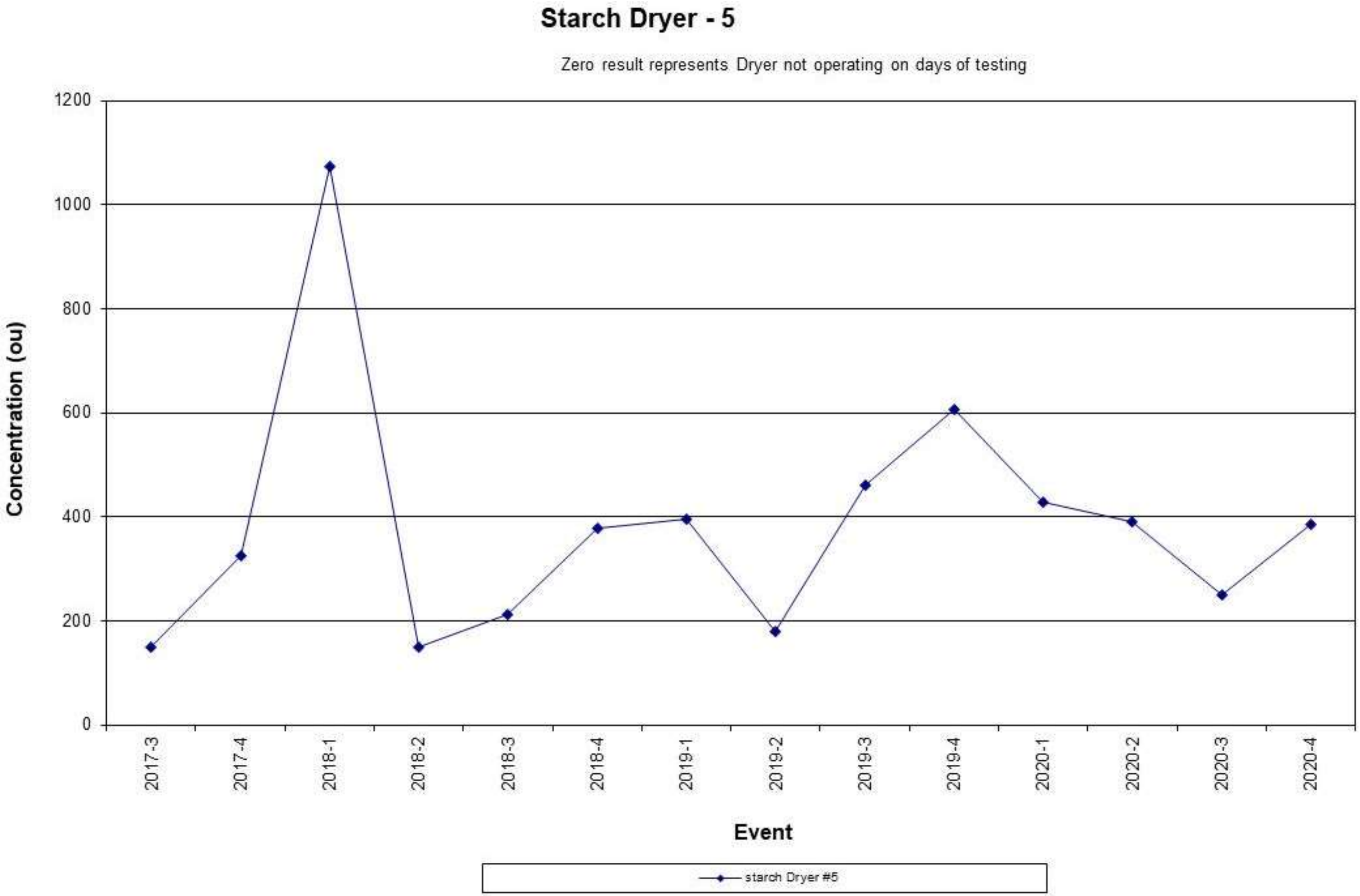


FIGURE 5-4 ODOUR EMISSION CONCENTRATIONS, FERMENTERS (EPA 44)

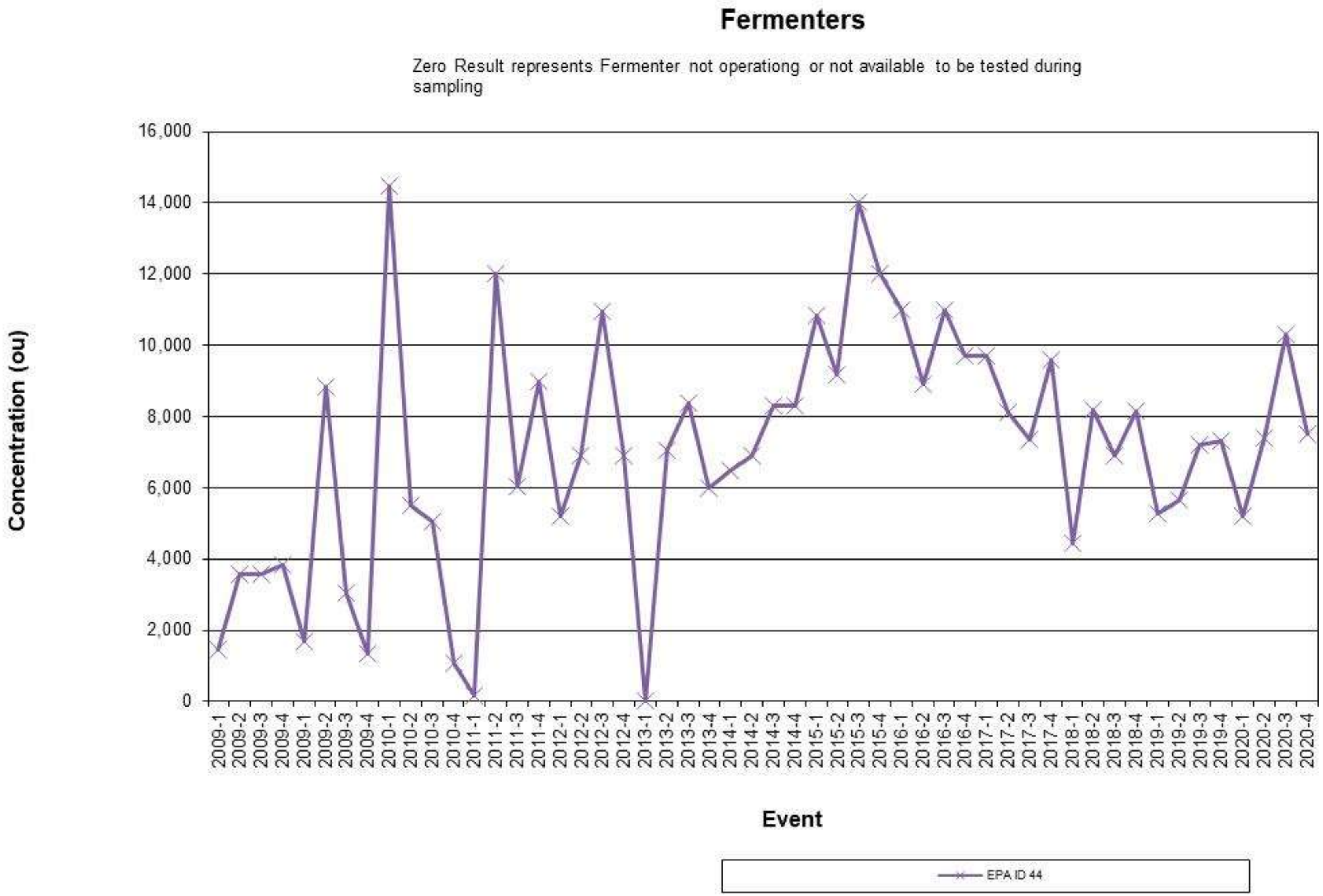


FIGURE 5-5 ODOUR EMISSION CONCENTRATIONS, CARBON DIOXIDE SCRUBBER OUTLET (EPA 16)

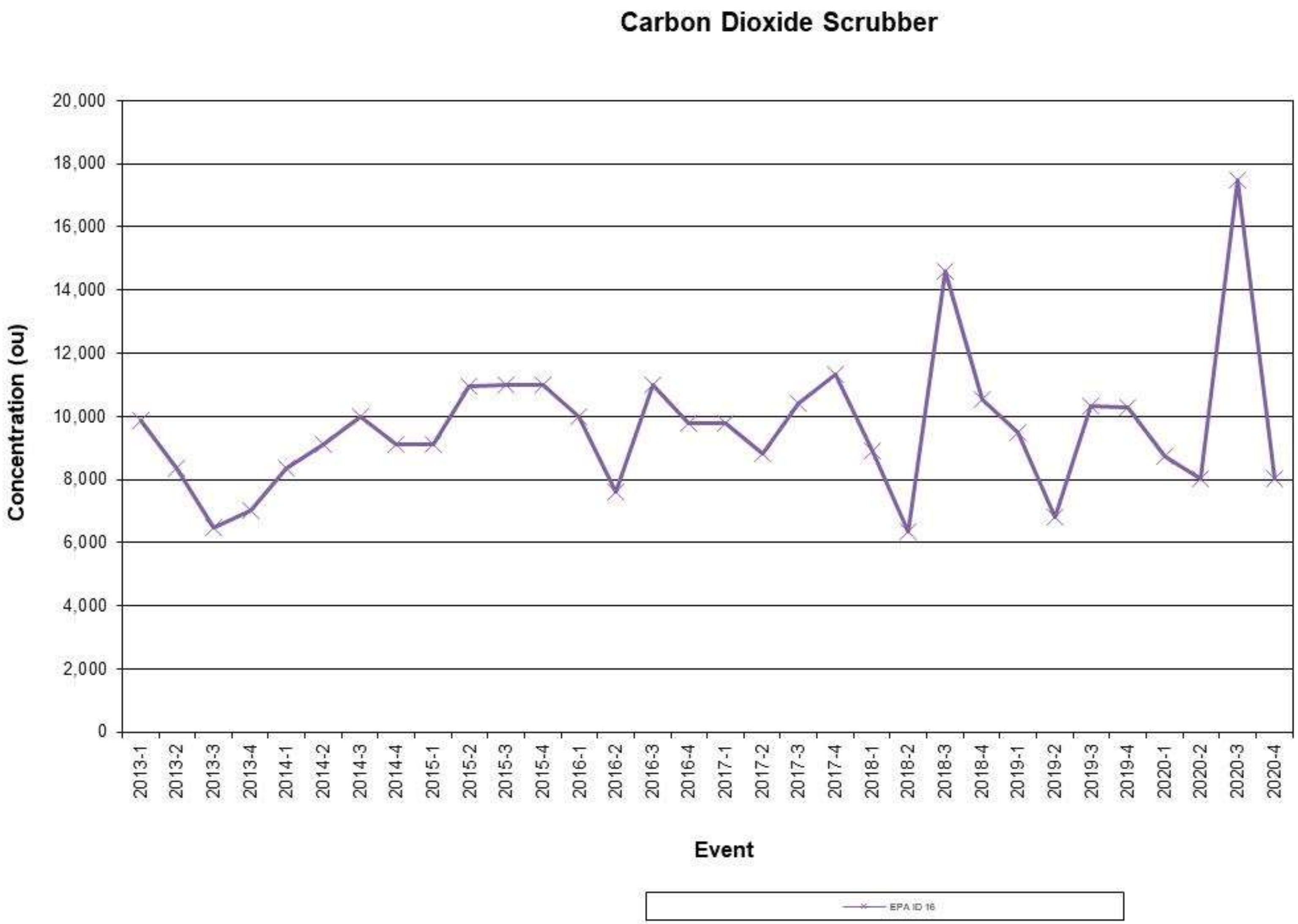


FIGURE 5-6 ODOUR EMISSION CONCENTRATIONS, COMBINED BOILER 5 & 6 STACK (EPA 35)

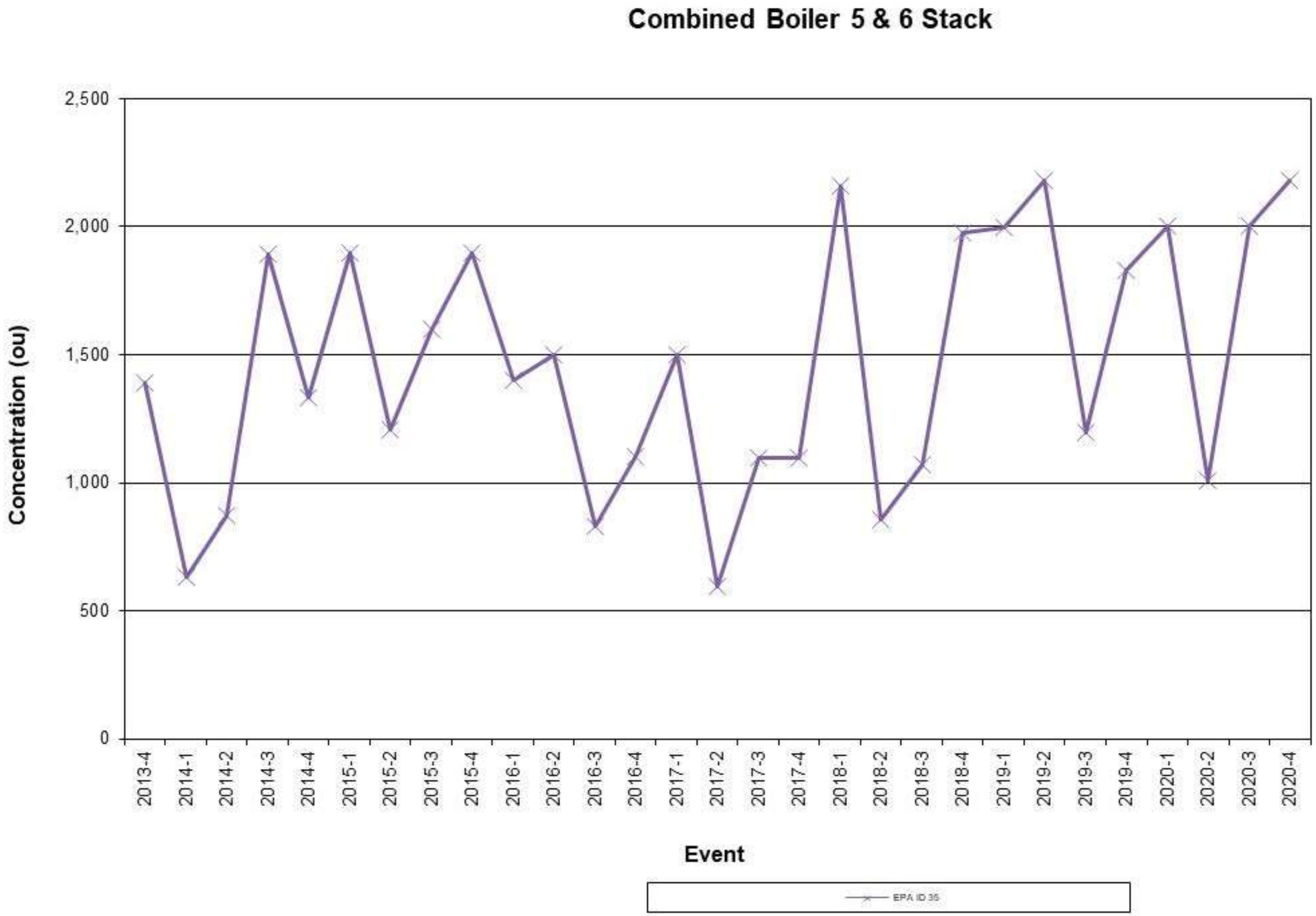


FIGURE 5-7 ODOUR EMISSION CONCENTRATIONS, BOILER 4 STACK (EPA 42)

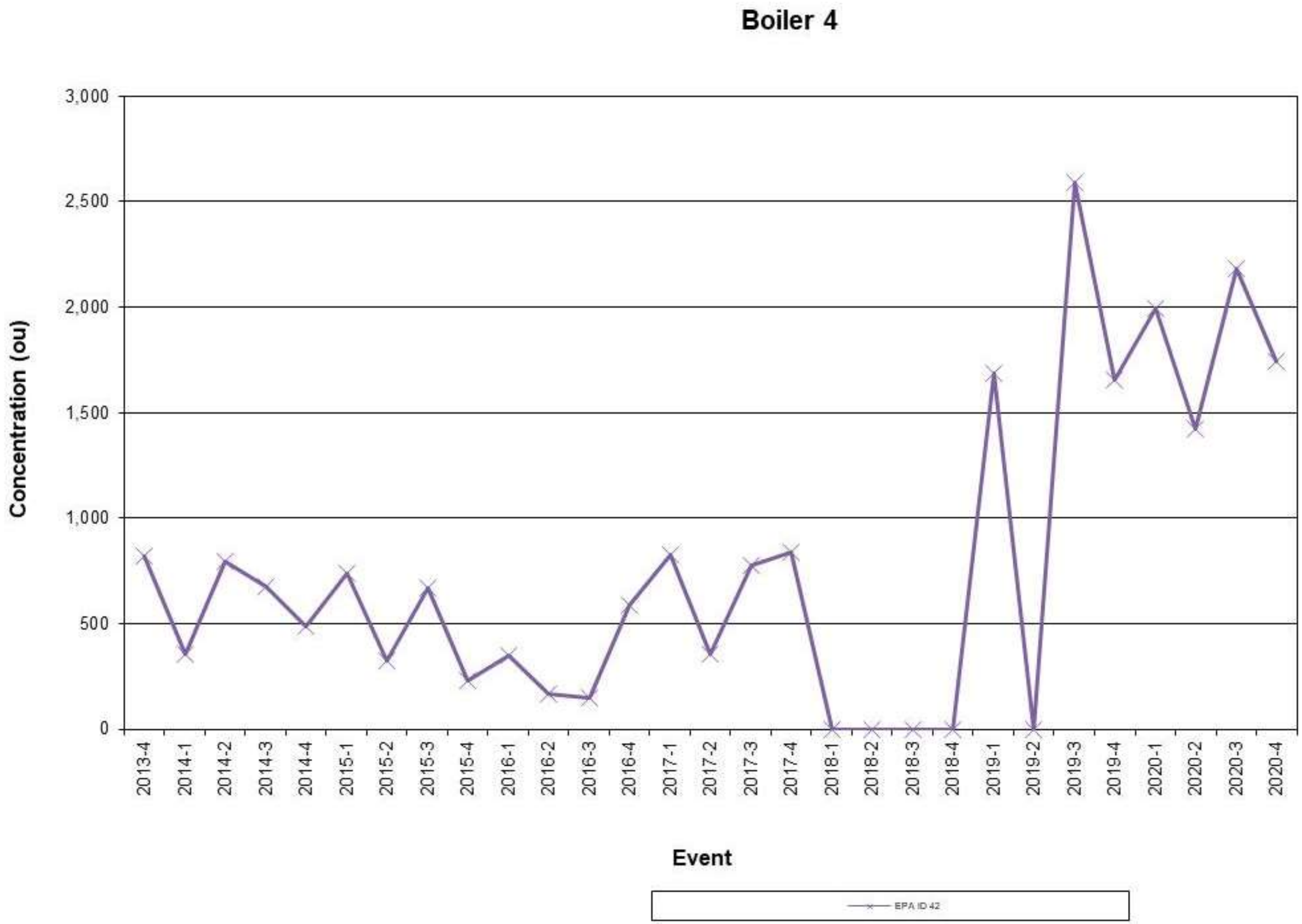


FIGURE 5-8 ODOUR EMISSION CONCENTRATIONS, BOILER 2 STACK (EPA 45)

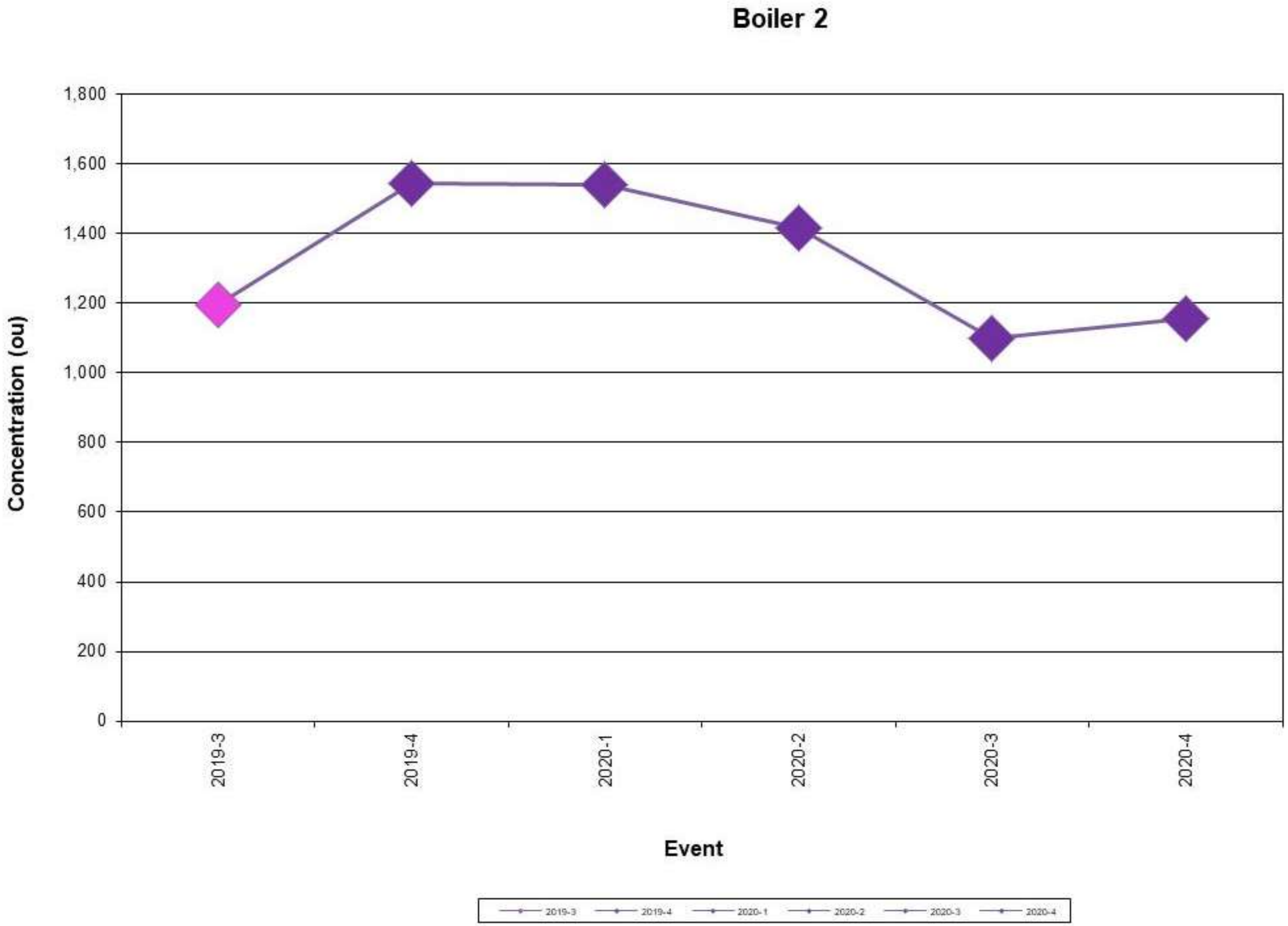


FIGURE 5-9 ODOUR EMISSION CONCENTRATIONS, BIOFILTERS (EPA 39, 40, 41)

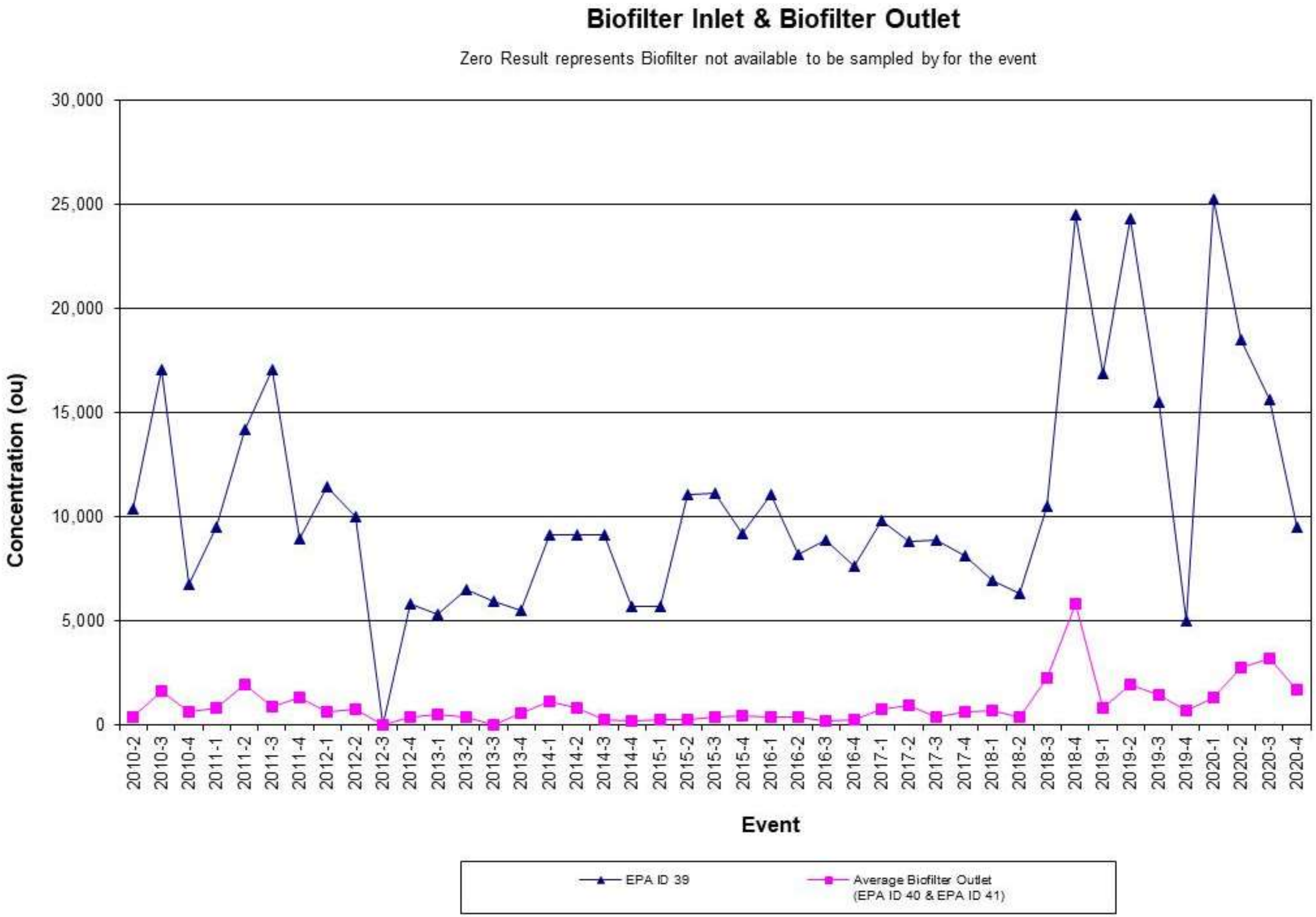


FIGURE 5-10 ODOUR EMISSION CONCENTRATIONS, DDG PELLET PLANT (EPA 46)

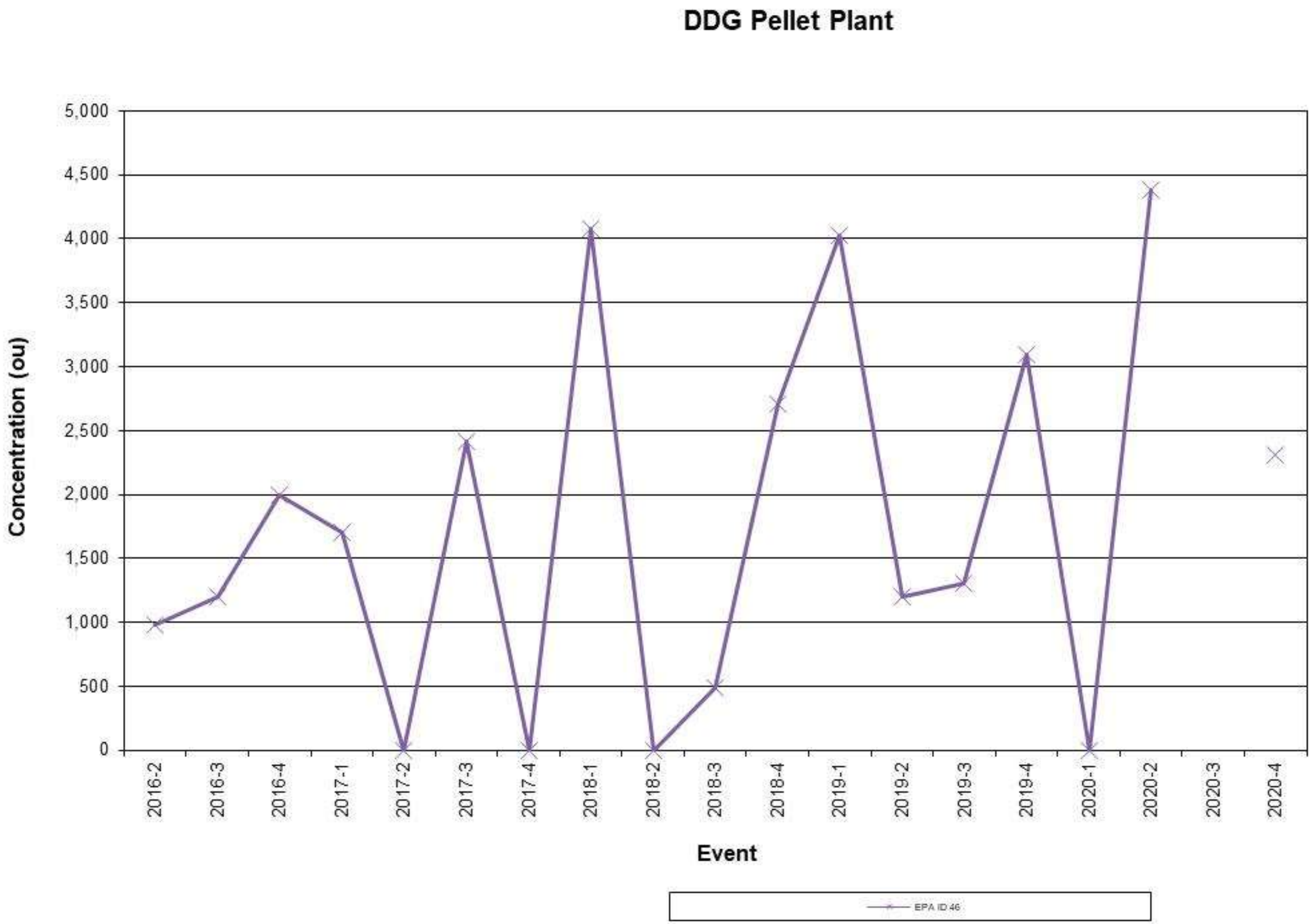


FIGURE 5-11 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 1

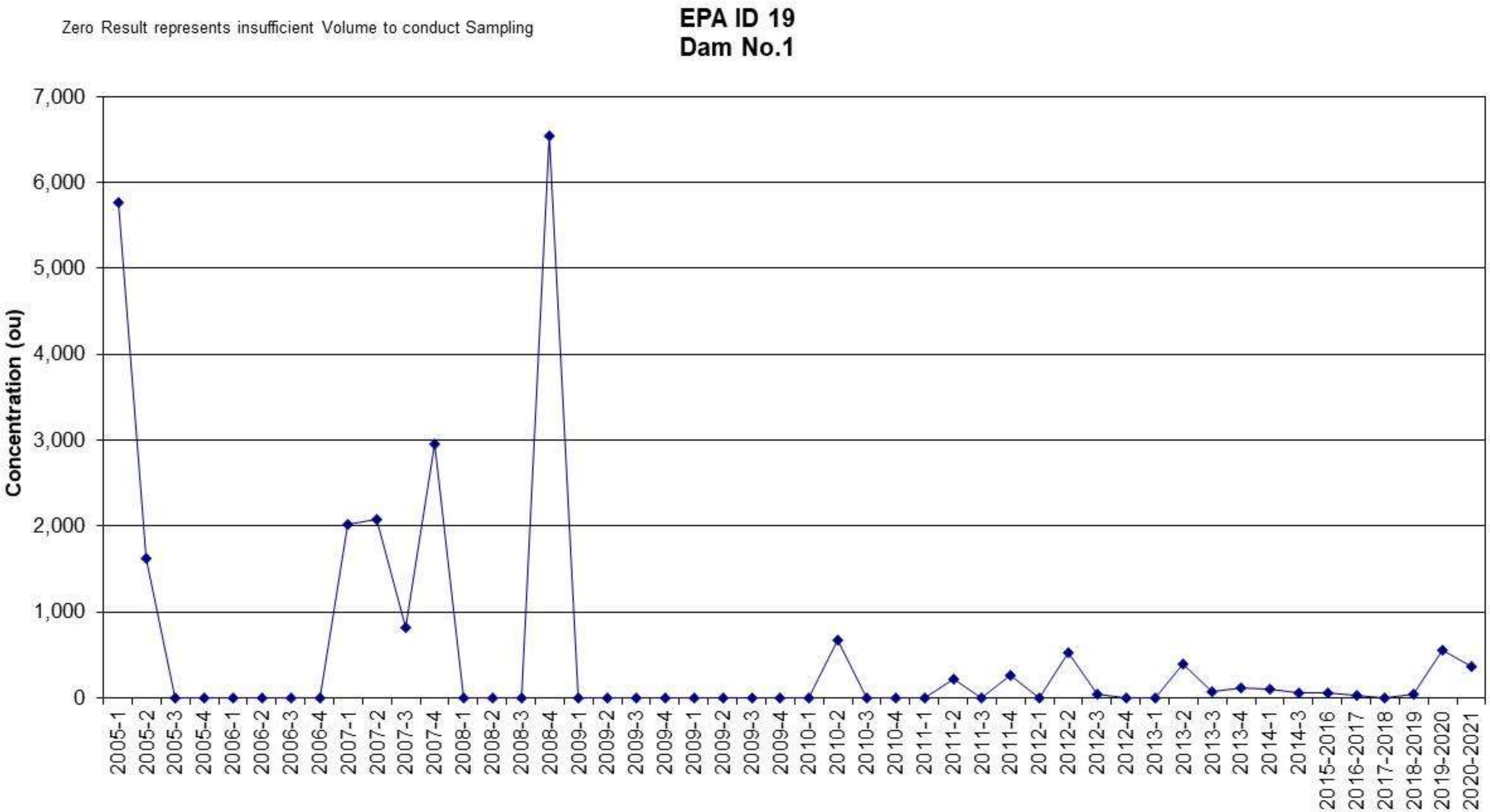


FIGURE 5-12 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 3

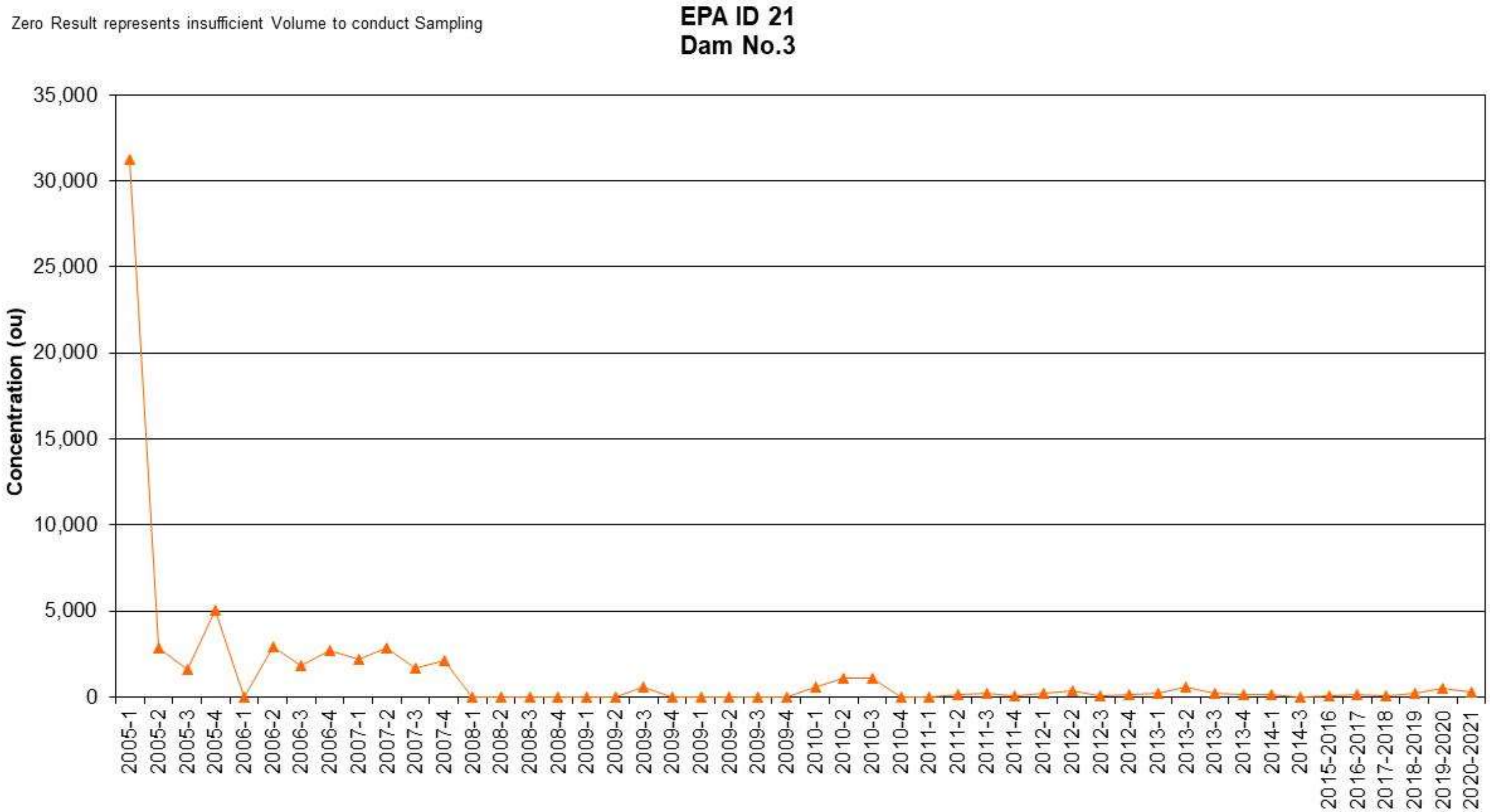


FIGURE 5-13 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 5

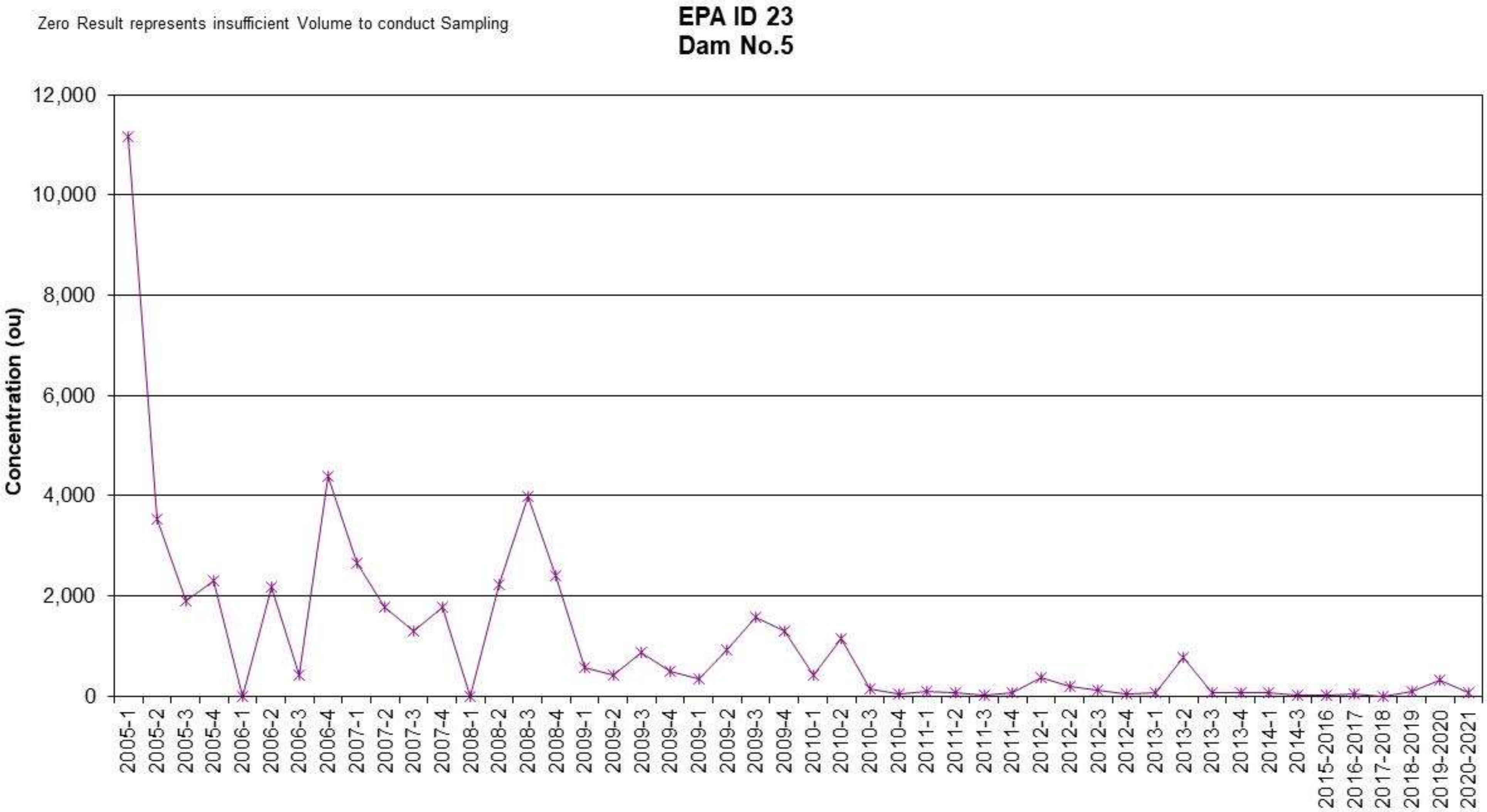


FIGURE 5-14 ODOUR EMISSION CONCENTRATIONS, EFFLUENT STORAGE DAM 6

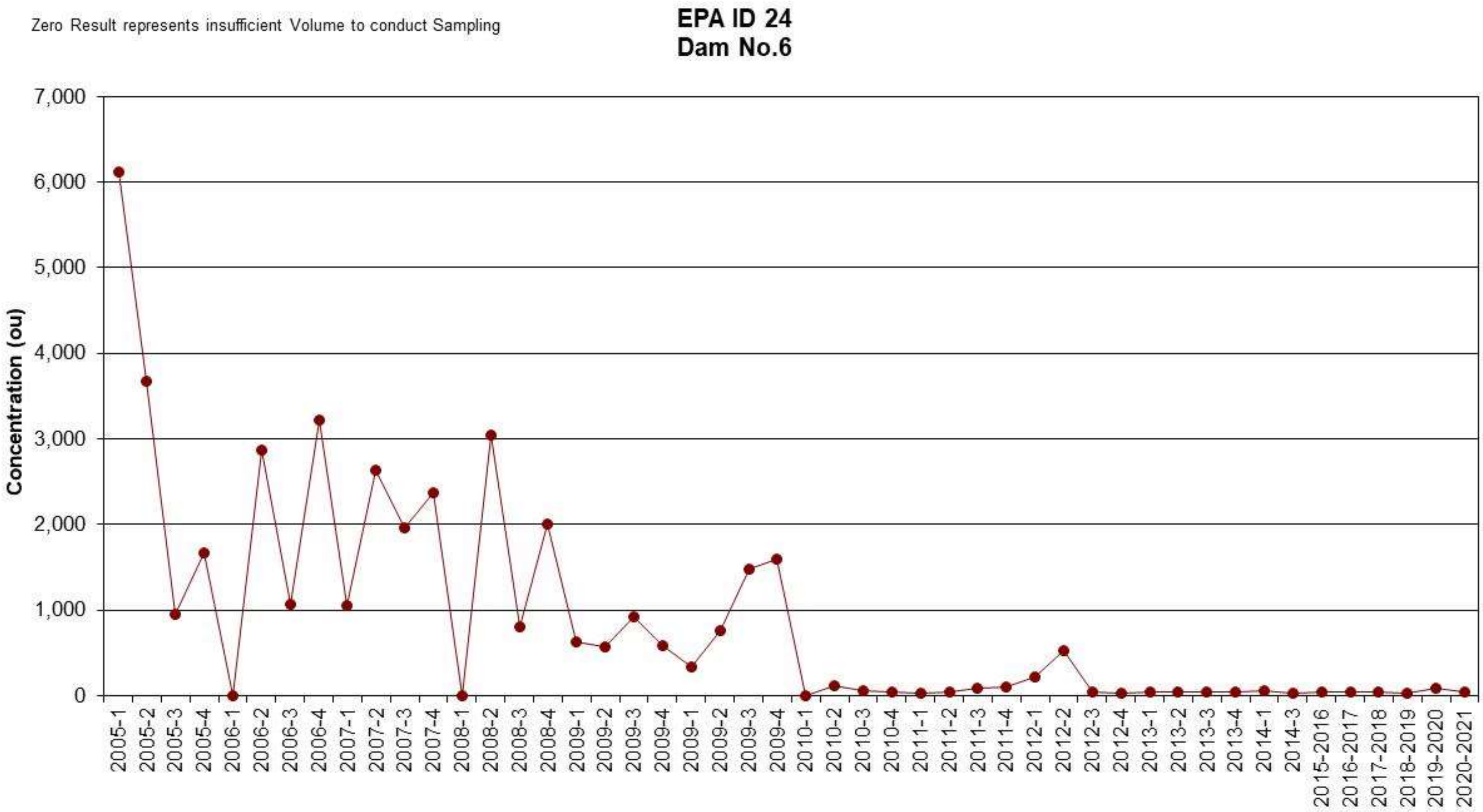
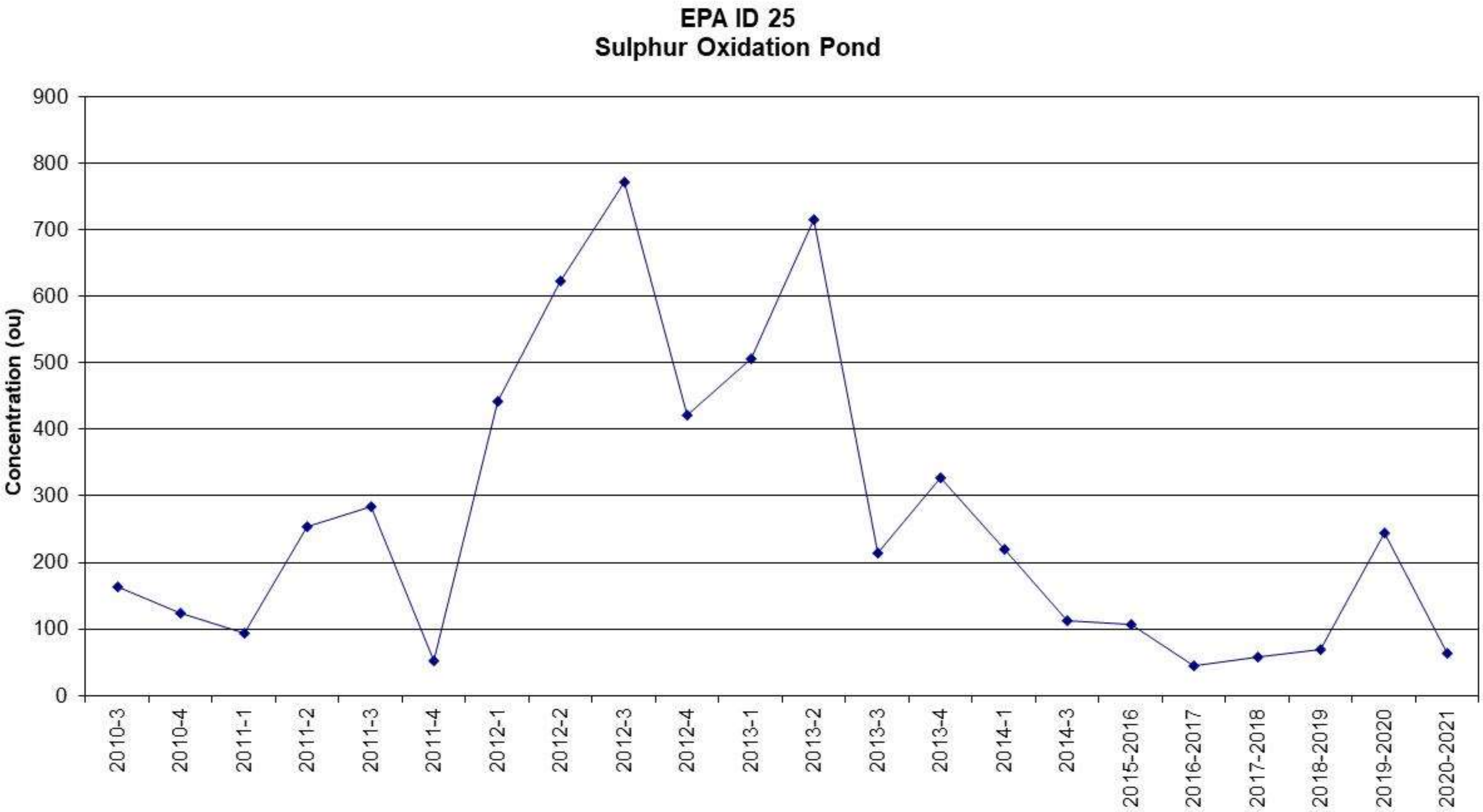


FIGURE 5-15 ODOUR EMISSION CONCENTRATIONS, SULPHUR OXIDATION POND



6 TEST METHODS

6.1 ODOUR MEASUREMENT/DYNAMIC OLFACTOMETRY

(AS 4323.3 & AS 4323.4 and OM-7 and OM-8)

Samples were collected in 30L Nalophane sampling bags which are enclosed in airtight plastic containers. Surface samples were collected utilising an equilibrium flux hood or witches hat flux hood.

Odorous gas for analysis was drawn through a Teflon (PTFE) sample probe. The gas then passes through a Teflon (PTFE) tube connected to the Nalophane sampling bag. The sampling pump is connected to the airtight plastic container to provide a sample gas flow-rate of approximately 0.5 – 1.5 litres per minute. After the required volume has been sampled, the pump is stopped and the bag sealed with a stainless steel valve. Two samples were collected from each site.

Using a triangular forced choice olfactometer, the Nalophane bag of odour sample was dynamically diluted to various concentrations with dry odour free air.

The diluted sample was then presented to a panel of screened panellists as one of these airflows. The panellists then recorded if they could detect any odour and from which flow. The other two flows were discharging odour free air.

The odour is always presented to the panellists in ascending concentration; that is, from lower to higher concentration. The panellists are required at each dilution level to give a response as to what they are smelling from the flows (forced choice methodology). The response options for the panellists are:

'Guess'	Unable to determine which air flow contains the diluted odours
'Inkle'	Thinks that one of the flows could be different from the other two flows
'Detect' or 'Certain'	Is confident that one of the airflows smells different from the other two flows. Not necessarily able to say what the smell is.
'Recognise'	Thinks that one of the flows could be different from the other two flows and is able to: ▪ Assign a 'hedonic tone' (pleasantness scale number) to the odour ranging from –10 to 10 and/or ▪ Able to assign a character to the colour, as in 'it smells like …' *Note: that the Recognise level concentration and Hedonic Tone and Odour descriptors are obtained with the diluted odour, panellists are not exposed to the full strength odour.*

The percentage panel response and dilution levels used were then entered into a computer programme to determine the 50% panel response. This dilution level corresponds to the odour concentration of the sample.

Sampling and dilution lines are constructed from teflon, stainless or glass to prevent contamination of the sample.

The sampling and the dilution procedures used were in accordance with OEH NSW Method OM-7 and OM-8, which are based on Standards Association of Australia, AS4323.3 and AS4323.4.

6.1.1 ODOUR PANEL SELECTION

Odour panellists must meet certain criteria to qualify as and remain panellists. Their average sensitivity to n-Butanol must be between 20 and 80 parts per billion (ppb) and their variability in response to n-Butanol must be within a certain range.

Panellists are screened against n-Butanol before every panel session to ensure they are in compliance.

Panellists should not suffer from respiratory complaints, nor should they eat or smoke or drink anything but water during the half hour preceding or during the test period and their person and clothing should be odour free and have not been exposed to an odorous environment before testing.

6.1.2 ODOUR TERMINOLOGY

The odour level is expressed in odour units and for mixed odours is analogous to concentration expressed in parts per billion. The odour detection level is defined as the ratio of *the volume that a sample of odorous gas would occupy when diluted to the threshold of detection of that odour* to *the volume of the sample*. In simpler terms, the ratio indicated the number of dilutions necessary to reduce the odour to its threshold of detection or odour detection threshold. This ratio is expressed in odour units or number of dilutions to detection threshold. For example, a value of 2,000 odour units would mean the volume of the initial sample of odorous gas would need to be diluted 2,000 times before the odour would just be detectable to the average human nose, that is, at the odour detection threshold.

6.2 EXHAUST GAS VELOCITY

(OEH NSW TM-2 and USEPA Method 12)

Velocity profiles were obtained across the stack utilising an Airflow Developments Ltd. S-type pitot tube and digital manometer.

6.3 EXHAUST GAS TEMPERATURE

(OEH NSW TM- 2, 3 & 4 and USEPA Methods 2, 3 & 4)

The exhaust gas temperature was measured using a Digital thermometer (0-1200°C) connected to a chromel/alumel (K-type) thermocouple probe.

6.4 OXYGEN (O_2)

(OEH NSW TM-24 and USEPA Method 3A)

O_2 was analysed by a Testo 350 analyser.

6.5 MOISTURE

(OEH NSW TM-22 and USEPA Method 4)

Moisture from the stack was determined in accordance with OEH NSW TM-22 and USEPA Method 4. In particular, M4 Section 2.2.1 which nominates a moisture approximation method used to enable calculation of isokinetic sampling rates and where isokinetic sampling is not required such as odour sampling.

6.6 ACCURACY

All results are quoted on a dry basis. SEMA has adopted the following (Table 6-1) uncertainties for various stack testing methods.

TABLE 6-1 ESTIMATION OF MEASUREMENT UNCERTAINTY

Pollutant	**Methods**	**Uncertainty**
Moisture	AS4323.2, TM-22, USEPA 4	25%
Odour	AS4323.3, AS4323.4	3 times
Oxygen and Carbon Dioxide	TM-24, TM-25, USEPA 3A	1% actual
Velocity	AS4323.1, TM-2, USEPA 2A & 2C	5%

Key:

Unless otherwise indicated the uncertainties quoted have been determined @ 95% level of Confidence level (i.e. by multiplying the repeatability standard deviation by a co-efficient equal to 1.96) (Source – Measurement Uncertainty)

Sources: *Measurement Uncertainty – implications for the enforcement of emission limits by Maciek Lewandowski (Environment Agency) & Michael Woodfield (AEAT) UK*

Technical Guidance Note (Monitoring) M2 Monitoring of stack emissions to air Environment Agency Version 3.1 June 2005.

APPENDIX A – EMISSION TEST RESULTS

Glossary:

%	=	percent
^{o}C	=	Degrees Celsius
am^3/min	=	cubic metre of gas at actual conditions per minute
Normal Volume (m^3)	=	cubic metre at 0°C and 760 mm pressure and 1 atmosphere
am^3	=	cubic metre of gas at actual conditions
g/g mole	=	grams per gram mole
g/s	=	grams per second
hrs	=	hours
kg/m^3	=	kilograms per cubic metre
kPa	=	kilo Pascals
m^2	=	square metre
m/s	=	metre per second
m^3/sec	=	cubic metre per second at $0^{0}C$ and 1 atmosphere
mg	=	milligrams
mg/ m^3	=	milligrams per cubic metre at $0^{o}C$ and 1 atmosphere
O_2	=	Oxygen

Abbreviations for names of SEMA staff who completed either Sampling or Analysis or QA Checking

PWS	=	Peter W Stephenson
JW	=	Jay Weber

TABLE A-1 EMISSION TEST RESULTS – GLUTEN DRYERS NO. 1, 2, 3 & 4

Emission Test Results				
Project Number	**7116**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 8 Gluten Dryer 1***	**EPA ID 9 Gluten Dryer 2**	**EPA ID 10 Gluten Dryer 3**	**EPA ID 11 Gluten Dryer 4**
Date	18-Nov-20	18-Nov-20	18-Nov-20	18-Nov-20
	Dry			
Run	1			
Method	TM-1, TM-2 & TM-22			
Flow Start Time (hrs)	12:07	13:48	14:46	14:26
Flow Stop Time (hrs)	12:24	14:06	15:57	14:48
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	65.3	63.0	73.5	74.3
Stack Cross-Sectional area (m^2)	1.431	1.094	4.410	2.310
Average Stack Gas Velocity (m/s)	13.7	17.0	11.5	15.7
Actual Gas Flow Volume (am^3/min)	1,179	1,114	3,040	2,173
Total Normal Gas Flow Volume (m^3/min)	915	794	2,293	1,633
Total Normal Gas Flow Volume (m^3/s)	15.2	13.2	38.2	27.2
Total Stack Pressure (kPa)	102.5	93.4	102.8	102.5
Moisture Content (% by volume)	5.01	4.77	5.69	5.57
Molecular Weight Dry Stack Gas (g/gmole)	28.8	28.8	28.8	28.8
Dry Gas Density (kg/m^3)	1.29	1.29	1.29	1.29
Oxygen (%)	20.9	20.9	20.9	20.9
Analysis	**Odour**	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5446	5447	5448	5449
SEMA Number	728138	728139	728140	728141
Sample Start Time (hrs)	12:58	13:53	14:57	14:38
Sample Finish Time (hrs)	13:08	14:06	15:07	14:48
Odour Concentration (As Received) (ou)	468	254	302	359
Odour Concentration (Final) (ou)	**470**	**250**	**300**	**360**
Normal MOER (As Received) (ou m^3/s)	7,136	3,362	11,540	9,768
Normal MOER (Final) (ou m^3/s)	7,136	3,362	11,540	9,768
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit	No Limit
Sample storage prior to disposal	2 days	2 days	2 days	2 days
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

* Re. Gluten Dryer No.1 (EPA ID 8), odour measurements were taken. However, new silencer and ductwork no longer enable access to the duct. Thus, flow measurements were unable to be taken. To enable calculation of the MOER, flow measurements have been based on previous Quarter 1, 2020 results.

TABLE A-2 EMISSION TEST RESULTS – STARCH DRYERS NO.1, 3, 4 & 5

Emission Test Results				
Project Number	**7116**			
Project Name	**Shoalhaven Starches**			
Test Location	**EPA ID 12 Starch Dryer 1**	**EPA ID 13 Starch Dryer 3**	**EPA ID 14 Starch Dryer 4**	**EPA ID 47 Starch Dryer 5**
Date	18-Nov-20	18-Nov-20	18-Nov-20	24-Nov-20
	Dry			
Run	1			
Method	TM-1, TM-2 & TM-22			
Flow Start Time (hrs)	12:47	15:26	15:25	13:19
Flow Stop Time (hrs)	13:09	15:48	16:47	13:40
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	41.4	40.1	39.5	64.4
Stack Cross-Sectional area (m^2)	2.250	1.000	1.000	4.524
Average Stack Gas Velocity (m/s)	7.3	20.2	21.0	14.9
Actual Gas Flow Volume (am^3/min)	980	1,214	1,258	4,047
Total Normal Gas Flow Volume (m^3/min)	812	1,004	1,046	3,020
Total Normal Gas Flow Volume (m^3/s)	13.5	16.7	17.4	50.3
Total Stack Pressure (kPa)	102.47	102.53	102.54	101.11
Moisture Content (% by volume)	5.75	6.22	5.99	7.61
Molecular Weight Dry Stack Gas (g/gmole)	28.8	28.8	28.8	28.8
Dry Gas Density (kg/m^3)	1.29	1.29	1.29	1.29
Oxygen (%)	20.9	20.9	20.9	20.9
Analysis	**Odour**	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5445	5450	5451	5457
SEMA Number	728137	728142	728143	728148
Sample Start Time (hrs)	12:59	15:38	16:37	13:30
Sample Finish Time (hrs)	13:09	15:48	16:47	13:40
Odour Concentration (As Received) (ou)	470	116	106	386
Odour Concentration (Final) (ou)	**470**	**120**	**110**	**390**
Normal MOER (As Received) (ou m^3/s)	6,358	1,942	1,848	19,428
Normal MOER (Final) (ou m^3/s)	6,358	1,942	1,848	19,428
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit	No Limit
Sample storage prior to disposal	2 days	2 days	2 days	2 days
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

TABLE A-3 EMISSION TEST RESULTS – BOILERS NO. 5 & 6, 4 & 2

Emission Test Results			
Project Number	**7116**		
Project Name	**Shoalhaven Starches**		
Test Location	**EPA ID 35 Boilers 5&6**	**EPA ID 42 Boiler 4**	**EPA ID 45 Boiler 2**
Date	24-Nov-20	24-Nov-20	24-Nov-20
	Dry		
Run	1		
Method	TM-1, TM-2 & TM-22		
Flow Start Time (hrs)	11:38	10:43	10:00
Flow Stop Time (hrs)	12:00	11:05	10:20
Inlet/Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	135.2	164.6	214.0
Stack Cross-Sectional area (m^2)	3.142	1.057	0.950
Average Stack Gas Velocity (m/s)	16.5	18.7	8.3
Actual Gas Flow Volume (am^3/min)	3,117.3	1,187.5	475.9
Total Normal Gas Flow Volume (m^3/min)	1,973.7	702.2	254.5
Total Normal Gas Flow Volume (m^3/s)	32.895	11.704	4.242
Total Stack Pressure (kPa)	101.11	101.23	101.23
Moisture Content (% by volume)	5.15	5.15	4.54
Molecular Weight Dry Stack Gas (g/gmole)	30.080	29.840	30.080
Dry Gas Density (kg/m^3)	1.34	1.33	1.34
Oxygen (%)	8.4	10.0	8.4
Analysis	**Odour**	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**	**AS4323.3**
ORLA Number	5455	5454	5453
SEMA Number	728146	728145	728144
Sample Start Time (hrs)	11:50	10:55	10:10
Sample Finish Time (hrs)	12:00	11:05	10:20
Odour Concentration (As Received) (ou)	2,181	1,742	1,156
Odour Concentration (Final) (ou)	**2,200**	**1,700**	**1,200**
Normal MOER (As Received) (ou m^3/s)	71,745	20,388	4,904
Normal MOER (Final) (ou m^3/s)	71,745	20,388	4,904
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit
Sample storage prior to disposal	2 days	2 days	2 days
Calculations entered by	JW	JW	JW
Calculations checked by	PWS	PWS	PWS

TABLE A-4 EMISSION TEST RESULTS – FERMENTER 16 & CO_2 SCRUBBER OUTLET

Emission Test Results		
Project Number	**7116**	
Project Name	**Shoalhaven Starches**	
Test Location	**EPA ID 44 Fermenter 16**	**EPA ID 16 CO_2 Scrubber outlet**
Date	18-Nov-20	18-Nov-20
	Dry	
Run	1	
Method	TM-1,TM-2 & TM-22	
Flow Start Time (hrs)	10:36	11:02
Flow Stop Time (hrs)	10:57	11:22
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	32.2	28.4
Stack Cross-Sectional area (m^2)	0.071	0.196
Average Stack Gas Velocity (m/s)	6.1	7.6
Actual Gas Flow Volume (am^3/min)	25.7	90
Total Normal Gas Flow Volume (m^3/min)	22.4	79
Total Normal Gas Flow Volume (m^3/s)	0.373	1.320
Total Stack Pressure (kPa)	102.51	102.51
Moisture Content (% by volume)	3.80	3.45
Molecular Weight Dry Stack Gas (g/gmole)	29.620	31.204
Dry Gas Density (kg/m^3)	1.32	1.39
Oxygen (%)	0.5	0.1
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5442	5443
SEMA Number	728134	728135
Sample Start Time (hrs)	10:47	11:12
Sample Finish Time (hrs)	10:57	11:22
Odour Concentration (As Received) (ou)	7,516	8,035
Odour Concentration (Final) (ou)	**7,500**	**8,000**
Normal MOER (As Received) (ou m^3/s)	2,804	10,609
Normal MOER (Final) (ou m^3/s)	2,804	10,609
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample storage prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

TABLE A-5 EMISSION TEST RESULTS – INLET TO BIOFILTERS, DDG DRYERS 1, 2, 3 & 4

Emission Test Results		
Project Number	**7116**	
Project Name	**Shoalhaven Starches**	
Test Location	**EPA ID 39 Biofilter Inlet DDG Dryers 1, 2 & 3**	**EPA ID 39A Biofilter Inlet DDG Dryer 4**
Date	24-Nov-20	24-Nov-20
	Dry	Dry
Run	1	1
Method	TM-1,TM-2 & TM-22	TM-1,TM-2 & TM-22
Flow Start Time (hrs)	14:50	14:50
Flow Stop Time (hrs)	14:50	15:12
Inlet/Exhaust	Exhaust	Exhaust
Stack Temperature (°C)	41.8	30.1
Stack Cross-Sectional area (m^2)	0.283	0.049
Average Stack Gas Velocity (m/s)	13.6	8.5
Actual Gas Flow Volume (am^3/min)	231	25
Total Normal Gas Flow Volume (m^3/min)	178	22
Total Normal Gas Flow Volume (m^3/s)	3.0	0.4
Total Stack Pressure (kPa)	96.42	101.39
Moisture Content (% by volume)	6.90	3.93
Molecular Weight Dry Stack Gas (g/gmole)	28.836	28.836
Dry Gas Density (kg/m^3)	1.287	1.287
Oxygen (%)	20.9	20.9
Analysis	**Odour**	**Odour**
Method	**AS4323.3**	**AS4323.3**
ORLA Number	5462	5463
SEMA Number	728153	728154
Sample Start Time (hrs)	14:16	15:02
Sample Finish Time (hrs)	14:26	15:12
Odour Concentration (As Received) (ou)	9,495	70,388
Odour Concentration (Final) (ou)	**9,500**	**70,400**
Normal MOER (As Received) (ou m^3/s)	28,146	25,522
Normal MOER (Final) (ou m^3/s)	28,146	25,522
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit
Sample Storage prior to disposal	2 days	2 days
Calculations entered by	JW	JW
Calculations checked by	PWS	PWS

TABLE A-6 EMISSION TEST RESULTS DDG PELLET PLANT

Emission Test Results	
Project Number	**7116**
Project Name	**Shoalhaven Starches**
Test Location	**EPA ID 46 DDG Pellet Plant Stack**
Date	24-Nov-20
	Dry
Run	1
Method	TM-1,TM-2 & TM-22
Flow Start Time (hrs)	11:24
Flow Stop Time (hrs)	11:47
Inlet/Exhaust	Exhaust
Stack Temperature (°C)	45.0
Stack Cross-Sectional area (m^2)	1.674
Average Stack Gas Velocity (m/s)	12.5
Actual Gas Flow Volume (am^3/min)	1,255.6
Total Normal Gas Flow Volume (m^3/min)	1,051.8
Total Normal Gas Flow Volume (m^3/s)	17.530
Total Stack Pressure (kPa)	101.07
Moisture Content (% by volume)	2.20
Molecular Weight Dry Stack Gas (g/gmole)	28.836
Dry Gas Density (kg/m^3)	1.29
Oxygen (%)	20.9
Analysis	**Odour**
Method	**AS4323.3**
ORLA Number	5456
SEMA Number	728147
Sample Start Time (hrs)	11:24
Sample Finish Time (hrs)	11:47
Odour Concentration (As Received) (ou)	2,307
Odour Concentration (Final) (ou)	**2,300**
Normal MOER (As Received) (ou m^3/s)	40,442
Normal MOER (Final) (ou m^3/s)	40,442
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit
Sample Storage prior to disposal	2 days
Calculations entered by	JW
Calculations checked by	PWS

TABLE A- 7 EMISSION TEST RESULTS – BIOFILTER OUTLETS

Emission Test Results				
Project Number	7116			
Project Name	Shoalhaven Starches			
Test Location	**EPL ID 40 Biofilter A East**	**EPL ID 40 Biofilter A West**	**EPL ID 41 Biofilter B East**	**EPL ID 41 Biofilter B West**
Date	24-Nov-20	24-Nov-20	24-Nov-20	24-Nov-20
	Dry	Dry	Dry	Dry
Run	1	1	1	1
Method	TM-2 & TM-22			
Sample Start Time (hrs)	15:37	16:32	15:32	16:15
Sample Stop Time (hrs)	15:47	16:42	15:42	16:25
Inlet/Exhaust	Exhaust			
Stack Temperature (^{o}C)	39.1	37.8	39.5	36.4
Proportion of Inlet air flow	**0.26**	**0.24**	**0.24**	**0.26**
Calculated from inlet flow Actual Gas Flow Volume (am^3/min)	65.4	62.2	62.2	66.8
Calculated from inlet flow Total Normal Gas Flow Volume (m^3/min)	50.90	48.36	48.36	52.0
Analysis	Odour			
Method	AS4323.3			
ORLA Number	5458	5460	5459	5461
SEMA Number	728149	728151	728150	728152
Sample Start Time (hrs)	15:37	16:32	15:32	16:15
Sample Stop Time (hrs)	15:47	16:42	15:42	16:25
Odour Concentration (As Received) (ou)	1,242	1,679	2,004	1,830
Odour Concentration (Final) (ou)	1,200	1,680	2,000	1,830
Normal MOER (As Received) (ou m^3/s)	1054	1353	1615	1586
Normal MOER (Final) (ou m^3/s)	1054	1353	1615	1586
Calculations entered by	JW	JW	JW	JW
Calculations checked by	PWS	PWS	PWS	PWS

APPENDIX B – CERTIFICATES OF ANALYSIS

Odour Research Laboratories Australia

A Division of Peter W. Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

52A Hampstead Road
Auburn NSW 2144 Australia
Tel: (02) 9737 9991
E-Mail: pstephenson@orla.com.au

Olfactometry Test Report

The measurement was commissioned by SEMA on behalf of:

Client	Organisation:	Shoalhaven Starches
	Address:	Bolong Road, Bomaderry NSW 2541
	Contact:	John Studdert
	Sampling Site:	Ponds 1, 3, 5 & 6, SO Basin Pond, Starch Dryers 1, 3, 4 & 5, Gluten Dryers 1, 2, 3 & 4, Boiler 2, Boiler 4, Boilers 5&6, Biofilter A outlets, Biofilter B outlets, Biofilter inlet from DDG Evaporators No. 1, 2, 3,& 4, CO_2 Scrubber inlet & outlet, Fermenter 16, DDG Pellet Plant stack
	Telephone:	02 4423 8254
	Email:	John.studdert@manildra.com.au
Project	ORLA Report Number:	7116/ORLA/01
	Project Manager:	Margot Kimber
	Testing operator:	Peter Stephenson
	ORLA Sample number(s):	5441 to 5469
	SEMA Sample number(s):	728134 to 728159
Order	Analysis Requested:	Odour Analysis
	Order requested by:	SEMA on behalf of Shoalhaven Starches
	Date of order:	18 November 2020
	Order number:	5175
	Telephone:	02 9737 9991
	Signed by:	Margot Kimber
	Order accepted by:	Peter Stephenson
Report	Date of issue:	18 December 2020

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NATA accredited laboratory number 15043.

Accredited for Compliance with ISO/IEC 17025 - Testing

ODOUR CONCENTRATION MEASUREMENTS RESULTS 7116/ORLA/01

Investigated Item	Odour concentration in odour units 'ou' determined by Sensory odour concentration measurements, of an odour sample supplied in a sampling bag. All samples were received in good condition.
Analysis Method	The samples were analysed in accordance with AS/NZS4323.3:2001.
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 n-butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Instrument Used	The Olfactometer used during this testing session was: AC'SCENT International Olfactometer
Measuring Range	The measuring range of the AC'SCENT International olfactometer is $12 \leq \chi \leq 92{,}102$ ou. . If the measuring range was insufficient the odour samples will have been pre-diluted.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between ± 3°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.05$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $r = 0.0020$ (February 2020) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.20$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $A = 0.020$ (February 2020) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the AC'SCENT International Olfactometer has been determined to be 12 ou.
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 every session to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

18 December, 2020

Peter Stephenson
Managing Director

Odour Research Laboratories Australia

Odour Olfactometry Results – 7116/ORLA/01

Sample				Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Fermenter No.16	728134	18/11/2020 10:50	5442	19/11/2020 10:55	4	8	Nil	7500	7500	Strawberry Yoplait, oily, vinegar, sharp, alcohol, sweet, veggie oil, glue, gas, ink pen (-1)^
Sample ID: CO_2 scrubber outlet	728135	18/11/2020 11:12	5443	19/11/2020 11:26	4	8	Nil	8000	8000	Vinegar, sharp, sweet, glue, oily, veggie oil, strawberry, slight decay, decomposing fruit, alcohol (-1)
Sample ID: CO_2 scrubber inlet	728136	18/11/2020 11:14	5444	19/11/2020 11:54	4	8	Nil	10600	10600	Fruity, faint strawberry, oily, sweet, sharp, alcohol, veggie oil, vinegar (-1)^
Sample ID: Starch Dryer 1	728137	18/11/2020 12:59	5445	19/11/2020 12:25	4	8	Nil	470	470	Swampy, woody, earth, weet-bix, yeast, fresh bread, starchy, banana, vinegar (-0)^
Sample ID: Gluten Dryer 1	728138	18/11/2020 12:58	5446	19/11/2020 13:40	4	8	Nil	470	470	Earth, natural gas, wheat, grain, fresh bread, starchy vegetables, yoghurt (0)^
Sample ID: Gluten Dryer 2	728139	18/11/2020 13:53	5447	19/11/2020 14:09	4	8	Nil	250	250	Fermenting yoghurt, Yoplait, banana, fresh bread, plastic, vacuum cleaner dust (-1)^
Sample ID: Gluten Dryer 3	728140	18/11/2020 14:57	5448	19/11/2020 15:07	4	8	Nil	300	300	Plastic, yeast, slight sour, strawberry, yoghurt, cereal, plastic taste, fast food potato and gravy (0)^

Odour Research Laboratories Australia

Odour Olfactometry Results – 7116/ORLA/01

Sample				Analysis Date/Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Gluten Dryer 4	728141	18/11/2020 14:38	5449	19/11/2020 14:38	4	8	Nil	360	360	Nestle Quik, caramel, vanilla, earth, chocolate, slight coffee, cocoa (2)^
Sample ID: Starch Dryer 3	728142	18/11/2020 15:38	5450	19/11/2020 15:38	4	8	Nil	120	120	Musty, dust, earth, mushroom, gas, peat, cereal, hops (-1)^
Sample ID: Starch Dryer 4	728143	18/11/2020 16:37	5451	19/11/2020 15:41	4	8	Nil	110	110	Hops, cereal, earth, peat, plastic, musty, potato (-1)^
Sample ID: Boiler 2	728144	24/11/2020 10:10	5453	25/11/2020 10:55	4	8	Nil	1200	1200	Acid, chalk, ammonia, earthy, moss exhaust, household gas, swamp gas, dirty, mould, dusty, fireplace heater, (-2)^
Sample ID: Boiler 4	728145	24/11/2020 10:55	5454	25/11/2020 11:25	4	8	Nil	1700	1700	Acid, lime, citrus, gas, burnt jet fuel, swamp gas, earth, mushroom, chlorine, bleach (-1)^
Sample ID: Boiler 5&6	728146	24/11/2020 11:50	5455	25/11/2020 11:54	4	8	Nil	2200	2200	Chlorine, acid, oil, burnt kerosene or jet fuel exhaust gas, swampy, natural gas (-2)^
Sample ID: DDG Pellet	728147	24/11/2020 11:37	5456	25/11/2020 12:24	4	8	Nil	2300	2300	Yeast, baking bread, herbs, powdered cheese, vegemite, bitter (1)^

Odour Research Laboratories Australia

Odour Olfactometry Results – 7116/ORLA/01

Sample				Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1*	(ou) 2*	
Sample ID: Starch Dryer 5	728148	24/11/2020 13:30	5457	25/11/2020 13:55	4	8	Nil	390	390	Wet towel, musty, mould, mushroom, yeast, baking bread, dirty socks, coal, oil, plastic, paint (-1)^
Sample ID: Biofilter A East outlet	728149	24/11/2020 13:37	5458	25/11/2020 14:25	4	8	Nil	1200	1200	Smelly sandshoes, smelly socks, garbage, septic, dirt, soil, plastic paint, vinegar, sour, tannin from decayed vegetable matter and mangroves (-3)^
Sample ID: Biofilter B East outlet	728150	24/11/2020 15:32	5459	25/11/2020 14:53	4	8	Nil	2000	2000	Garbage, smelly socks, sewerage, methylated spirits, rotten vegetables, faeces, decomposed matter, tyres (-3)^
Sample ID: Biofilter A West outlet	728151	24/11/2020 16:32	5460	25/11/2020 15:22	4	8	Nil	1680	1680	Decomposing starch, garbage, yeast, rotten vegetables, faeces, coal, tar, roadworks (-3)^
Sample ID: Biofilter B West outlet	728152	24/11/2020 16:15	5461	25/11/2020 15:51	4	8	Nil	1830	1830	Decomposing vegetation, ammonia,faeces, garbage, stinky socks, rubber, coal, tar (-3)^
Sample ID: Bio inlet DDG Evap. 1,2,3	728153	24/11/2020 14:16	5462	25/11/2020 17:23	4	8	Nil	9500	9500	Cocoa, chocolate, coffee, cereal, wheat, green wheat, corn bread, squishy rubber toys (1)^

Odour Research Laboratories Australia

Odour Olfactometry Results – 7116/ORLA/01

Sample				Analysis Date/Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration		Odour Character & Hedonic Tone^ *
Location	ID No.	Date/Time	ORLA No.					(ou) 1 *	(ou) 2 *	
Sample ID: Bio inlet DDG Evap. 4	728154	24/11/2020 15:02	5463	25/11/2020 17:27	4	8	Nil	70400	70400	Compost, wheat, plastic playdough (-2)^
Sample ID: Pond 1	728155	07/12/2020 15:00	5465	08/12/2020 10:25	4	8	Nil	360	360	Earthy, mushrooms, yoghurt, yeast, vegemite, dirty, floral, creek, chicken salt, 2-minute noodles, slight motor oil (-1)^
Sample ID: Pond 3	728156	07/12/2020 16:13	5466	08/12/2020 11:13	4	8	Nil	280	280	Earthy, grass, mushrooms, corn, very faint sharp musty odour, styrofoam, 2-minute noodles, plastic (-1)^
Sample ID: Pond 5	728157	07/12/2020 17:38	5467	08/12/2020 11:49	4	8	Nil	63	63	Grain, tobacco leaf, earthy, coffee, mushroom, powered beef stock, decomposing logs, wood, wet forest, air from rubber tube, slight plastic (-2)^
Sample ID: Pond 6	728158	07/12/2020 18:19	5468	08/12/2020 12:22	4	8	Nil	38	38	Dry grass, reeds, dirt, decaying wet wood, earthy, mushrooms, bark, drain water with unperfumed soap (-2)^
Sample ID: SO Basin	728159	07/12/2020 20:00	5469	08/12/2020 14:17	4	8	Nil	63	63	Musty, stale, sports shoes, vinegar, peppermint, sweet dried tobacco, menthol cigarettes, dirt, pen ink (1)^

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Odour Panel Calibration Results – 7116/ORLA/01

Reference Odorant	ORLA Sample No.	Date	Concentration of Reference Gas (ppm)	Reference Gas Measured Concentration (ou)	Panel Average Measured Concentration (ppb) [3]	Does panel calibration measurement comply with AS/NZS4323.3:P2001 (Yes/No) [4]
n-butanol	5441	19/11/2020	62.0	1236	50.2	Yes
n-butanol	5452	25/11/2020	62.0	1264	49.1	Yes
n-butanol	5464	08/12/2020	62.0	1269	48.9	Yes

Comments: All samples were collected by Stephenson Environmental Management Australia and analysed by Odour Research Laboratories Australia at their Sydney Laboratory.

Notes from Odour Olfactometry Results:

[1] Sample Odour Concentration: as received in the bag

[2] Sample Odour Concentration: allowing for pre-dilution

[3] Panel Average Measured Concentration: indicates the sensitivity of the panel for the session completed

[4] Target Range for reference gas n-butanol is $20 \le \chi \le 80$ ppb and compliance with AS/NZ4323.3:2001 is based on the individuals rolling average and not on the panel average measured concentration.

Panellist Rolling Average:

19/11/2020: SR = 46.9, PR = 61.3, MB = 54.1, JW= 42.4

25/11/2020: SR = 46.9, PR = 59.3, TL = 31.1, JW = 43.8, MB = 52.4

08/12/2020: SR = 48.5, PR = 57.3, TL = 31.1, JW = 45.3, MB = 51.8

^ denotes the Average Hedonic Tone: describes the pleasantness of the odour being presented where (+5) represents Very Pleasant, (0) represents Neutral and (-5) represents Very Unpleasant and has been derived from the panellist responses at the recognition threshold.

+ This value is not part of our NATA Scope of Accreditation and AS4323.3

--END OF TEST REPORT--

APPENDIX C – DETAILS OF INSTRUMENT CALIBRATION

TABLE C- 1 INSTRUMENT CALIBRATION DETAILS DAY 1

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	19-Oct-20	19-Apr-21
920	Thermocouple	19-Oct-20	19-Apr-21
805	Thermocouple	19-Oct-20	19-Apr-21
815	Digital Manometer	13-Nov-20	13-Nov-21
726	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	combustion analyzer	02-Sep-20	02-Mar-21
835	Personal Sampler	26-Feb-20	26-Feb-21
832	Personal Sampler	26-Feb-20	26-Feb-21
753	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	16-Nov-20	16-Nov-21
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C- 2 INSTRUMENT CALIBRATION DETAILS DAY 2

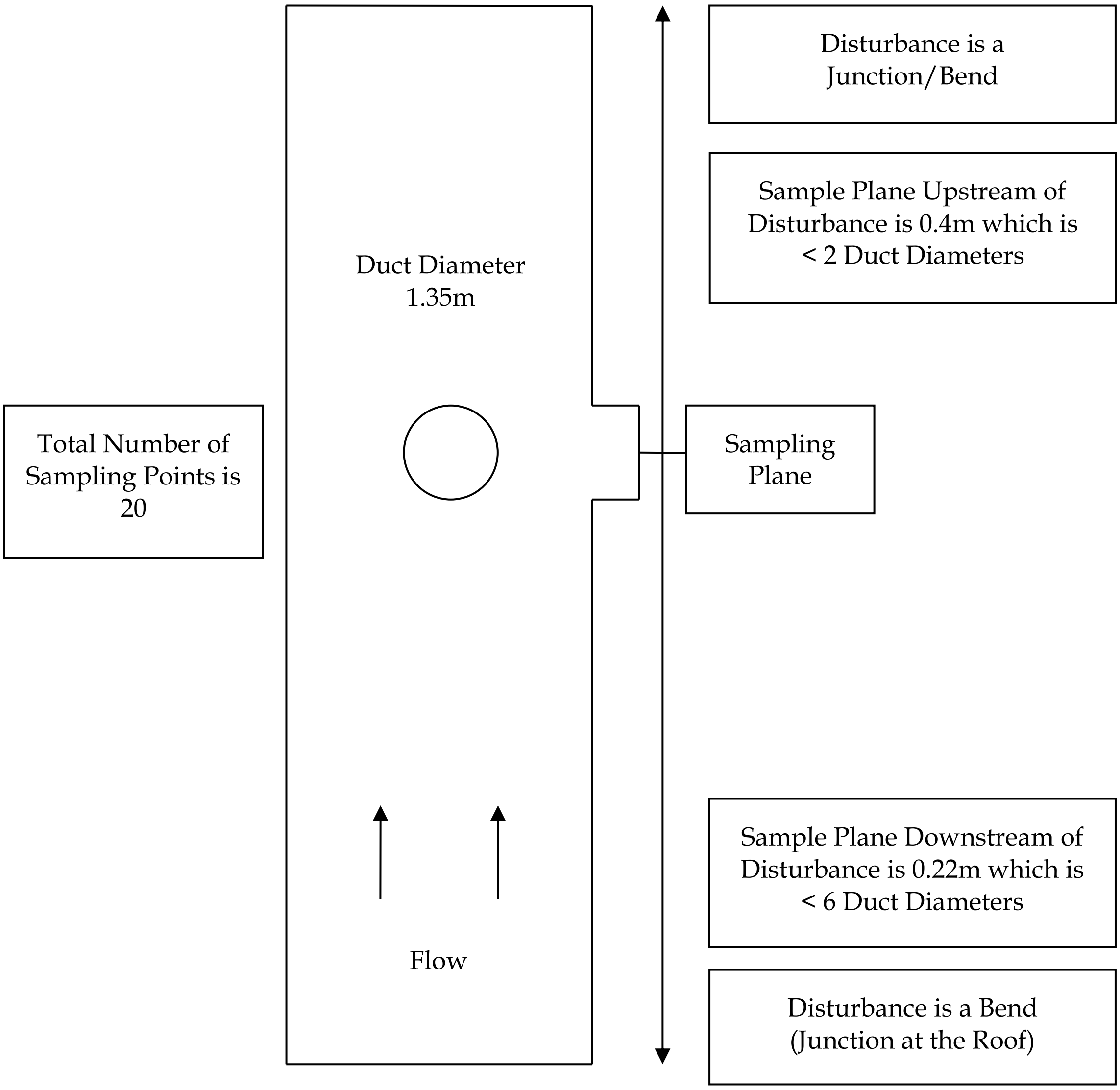
SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	19-Oct-20	19-Apr-21
920	Thermocouple	19-Oct-20	19-Apr-21
805	Thermocouple	19-Oct-20	19-Apr-21
815	Digital Manometer	13-Nov-20	13-Nov-21
726	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
183	Pitot	17-Mar-20	17-Mar-2021 Visually inspected On-Site before use
946	combustion analyzer	02-Sep-20	02-Mar-21
835	Personal Sampler	26-Feb-20	26-Feb-21
832	Personal Sampler	26-Feb-20	26-Feb-21
753	Personal Sampler	12-Mar-20	12-Mar-21
613	Barometer	16-Nov-20	16-Nov-21
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
0.099% 9.8% 10.1%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALWB 5361	17-Jul-21

TABLE C- 3 INSTRUMENT CALIBRATION DETAILS DAY 3

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
857	Digital Temperature Reader	19-Oct-20	19-Apr-21
605	Thermocouple	19-Oct-20	19-Apr-21
607	Thermocouple	19-Oct-20	19-Apr-21
753	Personal Sampler	12-Mar-20	12-Mar-21
835	Personal Sampler	26-Feb-20	26-Feb-21
613	Barometer	16-Nov-20	16-Nov-21

APPENDIX D – SAMPLE LOCATIONS

FIGURE D-1 GLUTEN DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC



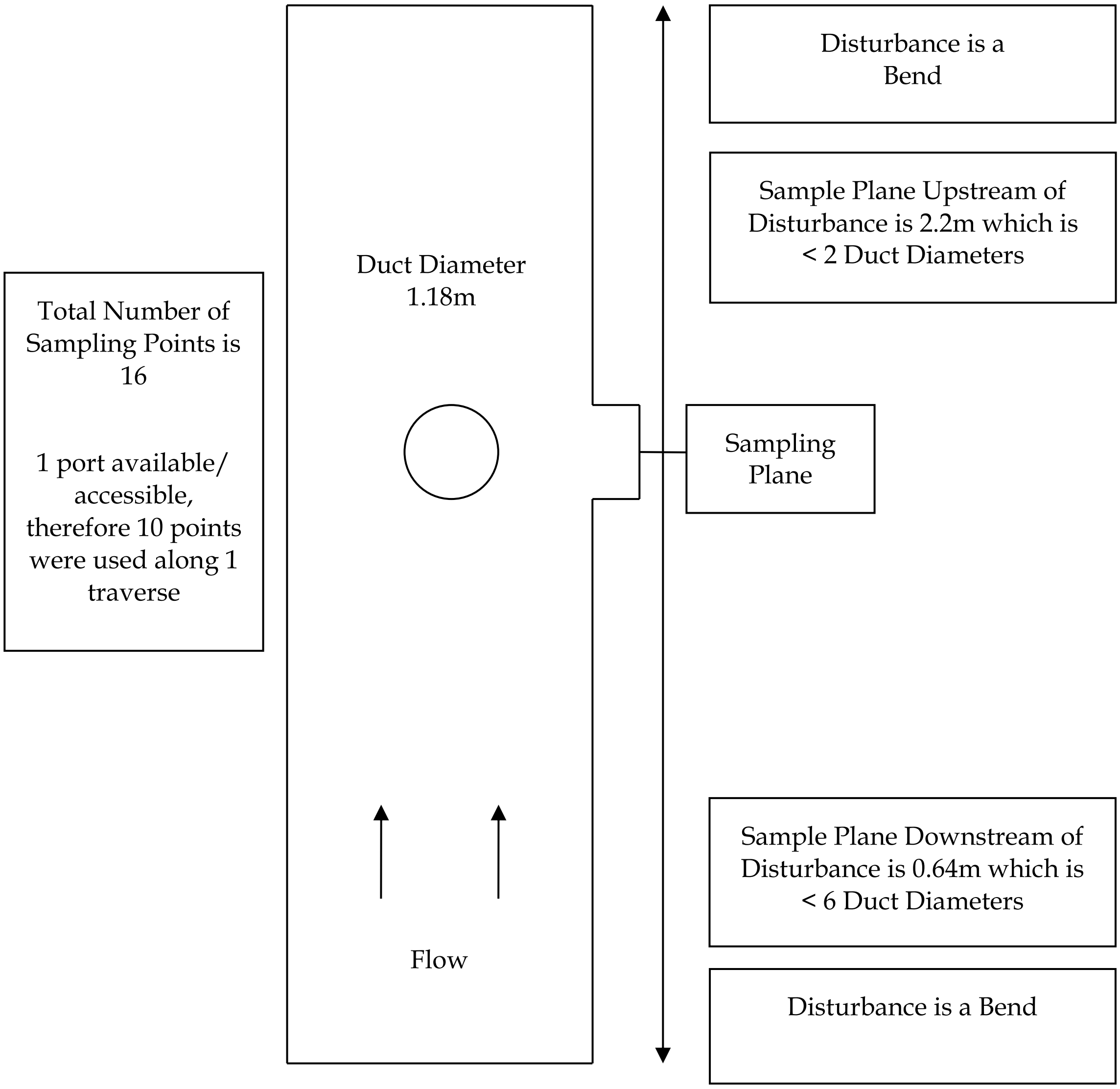
In the absence of cyclonic flow activity ideal sampling plane positions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane would most likely comply with AS4323.1 temperature, velocity and gas flow profile criteria for sampling; once the sampling ports are replaced in the new duct work.

FIGURE D-2 GLUTEN DRYER NO. 1 – SAMPLE LOCATION

FIGURE D-3 GLUTEN DRYER NO. 2 –SAMPLE LOCATION SCHEMATIC



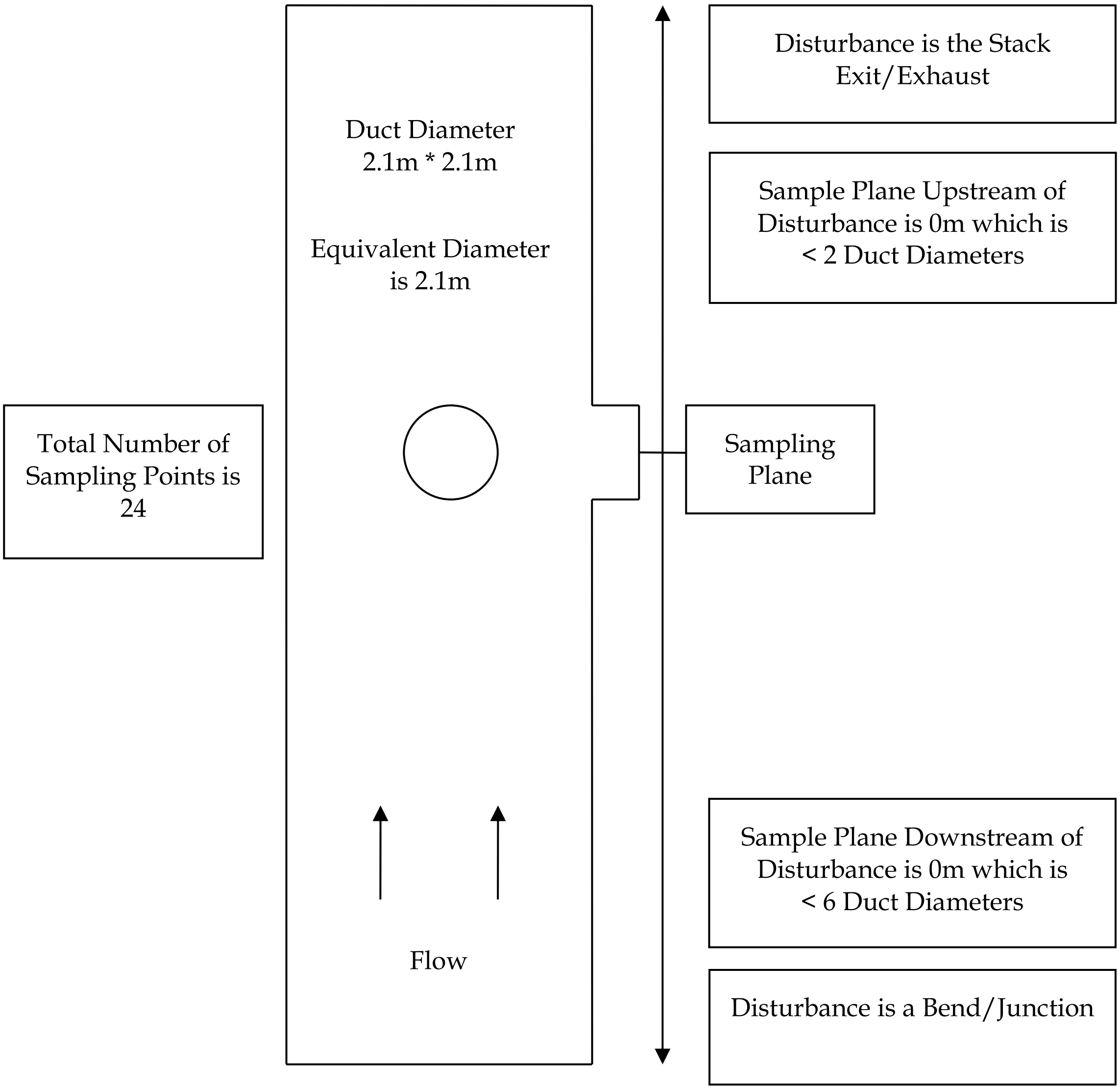
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the interim exit sampling plane complies with AS4323.1 temperature and AS4323.3 odour criteria for sampling.

FIGURE D-4 GLUTEN DRYER NO. 2 – ODOUR SAMPLE LOCATION AT DUCT EXIT

FIGURE D-5 GLUTEN DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC



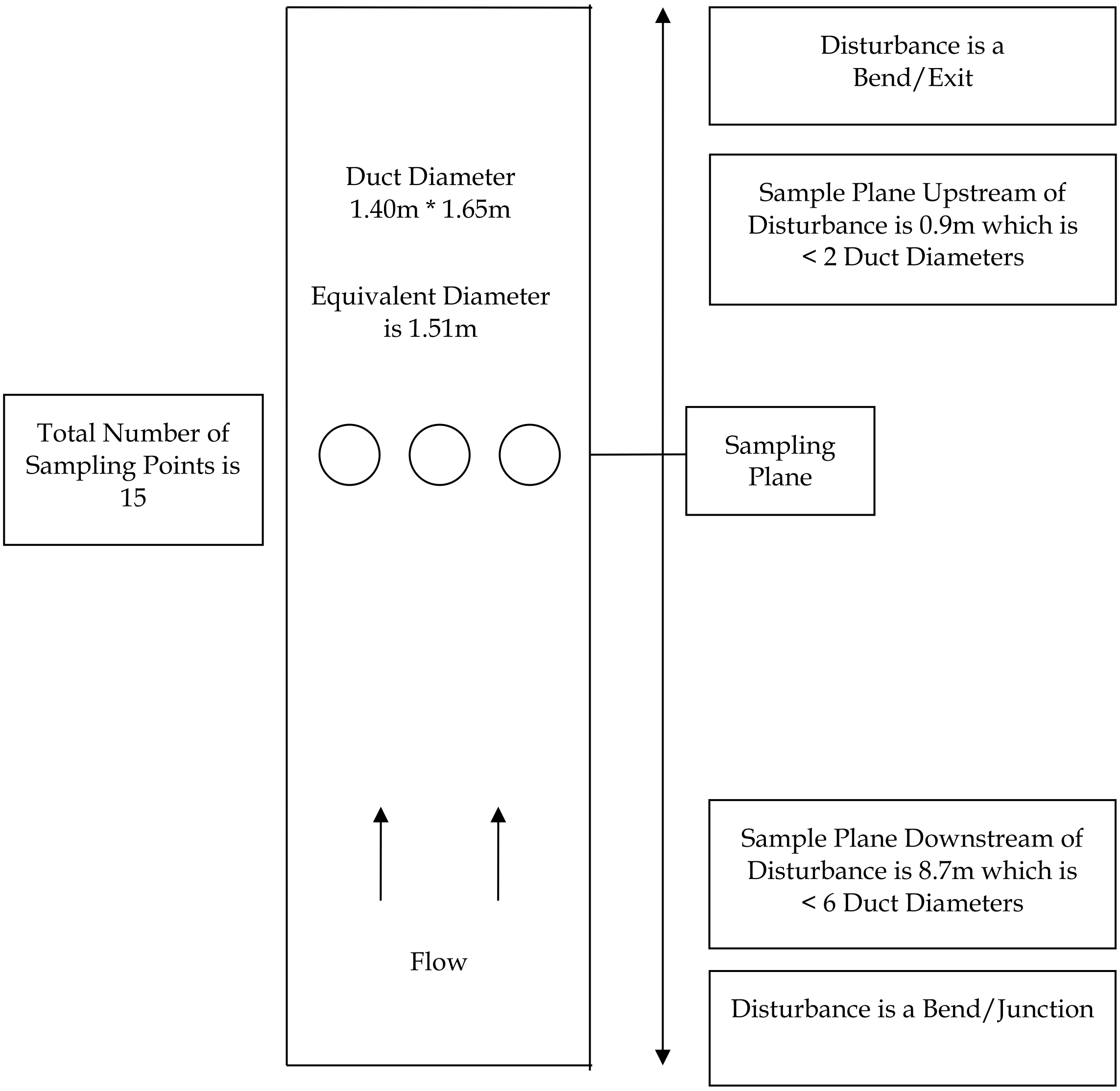
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of minimum velocity profile not meeting the minimum 3 metres per second (m/s) at every sampling point. Previous Minimum (0.8 m/s), Current Minimum (0 m/s).

FIGURE D-6 GLUTEN DRYER NO. 3 – SAMPLE LOCATION

FIGURE D-7 GLUTEN DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC



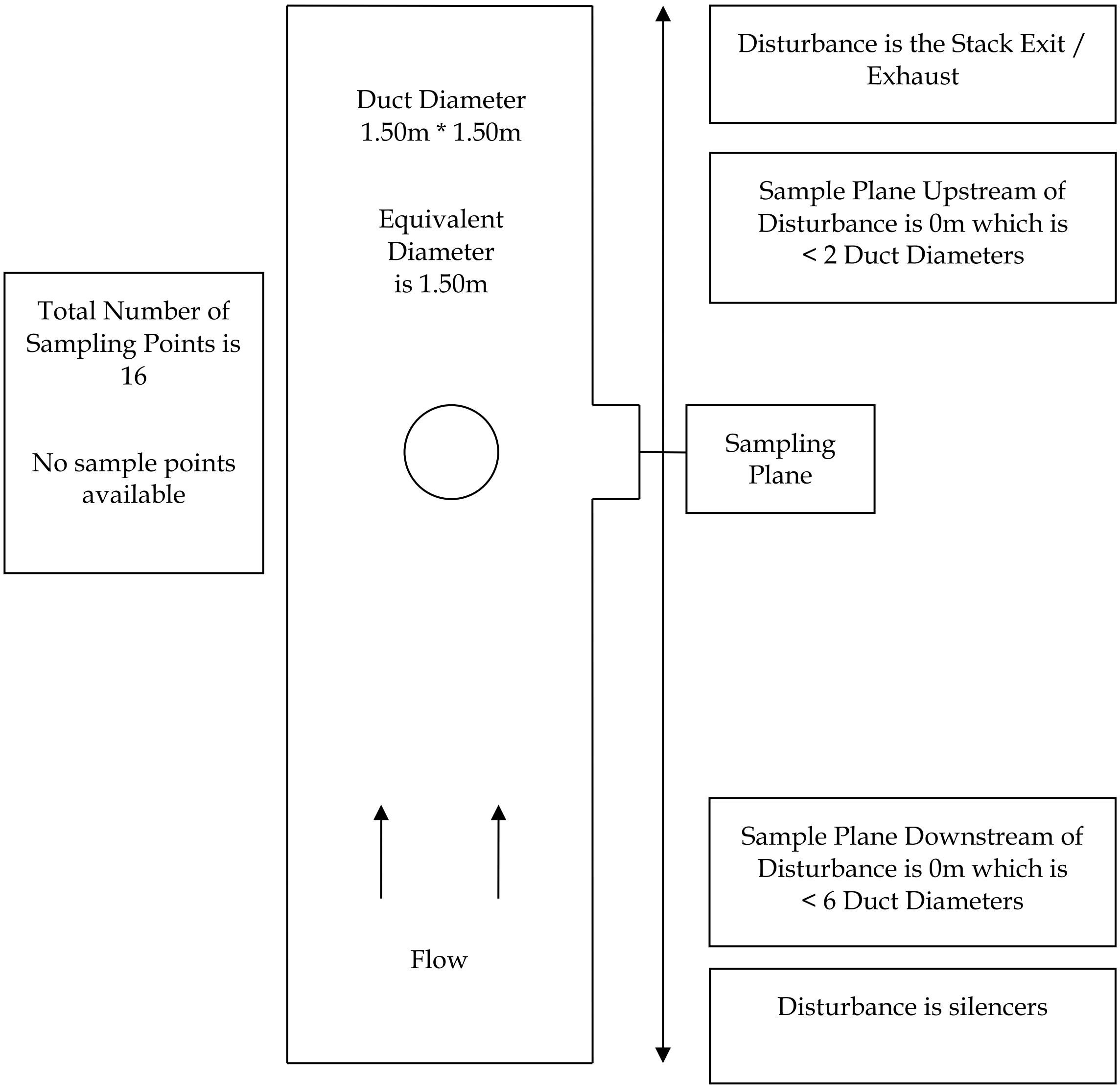
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane does meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-8 GLUTEN DRYER NO. 4 – SAMPLE LOCATION

FIGURE D-9 STARCH DRYER NO. 1 – SAMPLE LOCATION SCHEMATIC



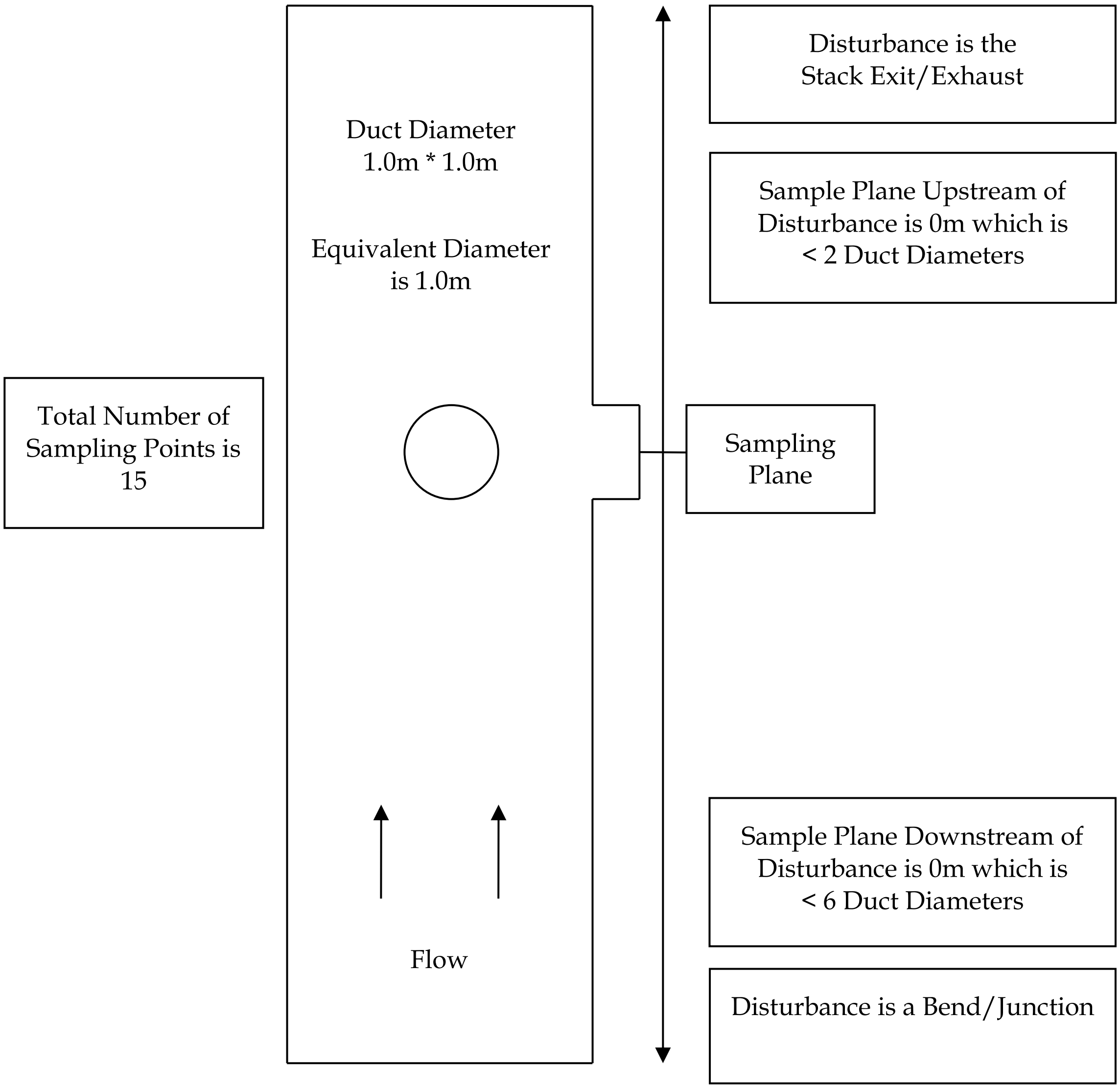
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-10 STARCH DRYER NO. 1 – SAMPLE LOCATION

FIGURE D-11 STARCH DRYER NO. 3 – SAMPLE LOCATION SCHEMATIC



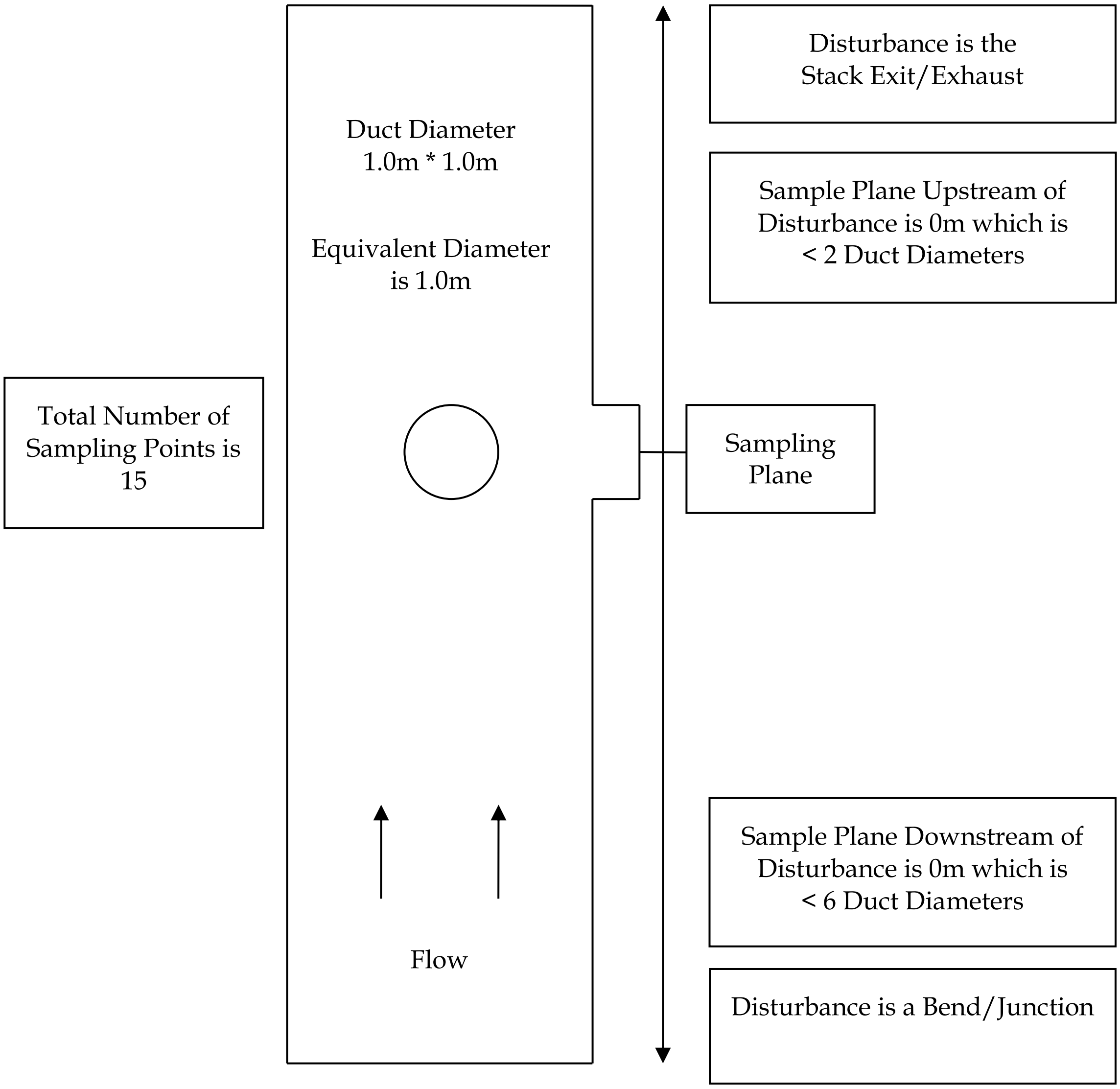
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-12 STARCH DRYER NO. 3 – SAMPLE LOCATION

FIGURE D-13 STARCH DRYER NO. 4 – SAMPLE LOCATION SCHEMATIC



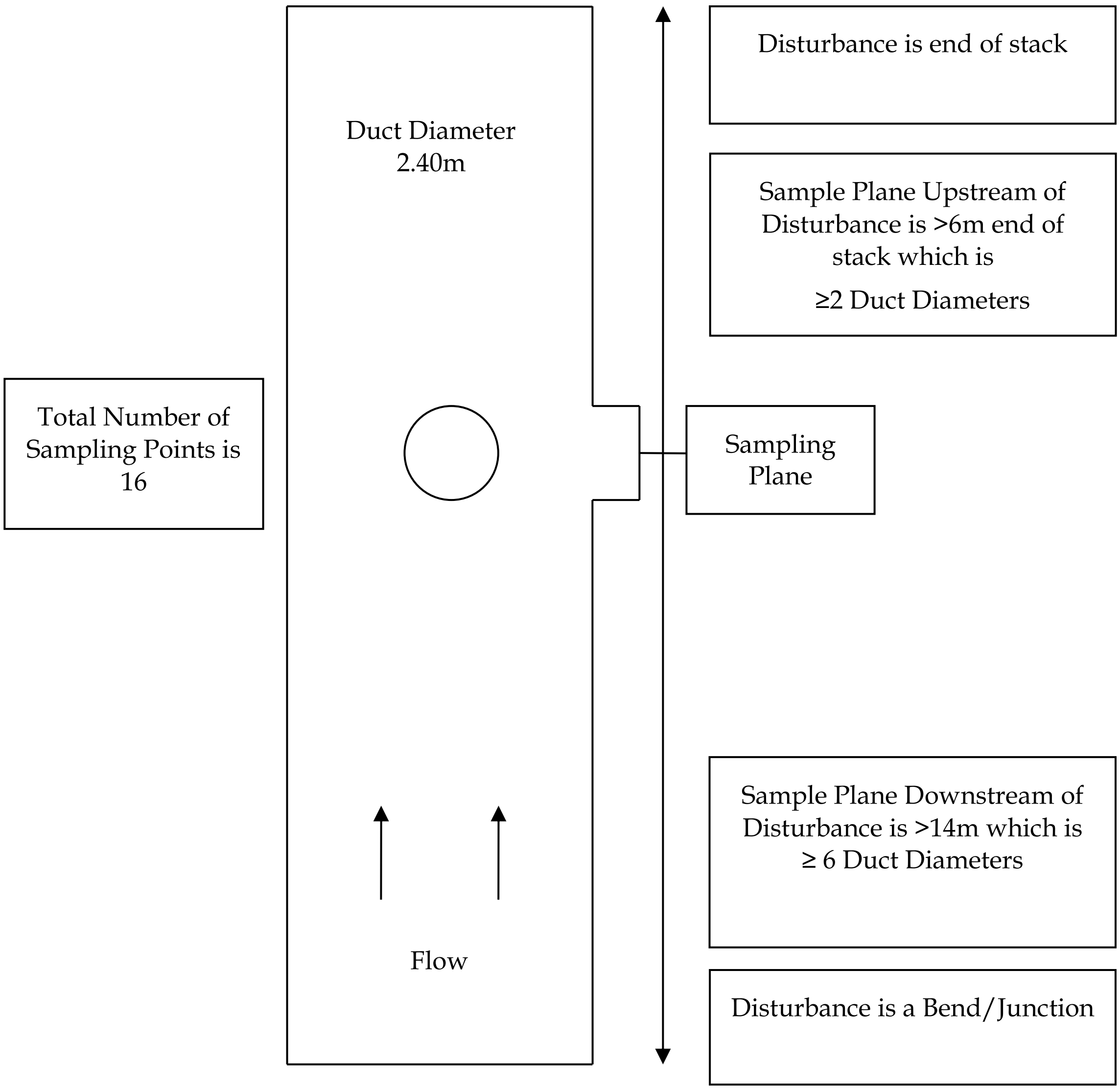
In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-14 STARCH DRYER NO. 4 – SAMPLE LOCATION

FIGURE D-15 STARCH DRYER NO. 5 – SAMPLE LOCATION SCHEMATIC

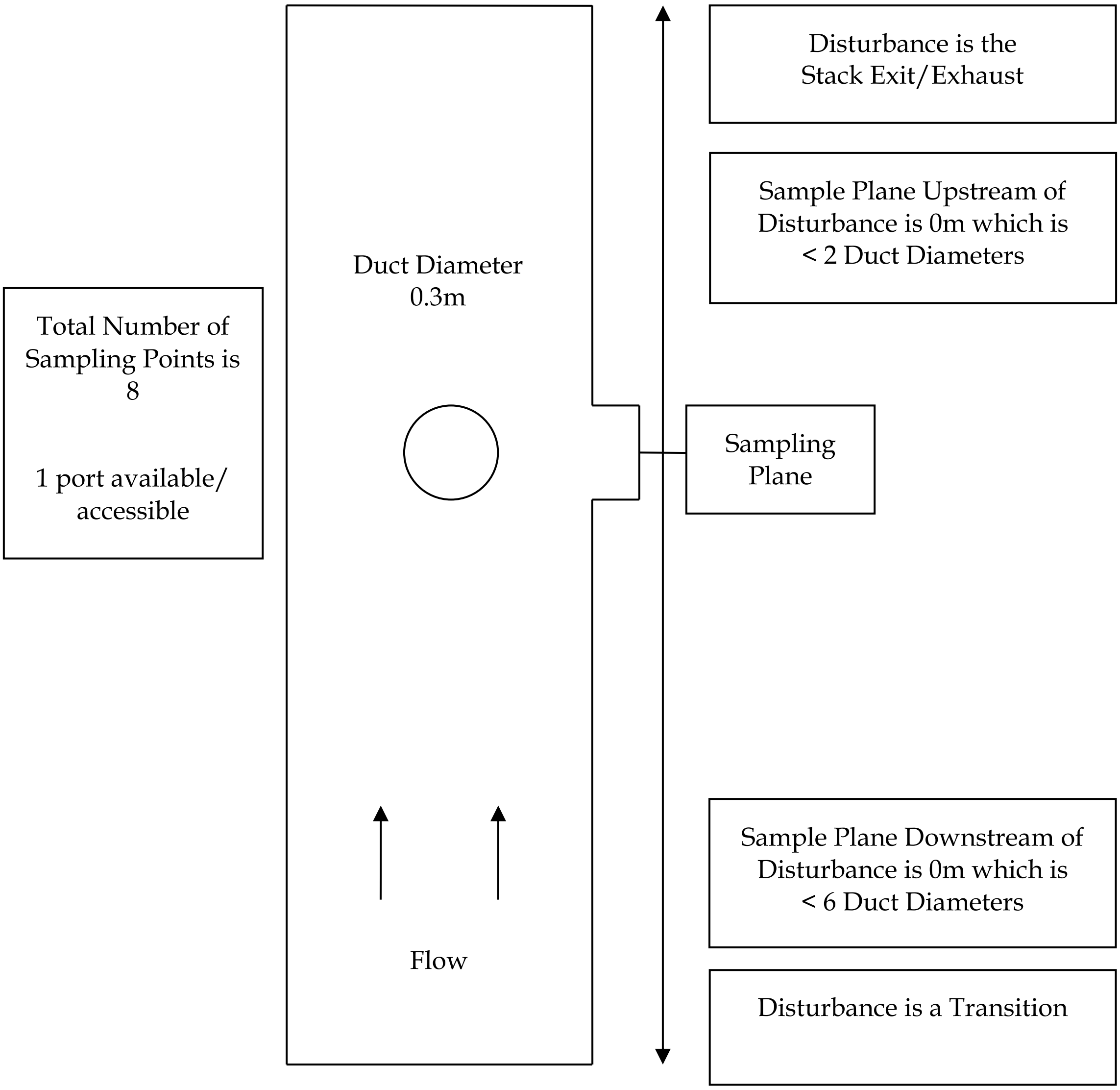


In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does meet this criterion. .

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-16 STARCH DRYER NO. 5 – SAMPLE LOCATION

FIGURE D-17 FERMENTERS – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

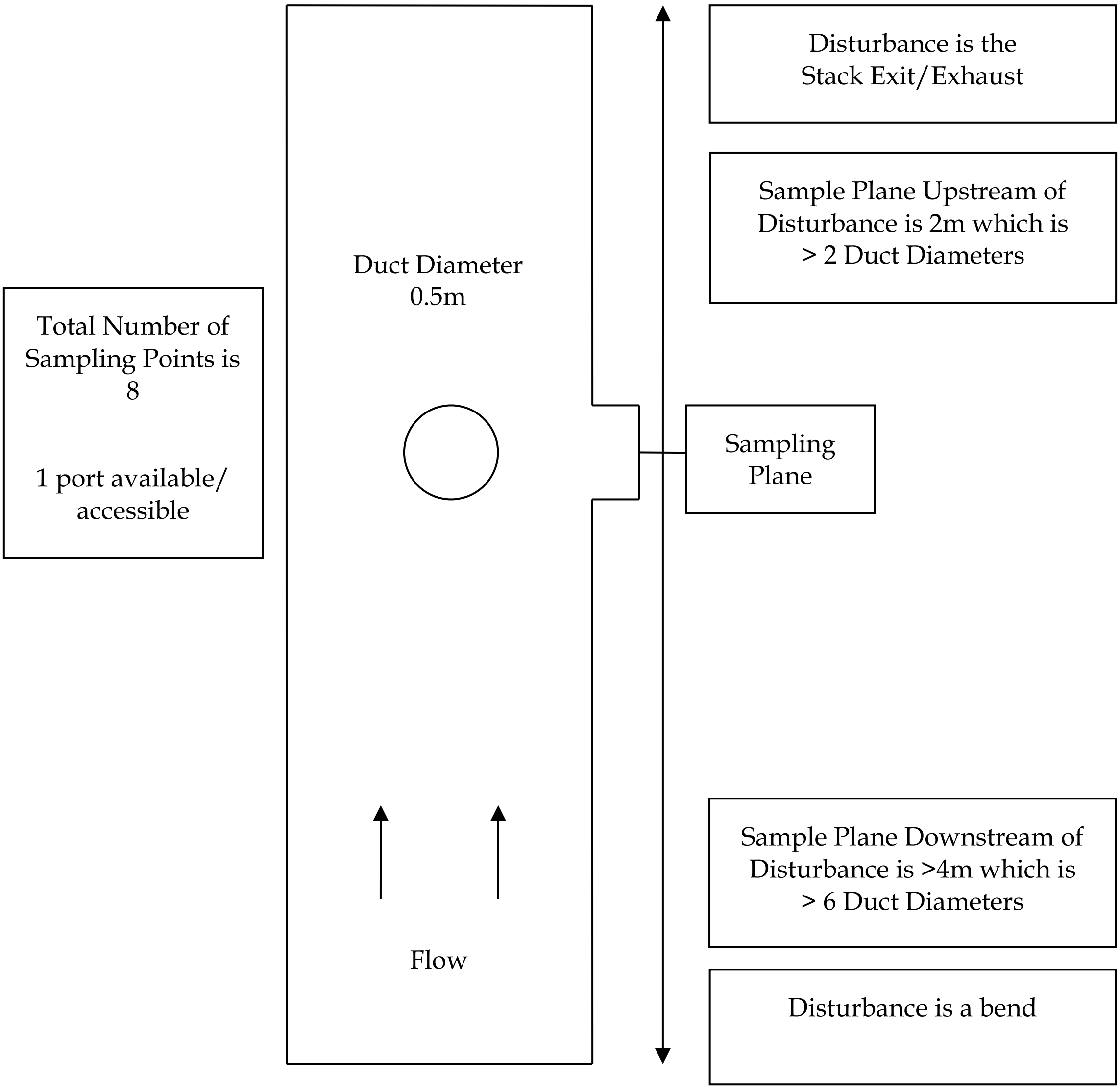
However the sample plane also does not meet the minimum sampling plane position; sampling plane position will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance. A suitable sampling plane should be sought fitting these criteria.

The sample location also does not meet the minimum number of access holes available.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of the velocity profile not meeting the minimum 3 metres per second (m/s) at any sampling point. Previous measurements were Average (0.9 m/s), maximum (1.1 m/s) and minimum (0.8 m/s) velocity profile. Current measurements are Average (1.7 m/s), maximum (3.5 m/s) and minimum (0 m/s) velocity profile.

FIGURE D-18 FERMENTERS – SAMPLE LOCATION

FIGURE D-19 CO_2 SCRUBBER OUTLET – SAMPLE LOCATION SCHEMATIC

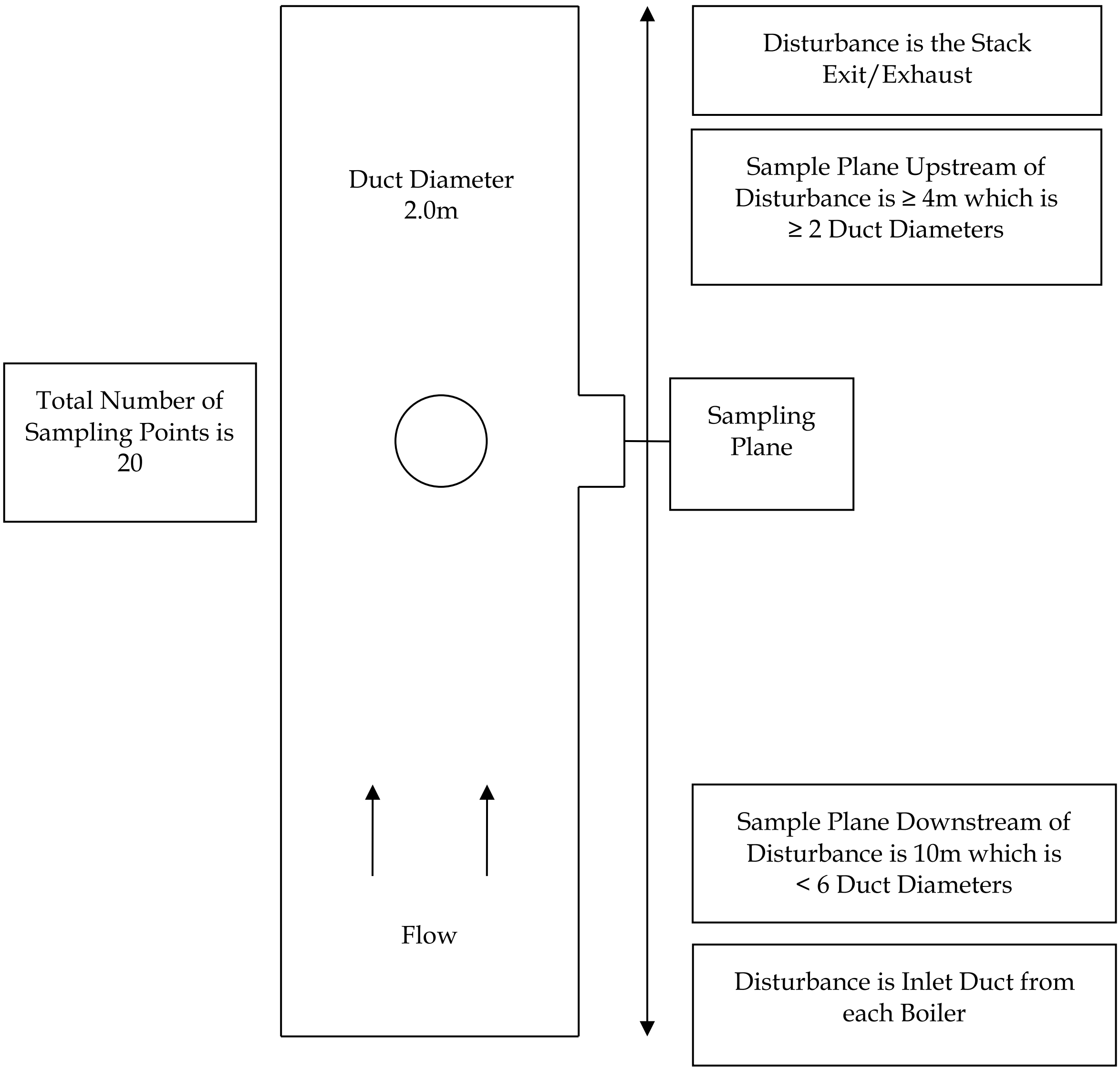


In the absence of cyclonic flow activity ideal sampling plane position will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does meet this criterion.

The sample location does not meet the minimum number of access holes available.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-20 BOILER NOS. 5 & 6 – SAMPLE LOCATION SCHEMATIC



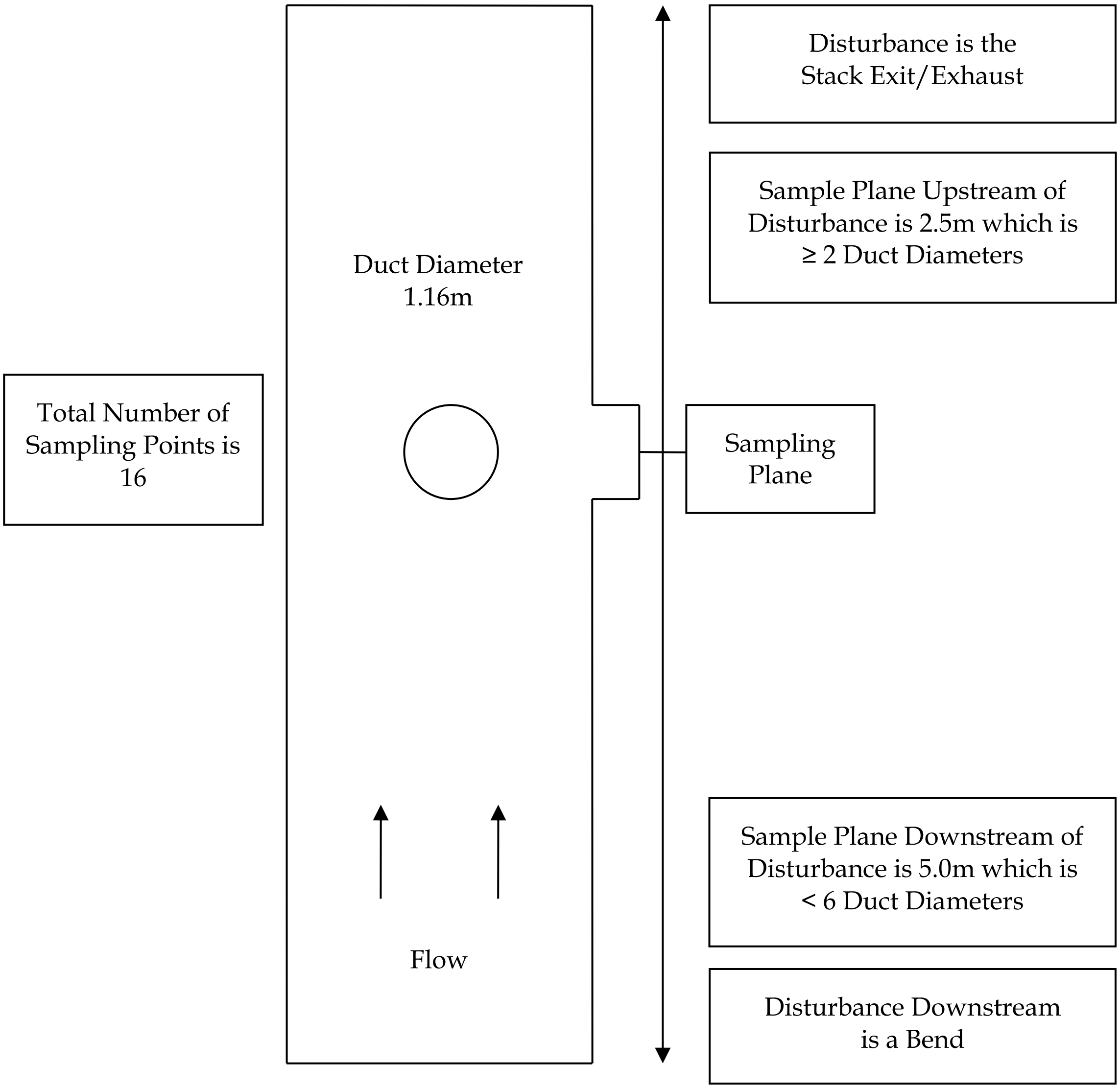
In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-21 BOILER NOS. 5 & 6 – SAMPLE LOCATION

FIGURE D-22 BOILER NO. 4– SAMPLE LOCATION SCHEMATIC



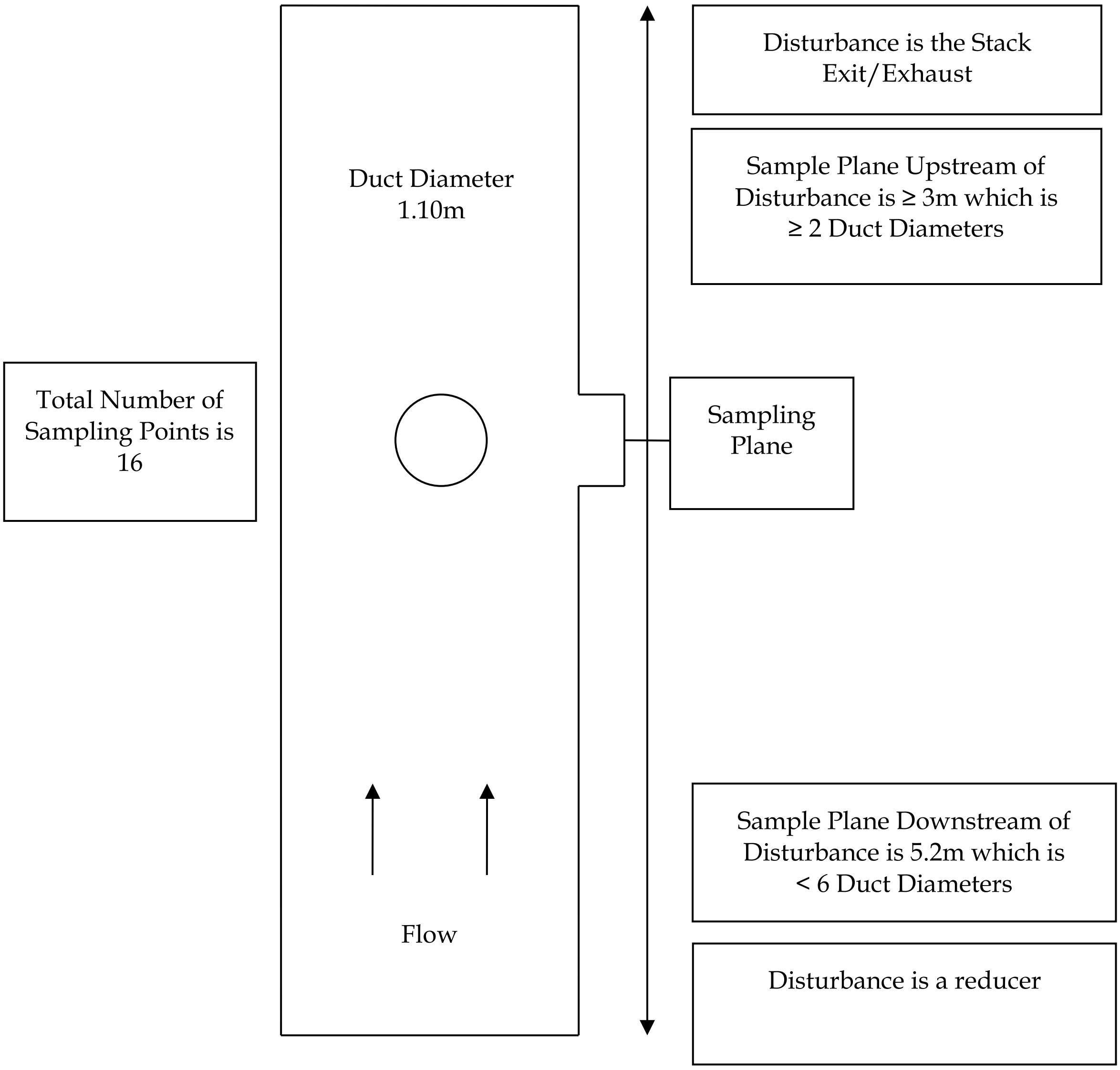
In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-23 BOILER NO 4 – SAMPLE LOCATION

FIGURE D-24 BOILER NO 2 – SAMPLE LOCATION SCHEMATIC

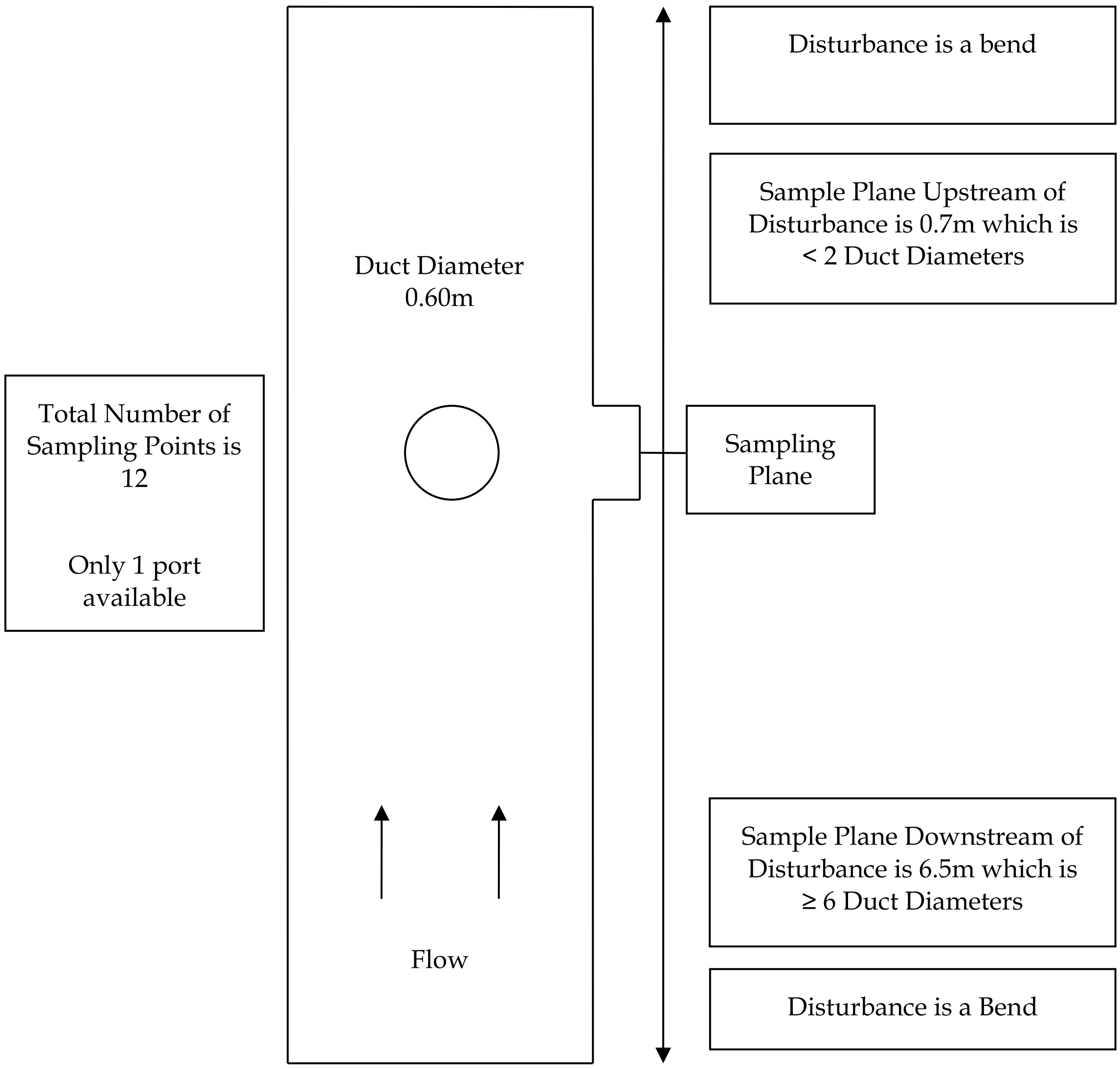


In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-25 BIOFILTER INLET – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

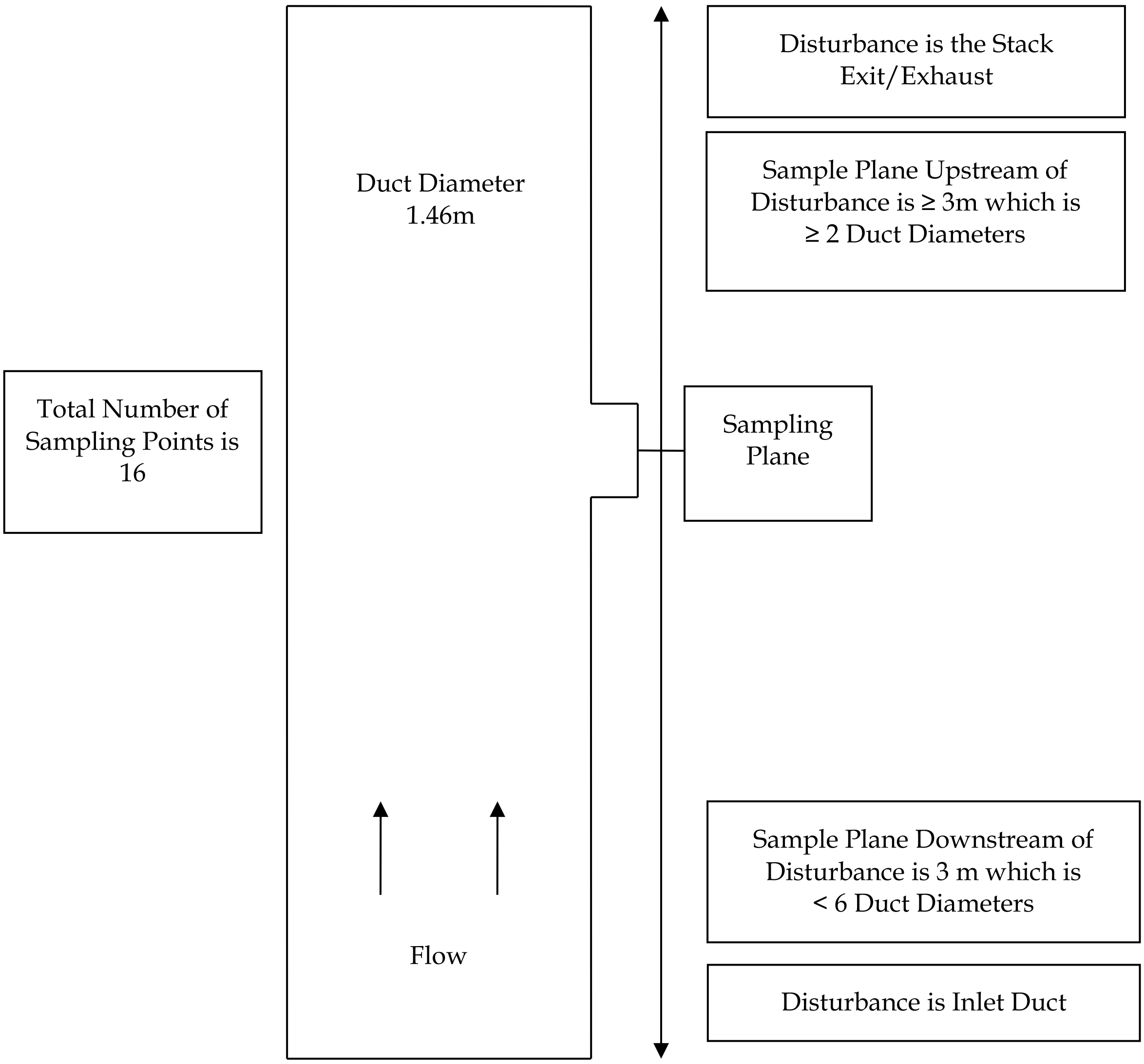
The sample plane also does not meet the minimum number of access points required. Additional sample points were used in compliance with AS4323.1.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling with the exception of velocity meeting the minimum velocity of 3m/s at every sampling point. Maximum = 5.2 m/s, Average = 2.4 m/s, Minimum = 1.0 m/s.

FIGURE D-26 BIOFILTER OUTLET EAST EPL ID 40 & 41 – SAMPLE LOCATION

FIGURE D-27 BIOFILTER OUTLET WEST EPL ID 41 – SAMPLE LOCATION

FIGURE D-28 DDG PELLET PLANT STACK – SAMPLE LOCATION SCHEMATIC



In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

The sample plane however does meet the minimum sampling plane conditions; sampling plane conditions will be found to exist at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

FIGURE D-29 DDG PELLET PLANT STACK – SAMPLE LOCATION PHOTOGRAPH

Ektimo

TO: John Studdert
COMPANY: Manildra Group
EMAIL: john.studdert@manildra.com.au
DATE: 22 December 2021
PAGE: 1 of 11
FROM: Zoe Parker
OUR REF: R012021p

RE: Preliminary Report

This is a preliminary report and the results contained herein should be used as an indication only. A final report will be issued subsequent to the results being verified.

LICENCE COMPARISON

The following licence comparison table shows that all analytes highlighted in green are below the licence limit set by the NSW EPA as per licence 883 (last amended on 9 November 2021).

EPA No.	Pollutant	Units	Limit	Detected values	Detected Values (corrected to 7% O2)
Gas Fired Boiler 1	Volatile organic compounds (as n-propane equilvalent)	mg/m^3	NA	8.2	NA
Gas Fired Boiler 3	Volatile organic compounds (as n-propane equilvalent)	mg/m^3	NA	71	NA
Gas Fired Boiler 7	Volatile organic compounds (as n-propane equilvalent)	mg/m^3	NA	0.18	NA
EPA ID 35 - Combined Boiler 5 & 6	Volatile organic compounds (as n-propane equilvalent)	mg/m^3	40	<4	<4
EPA ID 45 - Boiler 2	Volatile organic compounds (as n-propane equilvalent)	mg/m^3	40	0.12	0.18

Regards

Zoe Parker
Zoe.parker@ektimo.com.au

RESULTS

Gas Fired Boiler 1

Date	8/12/2021	**Client**	Manildra Group
Report	R012021	**Stack ID**	Gas Fired Boiler 1
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		

Sampling Plane Details	
Sampling plane dimensions	2500 x 1600 mm
Sampling plane area	4 m²
Sampling port size, number	1 x 10mm hole
Access & height of ports	Stairs 11 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Change in diameter 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	0 0
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments

Velocity could not be measured due to inadequate access for the sampling gear and surrounding infastructure prohibited access.
Sampling plane dimensions are estimations only due to access constraints.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Total VOCs (as n-Propane)	Results	
	Concentration	
	ppm	mg/m³
C1-C4	10	7.5
C5-C20	0.18	0.68
Total	11	8.2

VOC's C1-C4	Results	
Sampling time	1419-1422	
	Concentration	
	ppm	mg/m³
Methane	3.8	2.7
Ethane	<1	<1
Ethylene	<1	<1
Acetylene	<1	<1
Propane	<1	<2
Cyclopropane	<1	<2
Propylene	<1	<2
Propadiene	<1	<2
Isobutane	<1	<3
n-Butane	<1	<3
1-Butene	<1	<3
Propyne	<1	<2
trans-2-Butene	<1	<3
cis-2-Butene	<1	<3
1,3-Butadiene	<1	<2

Ektimo

Date	8/12/2021	**Client**	Manildra Group
Report	R012021	**Stack ID**	Gas Fired Boiler 1
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		

VOC (speciated)	Results	
Sampling time	1317-1418	
	Concentration	
	ppm	mg/m^3
Detection limit(1)	<0.009	<0.04
Toluene	0.28	1.2
Acetone	0.063	0.16

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Gas Fired Boiler 3

Date	8/12/2021	**Client**	Manildra Group
Report	R012021	**Stack ID**	Gas Fired Boiler 3
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		211208

Sampling Plane Details	
Sampling plane dimensions	2140 x 630 mm
Sampling plane area	1.35 m²
Sampling port size, number	1 x 15mm hole
Access & height of ports	Stairs 0 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Change in diameter 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments

Sampling plane dimensions are estimations only due to access constraints.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	4.3	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.63	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1325 & 1435	
Temperature, °C	283	
Temperature, K	556	
Velocity at sampling plane, m/s	24	
Volumetric flow rate, actual, m³/s	32	
Volumetric flow rate (wet STP), m³/s	16	
Volumetric flow rate (dry STP), m³/s	15	
Mass flow rate (wet basis), kg/hour	72000	
Velocity difference, %	-1	

Total VOCs (as n-Propane)	Results		
	Concentration		Mass Rate
	ppm	mg/m³	g/min
C1-C4	99	71	64
C5-C20	0.064	0.17	0.15
Total	99	71	64

Ektimo

Date	8/12/2021	**Client**	Manildra Group
Report	R012021	**Stack ID**	Gas Fired Boiler 3
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		211208

VOC's C1-C4	Results		
Sampling time	1429-1432		
	Concentration		Mass Rate
	ppm	mg/m^3	g/min
Methane	36	26	23
Ethane	<1	<1	<1
Ethylene	<1	<1	<1
Acetylene	<1	<1	<1
Propane	<1	<2	<2
Cyclopropane	<1	<2	<2
Propylene	<1	<2	<2
Propadiene	<1	<2	<2
Isobutane	<1	<3	<2
n-Butane	<1	<3	<2
1-Butene	<1	<3	<2
Propyne	<1	<2	<2
trans-2-Butene	<1	<3	<2
cis-2-Butene	<1	<3	<2
1,3-Butadiene	<1	<2	<2

VOC (speciated)	Results		
Sampling time	1327-1428		
	Concentration		Mass Rate
	ppm	mg/m^3	g/min
Detection limit(1)	<0.009	<0.04	<0.03
Acetone	0.085	0.22	0.2

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Ektimo

Gas Fired Boiler 7

Date	8/12/2021	**Client**	Manildra Group
Report	R012021	**Stack ID**	Gas Fired Boiler 7
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		*211208*

Sampling Plane Details	
Sampling plane dimensions	2140 x 600 mm
Sampling plane area	1.28 m²
Sampling port size, number	1 x 10mm hole
Access & height of ports	Stairs 13 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Change in diameter 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1 (1995)	Non-compliant

Comments

Sampling plane dimensions are estimations only due to access constraints.
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	4.3	
Gas molecular weight, g/g mole	28.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.63	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1413 & 1522	
Temperature, °C	284	
Temperature, K	557	
Velocity at sampling plane, m/s	40	
Volumetric flow rate, actual, m³/s	51	
Volumetric flow rate (wet STP), m³/s	25	
Volumetric flow rate (dry STP), m³/s	24	
Mass flow rate (wet basis), kg/hour	120000	
Velocity difference, %	-2	

Total VOCs (as n-Propane)	Results		
	Concentration		Mass Rate
	ppm	mg/m³	g/min
C1-C4	<5	<4	<6
C5-C20	0.057	0.18	0.27
Total	0.057	0.18	0.27

Ektimo

Date	8/12/2021	**Client**	Manildra Group
Report	R012021	**Stack ID**	Gas Fired Boiler 7
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		211208

VOC's C1-C4	Results		
Sampling time	1517-1520		
	Concentration		Mass Rate
	ppm	mg/m³	g/min
Methane	<2	<1	<2
Ethane	<1	<1	<2
Ethylene	<1	<1	<2
Acetylene	<1	<1	<2
Propane	<1	<2	<3
Cyclopropane	<1	<2	<3
Propylene	<1	<2	<3
Propadiene	<1	<2	<3
Isobutane	<1	<3	<4
n-Butane	<1	<3	<4
1-Butene	<1	<3	<4
Propyne	<1	<2	<3
trans-2-Butene	<1	<3	<4
cis-2-Butene	<1	<3	<4
1,3-Butadiene	<1	<2	<3

VOC (speciated)	Results		
Sampling time	1415-1516		
	Concentration		Mass Rate
	ppm	mg/m³	g/min
Detection limit(1)	<0.009	<0.04	<0.05
Toluene	0.052	0.21	0.31
Acetone	0.042	0.11	0.16

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Ektimo

EPA ID 35 – Combined Boiler 5 & 6

Date	8/12/2021	**Client**	Manildra Group
Report	R012021	**Stack ID**	EPA ID 35 - Boiler 5 & 6 Combined Stack
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		211207

Sampling Plane Details	
Sampling plane dimensions	1985 mm
Sampling plane area	3.09 m²
Sampling port size, number & depth	4" BSP (x4), 100 mm
Access & height of ports	Stairs & ladders 40 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal

Comments

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	7.4	
Gas molecular weight, g/g mole	29.5 (wet)	30.4 (dry)
Gas density at STP, kg/m³	1.32 (wet)	1.36 (dry)
Gas density at discharge conditions, kg/m³	0.92	
% Oxygen correction & Factor	7 %	1.14
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1035 & 1240	
Temperature, °C	120	
Temperature, K	393	
Velocity at sampling plane, m/s	14	
Volumetric flow rate, actual, m³/s	42	
Volumetric flow rate (wet STP), m³/s	29	
Volumetric flow rate (dry STP), m³/s	27	
Mass flow rate (wet basis), kg/hour	140000	
Velocity difference, %	-8	

Date	8/12/2021	Client	Manildra Group
Report	R012021	Stack ID	EPA ID 35 - Boiler 5 & 6 Combined Stack
Licence No.	883	Location	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	State	NSW
Process Conditions	Please refer to client records.		211207

Total VOCs (as n-Propane)	Results			
	Concentration		Corrected to 7% O2	Mass Rate
	ppm	mg/m³	mg/m³	g/min
C1-C4	<5	<4	<4	<6
C5-C20	<0.02	<0.03	<0.04	<0.06
Total	<5	<4	<4	<6

VOC's C1-C4	Results			
Sampling time	1218-1222			
	Concentration		Corrected to 7% O2	Mass Rate
	ppm	mg/m³	mg/m³	g/min
Methane	<2	<1	<2	<2
Ethane	<1	<1	<2	<2
Ethylene	<1	<1	<1	<2
Acetylene	<1	<1	<1	<2
Propane	<1	<2	<2	<3
Cyclopropane	<1	<2	<2	<3
Propylene	<1	<2	<2	<3
Propadiene	<1	<2	<2	<3
Isobutane	<1	<3	<3	<4
n-Butane	<1	<3	<3	<4
1-Butene	<1	<3	<3	<4
Propyne	<1	<2	<2	<3
trans-2-Butene	<1	<3	<3	<4
cis-2-Butene	<1	<3	<3	<4
1,3-Butadiene	<1	<2	<3	<4

VOC (speciated)	Results			
Sampling time	1052-1152			
	Concentration		Corrected to 7% O2	Mass Rate
	ppm	mg/m³	mg/m³	g/min
Detection limit(1)	<0.009	<0.04	<0.04	<0.06
Acetone	<0.01	<0.04	<0.04	<0.06

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Ektimo

EPA ID 45 – Boiler 2

Date	7/12/2021	**Client**	Manildra Group
Report	R012021	**Stack ID**	EPA ID 45 - Boiler 2
Licence No.	883	**Location**	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	**State**	NSW
Process Conditions	Please refer to client records.		*211203*

Sampling Plane Details	
Sampling plane dimensions	1070 mm
Sampling plane area	0.899 m²
Sampling port size, number & depth	4" Flange (x2), 180 mm
Access & height of ports	Ladders 20 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter 5 D
No. traverses & points sampled	2 16
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal

Comments

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	5.9	
Gas molecular weight, g/g mole	29.3 (wet)	30.0 (dry)
Gas density at STP, kg/m³	1.31 (wet)	1.34 (dry)
Gas density at discharge conditions, kg/m³	0.75	
% Oxygen correction & Factor	7 %	1.47
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1055 & 1245	
Temperature, °C	201	
Temperature, K	474	
Velocity at sampling plane, m/s	8.8	
Volumetric flow rate, actual, m³/s	7.9	
Volumetric flow rate (wet STP), m³/s	4.5	
Volumetric flow rate (dry STP), m³/s	4.3	
Mass flow rate (wet basis), kg/hour	21000	
Velocity difference, %	-9	

Date	7/12/2021	Client	Manildra Group
Report	R012021	Stack ID	EPA ID 45 - Boiler 2
Licence No.	883	Location	Bomaderry
Ektimo Staff	Zoe Parker & Ahmad Ramiz	State	NSW
Process Conditions	Please refer to client records.		211203

Total VOCs (as n-Propane)	Results			
	Concentration		Corrected to 7% O2	Mass Rate
	ppm	mg/m^3	mg/m^3	g/min
C1-C4	<5	<4	<6	<1
C5-C20	0.048	0.12	0.18	0.032
Total	0.048	0.12	0.18	0.032

VOC's C1-C4	Results			
Sampling time	1208-1212			
	Concentration		Corrected to 7% O2	Mass Rate
	ppm	mg/m^3	mg/m^3	g/min
Methane	<2	<1	<2	<0.4
Ethane	<1	<1	<2	<0.3
Ethylene	<1	<1	<2	<0.3
Acetylene	<1	<1	<2	<0.3
Propane	<1	<2	<3	<0.5
Cyclopropane	<1	<2	<3	<0.5
Propylene	<1	<2	<3	<0.5
Propadiene	<1	<2	<3	<0.5
Isobutane	<1	<3	<4	<0.7
n-Butane	<1	<3	<4	<0.7
1-Butene	<1	<3	<4	<0.6
Propyne	<1	<2	<3	<0.5
trans-2-Butene	<1	<3	<4	<0.6
cis-2-Butene	<1	<3	<4	<0.6
1,3-Butadiene	<1	<2	<4	<0.6

VOC (speciated)	Results			
Sampling time	1118-1228			
	Concentration		Corrected to 7% O2	Mass Rate
	ppm	mg/m^3	mg/m^3	g/min
Detection limit[(1)]	<0.008	<0.03	<0.05	<0.008
Acetone	0.063	0.16	0.24	0.042

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Appendix D

GE Power manufacturer design specifications and emissions guarantees for proposed gas-fired co-generation plant

Property	Units	LM2500+ 100% GT Load	LM2500+ 100% GT Load	LM2500+ 94.3% GT Load	LM2500+ 70% GT Load	Fresh Air Firing
Gas Turbine Exhaust Flow	lb/hr	690,988	690,988	674,615	560,063	677,789
Stack Exhaust Flow	kg/s	87.82	87.82	85.89	71.80	87.18
Stack Exhaust Flow	lb/hr	-	696,996	681,678	569,851	691,916
Gas Turbine Exhaust Temperature	deg F	990.86	990.86	961.00	997.00	59.00
Stack Exhaust Temperature	deg C	532.80	101.72	101.92	98.73	100.91
		-	-	-	-	-
Actual exhaust flow at stack	m3/s	206.61	96.65	94.54	78.35	95.30
Stack exhuast velocity	m/s	37.74	16.88	16.51	13.68	16.64
Bypass/HRSG Stack Diameter	m	2.64	2.70	2.70	2.70	2.70
		-	-	-	-	-
Nitrogen Oxides, NOx as NO2	mg/Sm3, dry @15%O2	30.84	38.74	38.91	38.86	135.67
Carbon Monoxides, CO	mg/Sm3, dry @15%O2	45.07	48.61	48.66	91.78	56.53
Non-Methane, VOC as CH4	mg/Sm3, dry @15%O2	2.19	3.26	3.33	3.32	5.65
Sulfur Dioxide, SO2	mg/Sm3, dry @15%O2	3.21	3.21	3.28	3.28	3.20
Particulate	mg/Sm3, dry @15%O2	9.32	7.33	7.48	7.50	2.83
		-	-	-	-	-
Nitrogen Oxides, NOx as NO2	mg/m3 act.	10.01	38.73	38.06	37.99	98.78
Carbon Monoxides, CO	mg/m3 act.	14.62	48.60	47.60	89.72	41.16
Non-Methane, VOC as CH4	mg/m3 act.	0.71	3.26	3.26	3.25	4.12
Sulfur Dioxide, SO2	mg/m3 act.	1.04	3.21	3.21	3.21	2.33
articulate	mg/m3 act.	3.03	7.33	7.32	7.33	2.06
		-	-	-	-	-
O2 fraction in the exhaust	w/w	0.1529	0.1196	0.1218	0.1221	0.1524
H2O fraction in the exhaust	w/w	0.0456	0.0629	0.0618	0.0616	0.0419

GUARANTEE

PROJECT: MANILDRA NOWRA COGENERATION PLANT

LOCATION: AUSTRALIA

UNIT NET, KW	27128
BTU/KW-HR, LHV	9530
(KJ/KW-HR, LHV)	10053

EMISSIONS ARE VALID FOR T2 WITHIN 41°F-100°F AND A GTG LOAD DOWN TO 60% AS DEFINED IN STEADY STATE CONDITIONS FOR EMISSIONS GUARANTEE PROVIDED OPERATION IS IN ABC OR AB MODE ONLY

NOX: 15 PPMVD AT 15% O2 (31 mg/Nm3)

CO: 36 PPMVD AT 15% O2 (45 mg/Nm3)

K. Wacko

Wacko, Kamil
Performance Engineer
Date: 06-30-21

NOT VALID WITHOUT SIGNATURE

VALID UNTIL 09-30-21

BASIS OF GUARANTEE:	GAS FUEL NOZZLE SYSTEM NO BLEED OR EXTRACTED POWER
ENGINE:	(1) GE LM2500+ DLE GAS TURBINE
FUEL:	19910 Btu/lb / (46312 kJ/kg) LHV
FUEL SPEC:	MID-TD-0000-1 LATEST REVISION
FUEL TEMP:	SITE FUEL TEMPERATURE OF 77.0°F (25.0°C)
FUEL PRESS:	520 PSIG+/-20 PSIG (3585 KPAG+/-138 KPAG)
GENERATOR:	BDAX 71-193 ER
GENERATOR OUTPUT	11.0 kV, 50 Hz
POWER FACTOR:	0.85
AMBIENT TEMP:	59.0°F / (15.0°C)
AMBIENT RH:	60.0%
INLET CONDITIONING:	NONE
ALTITUDE:	0.0 ft / (0.0 m)
INLET FILTER LOSS:	4.5 inH_2O / (114.3 mmH_2O)
EXHAUST LOSS:	16.5 inH_2O / (419.1 mmH_2O)
NOX CONTROL:	DLE
ENGINE CONDITION:	NEW AND CLEAN ≤ 200 SITE FIRED HOURS
FIELD TEST METHODS	
PERFORMANCE:	GE POWER SGTGPTM
NOX:	EPA METHOD 20
CO:	EPA METHOD 10

BASIS OF GUARANTEE IS NOT FOR DESIGN, REFER TO PROJECT DRAWINGS FOR DESIGN REQUIREMENTS.
SI VALUES ARE FOR REFERENCE PURPOSES ONLY.

THIS GUARANTEE SUPERSEDES ANY PREVIOUS GUARANTEES PRESENTED

GUARANTEE
PROJECT: MANILDRA NOWRA COGENERATION PLANT
LOCATION: AUSTRALIA

NEAR FIELD NOISE:

85 DB(A) ARITHMETIC AVERAGE SOUND PRESSURE LEVEL (dB REF 20 MICROPASCALS, RMS) OF LOCATIONS AROUND THE PACKAGE (VERTICAL DISTANCE OF 5FT. (1.5M) ABOVE PACKAGE BASE AT A HORIZONTAL DISTANCE OF 3FT. (1M) FROM THE EXTERIOR PLANE OF EQUIPMENT AS TESTED IN A FREE-FIELD CONDITION OVER A HARD REFLECTING GROUND PLANE, OPERATING AT BASE LOAD)

K. Wacko

Wacko, Kamil
Performance Engineer
Date: 06-30-21

NOT VALID WITHOUT SIGNATURE

VALID UNTIL 09-30-21

BASIS OF GUARANTEE:	GAS FUEL NOZZLE SYSTEM NO BLEED OR EXTRACTED POWER
ENGINE:	(1) GE LM2500+ DLE GAS TURBINE
FUEL:	19910 Btu/lb / (46312 kJ/kg) LHV
FUEL SPEC:	MID-TD-0000-1 LATEST REVISION
FUEL TEMP:	SITE FUEL TEMPERATURE OF 77.0°F (25.0°C)
FUEL PRESS:	520 PSIG+/-20 PSIG (3585 KPAG+/-138 KPAG)
GENERATOR:	BDAX 71-193 ER
GENERATOR OUTPUT	11.0 kV, 50 Hz
POWER FACTOR:	0.85
AMBIENT TEMP:	59.0°F / (15.0°C)
AMBIENT RH:	60.0%
INLET CONDITIONING:	NONE
ALTITUDE:	0.0 ft / (0.0 m)
INLET FILTER LOSS:	4.5 inH_2O / (114.3 mmH_2O)
EXHAUST LOSS:	16.5 inH_2O / (419.1 mmH_2O)
NOX CONTROL:	DLE
ENGINE CONDITION:	NEW AND CLEAN ≤ 200 SITE FIRED HOURS
NEAR FIELD NOISE:	GE ACOUSTIC TESTING PROCEDURE AND ASME PTC-36-2004

BASIS OF GUARANTEE IS NOT FOR DESIGN, REFER TO PROJECT DRAWINGS FOR DESIGN REQUIREMENTS.
SI VALUES ARE FOR REFERENCE PURPOSES ONLY.

THIS GUARANTEE SUPERSEDES ANY
PREVIOUS GUARANTEES PRESENTED

GE POWER

Normal Operating Auxiliary and BOP Loads for 1xLM2500+ 6 Stage-DLE GAS FUEL 50Hz on Gas Fuel
June 30, 2021

STANDARD LOADS		
DESCRIPTION	**QTY**	**KW**
TURBINE ENCLOSURE VENT FAN A	1	45
TURBINE/GENERATOR LUBE OIL HEAT EXCHANGER FAN A	1	7.5
GENERATOR AC LUBE OIL PUMP	1	2.2
LIGHTING AND DISTRIBUTION PANEL	1	45
TOTAL STANDARD LOADS:		**99.7**

BOP ELECTRICAL LOADS		
DESCRIPTION	**QTY**	**KW**
FIN FAN COOLER	1	25
FIN FAN HEATER	1	12
GUILLOTINE WITH SEALING AIR FAN	1	10
DIVERTER DAMPER/BYPASS STACK	1	10
AIR COMPRESSOR WITH DRYER & RECEIVER	1	45
AIR CRAFT	1	3
CONTROLLER CABINET (RX3I / MARK VIE)	1	1
HMI	1	0.5
NETWORK RACK	1	0.5
HVAC PANEL IN CONTROL ROOM (PCM)	1	11
FIRE FIGHTING PANEL	1	1
ANTI CONDENSATION (HEATERS) FOR SWITCHGEAR	5	0.25
SPARE	1	5.5
SPARE	1	5.5
TOTAL BOP LOADS:		**130.3**

TOTAL LOADS: 230.0

Steady State Conditions for Emissions Guarantee

1.	Power Output (electrical)	±10.0% / Min
2.	T2 Compressor Inlet air temperature	± 2.5°F / 5.0 Min
3.	Heat Value - gaseous fuel per unit volume	±0.25% / Min
4.	Pressure - gaseous fuel as supplied to engine	± 10 PSIG / 5.0 Min

Conditions for Near Field Noise Guarantee

1. Based on arithmetic average of sound pressure levels at locations around the package.
2. Ancillary skids of the package must be located less than 6-ft of each other, and less than 6-ft of the main unit, measuring nearest edge-to-edge. If the package configuration requires the ancillary skids to be placed 6-ft or more from each other, then the ancillary skids must be located at least 10-ft apart.
3. If Fin Fan Cooler is to be located in front of the main unit (i.e. LM2X), then its location must be at least 10-ft away from the main unit, measuring nearest edge-to-edge. GE Power is to advise best location.
4. If Fin Fan Cooler is to be located broadside to the main unit, then its location must be at least 25-ft away from the main unit, measuring nearest edge-to-edge. GE Power is to advise best location.
5. If Fin Fan Cooler is to be located behind the generator end of the main unit, then its location must be at least 10-ft behind the generator end of the package, and off to one side, measuring nearest edge-to-edge, to avoid infringement on the rotor removal area. GE Power is to advise best location.
6. Ancillary skids of the package must be located at least 10-ft away from Fin Fan Cooler, measuring nearest edge-to-edge.
7. Per unit basis.
8. Base-load operation only.
9. GE Power GTG package scope of supply only, customer supplied equipment is not included.
10. GE Power GTG package scope of supply only, GE Power supplied BOP equipment is not included.
11. If GE Power supplies BOP equipment, then GE Power is to advise best location.

Estimated Average Engine Performance NOT FOR GUARANTEE, REFER TO PROJECT F&ID FOR DESIGN

GE Power

Performance By: **Wacko, Kamil**
Project Info: **Manildra Nowra Cogeneration Plant, Australia**

Engine: **LM2500+ 6 Stage-DLE 15 GAS FUEL (PR)**
Deck Info: **8pc.pip**
Generator: **BDAX 71-193ER 50Hz, 11.0kV, 0.85PF (EffCurve#: 32368; CapCurve#: 32366)**
Fuel: **Site Gas Fuel, 19910 Btu/lb, LHV**

Date: 6/30/2021
Time: 8:23:48

Case #	**100**	
Ambient Conditions		
Dry Bulb, °F	59.0	
RH, %	60.0	
Altitude, ft	0.0	
Ambient Pressure, psia	14.696	
Engine Inlet		
Comp Inlet Temp, °F	59.0	
RH, %	60.0	
Conditioning	None	
Tons(Chilling) or kBtu/hr(Heating)	0	
Pressure Losses		
Inlet Loss, inH2O	4.50	
Exhaust Loss, inH2O	16.50	
Partload %	**94.94**	**UNIT NET**
kW, Gen Terms	**27358**	**27128**
Est. Btu/kW-hr, LHV	**--**	**9501**
Guar. Btu/kW-hr, LHV	**--**	**9530**
Auxiliary Loads, kW	230.0	
Fuel Flow		
MMBtu/hr, LHV	257.7	
lb/hr	12960	
NOx Control	**DLE**	
Control Parameters		
T3 (Comp. Discharge), °F	907.7	
T48 (LPT Inlet), °F	1480.8	
PS3 (Comp. Disch), psia	326.4	
T25 (HPC Inlet), °F	59.0	
Exhaust Parameters		
Temperature, °F	971.5	
lb/sec	187.8	
lb/hr	676080	
Energy (Ref 0R), MMBTU/hr	246.8	
Emissions (ESTIMATED, NOT FOR GUARANTEE)		
NOx ppmvd Ref 15% O2	15.0	
CO ppmvd Ref 15% O2	36.0	
EXHAUST ANALYSIS % VOL.		
Argon	0.8900	
Nitrogen	74.8700	
Oxygen	13.8000	
Carbon Dioxide	3.2700	
Water	7.1600	
Fuel Composition (Volume %) for Stream		
Methane - CH4	91.6026	
Ethane - C2H6	4.6628	
Propane - C3H8	0.3776	
i-Butane - C4H10	0.0408	
n-Butane - C4H10	0.0453	
i-Pentane - C5H12	0.0121	
n-Pentane - C5H12	0.0099	
n-Hexane - C6H14	0.0325	
n-Heptane - C7H16	0.0010	
Carbon Dioxide - CO2	1.9583	
Nitrogen - N2	1.2650	
Oxygen - O2	0.0006	
n-Octane - C8H18	0.0003	
n-Nonane - C9H20	0.0003	
Fuel LHV, BTU/lb	19910.7	
Fuel Temperature, deg F	77.0	
Molecular Weight, lb/lbmol	17.6	
HHV, BTU/lb	22076.9	
NOx Scalar	0.98	
Specific Gravity	0.61	
MWI, (Btu/SCF)/SQRT(R)	48.925	

Estimated Average Engine Performance NOT FOR GUARANTEE, REFER TO PROJECT F&ID FOR DESIGN

GE Power

Performance By: **Wacko, Kamil**
Project Info: **Manildra Nowra Cogeneration Plant, Australia**

Engine: **LM2500+ 6 Stage-DLE 15 GAS FUEL (PR)**
Deck Info: **8pc.pip**
Generator: **BDAX 71-193ER 50Hz, 11.0kV, 0.85PF (EffCurve#: 32368; CapCurve#: 32366)**
Fuel: **Site Gas Fuel, 46312 kJ/kg, LHV**

Date: 6/30/2021
Time: 8:23:48

Case #	**100**	
Ambient Conditions		
Dry Bulb, °C	15.0	
RH, %	60.0	
Altitude, m	0.0	
Ambient Pressure, Bars	1.013	
Engine Inlet		
Comp Inlet Temp, °C	15.0	
RH, %	60.0	
Conditioning	None	
Tons(Chilling) or kBtu/hr(Heating)	0	
Pressure Losses		
Inlet Loss, mmH2O	114.30	
Exhaust Loss, mmH2O	419.10	
Partload %	**94.94**	**UNIT NET**
kW, Gen Terms	**27358**	**27128**
Est. kJ/kW-hr, LHV	**--**	**10023**
Guar. kJ/kW-hr, LHV	**--**	**10053**
Auxiliary Loads, kW	230.0	
Fuel Flow		
GJ/hr, LHV	271.9	
kg/hr	5879	
NOx Control	**DLE**	
Control Parameters		
T3 (Comp. Discharge), °C	486.5	
T48 (LPT Inlet), °C	804.9	
PS3 (Comp. Disch), kPa	2247.7	
T25 (HPC Inlet), °C	15.0	
Exhaust Parameters		
Temperature, °C	522.0	
kg/sec	85.3	
kg/hr	307000	
Exhaust Energy, GJ/hr - Ref T2	169.2	
Emissions (ESTIMATED, NOT FOR GUARANTEE)		
NOx mg/Nm3 Ref 15% O2	31	
CO mg/Nm3 Ref 15% O2	45	
Exhaust Analysis % vol. (NOT FOR USE IN ENVIRONMENTAL PERMITS)		
Argon	0.89	
Nitrogen	74.87	
Oxygen	13.80	
Carbon Dioxide	3.27	
Water	7.16	
Fuel Composition (Volume %) for Stream		
Methane - CH4	91.6026	
Ethane - C2H6	4.6628	
Propane - C3H8	0.3776	
i-Butane - C4H10	0.0408	
n-Butane - C4H10	0.0453	
i-Pentane - C5H12	0.0121	
n-Pentane - C5H12	0.0099	
n-Hexane - C6H14	0.0325	
n-Heptane - C7H16	0.0010	
Carbon Dioxide - CO2	1.9583	
Nitrogen - N2	1.2650	
Oxygen - O2	0.0006	
n-Octane - C8H18	0.0003	
n-Nonane - C9H20	0.0003	
Fuel LHV, kJ/kg	46312	
Fuel Temperature, deg C	25.0	
Molecular Weight, kg/kgmol	17.57	
HHV, kJ/kg	51351	
NOx Scalar	0.98	
Specific Gravity	0.61	
MWI, (kJ/Nm3) /SQRT(K)	51.281	

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→ The Power of Commitment

APPENDIX F – ODOUR COMPLAINT RECORDS

MANILDRA GROUP OF COMPANIES

Environmental Complaint

Complaint No: CC-ESHOAL064

Customer Code: SCUST90123

Date Lodged: 11-Oct-2021

Customer:	Environmental Protection Authority (EPA) Queanbeyan
Batch No.: N/A	**Product:** N/A
Complaint Detail:	Odour Complaint 6 - 8 October 2021 Bomaderry
Problem:	Odour complaint received via EPA on 11th October 2021 from resident [redacted] complaining of 'cheesy whey smell' detected on the evening of 6 October which persisted for the next two days. (see attached EPA email)
Cause Cat:	ODOUR Odour
Cause:	The likely cause of the odour was not coming from the Shoalhaven Starches premises but from local farmers applying fertiliser (chook manure) on their land.
Who To Do:	
Action Required By:	13-Oct-2021
Action:	A drive around the complainants location on the afternoon of the 11th October 2021 did not reveal any detected odours as described by the complainant, noting however the complaint was not received by Shoalhaven Starches until 5 days after the odour was detected. The complainant [redacted] was contacted Monday 11th October to discuss the details of the odour complaint and again this morning (13/10/21) to provide feedback from our investigations. We believe on this occasion the odour was not coming from the Shoalhaven Starches premises but from local farmers applying fertiliser (chook manure) on their land. We noticed a 'chook manure' smell last week, and subsequently our Farm Manager made some further enquiries and it was confirmed that some local farmers were applying chook manure on their land. During discussions with [redacted], [redacted] described the odour as a 'cheesy whey smell, like dynamic lifter', which is not consistent with the vegemite, yeasty, fermentation type odour typically associated with Shoalhaven Starches operations. [redacted] appeared satisfied with our response and indicated [redacted] would contact us in the future if [redacted] had any further concerns. See attached Shoalhaven Starches response to the EPA on 13-10-21.

MANILDRA GROUP OF COMPANIES

Environmental Complaint

Complaint No: CC-ESHOAL064

Customer Code: SCUST90123

Date Lodged: 11-Oct-2021

Review:	No further correspondence received from the complainant or EPA. No other odour complaints received. No further action taken.		
Status:	9 Closed	**Dept:**	SHOQA
Approved By:	Studdert.John	**Manufacturing Site:**	Shoalhaven Starches
Date:	18-Feb-2022	**Product Rejected:**	No
Recorded By:	Studdert.John	**Potential Claim:**	No

John Studdert

From: John Studdert
Sent: Wednesday, 13 October 2021 11:24 AM
To: 'Janine Goodwin'
Cc: Kane Livingstone; Scott Foggo
Subject: RE: Odour complaint 6-8th October

Hi Janine,

I contacted the complainant [redacted] on Monday 11th October to discuss the details of the odour complaint and again this morning to provide feedback from our investigations.

We believe on this occasion the odour was not coming from the Shoalhaven Starches premises but from local farmers applying fertiliser (chook manure) on their land.

We noticed a 'chook manure' smell last week, and subsequently our Farm Manager made some further enquiries and it was confirmed that some local farmers were applying chook manure on their land.

During discussions with [redacted] described the odour as a 'cheesy whey smell, like dynamic lifter', which is not consistent with the vegemite, yeasty, fermentation type odour typically associated with Shoalhaven Starches operations.

[redacted] appeared satisfied with our response and indicated [redacted] would contact us in the future if [redacted] had any further concerns.

Regards,

John Studdert | Quality Assurance & Environmental Coordinator
160 Bolong Rd Bomaderry, NSW 2541
[redacted]
manildra.com.au

MANILDRA GROUP
100% AUSTRALIAN OWNED

From: Janine Goodwin <Janine.Goodwin@epa.nsw.gov.au>
Sent: Monday, 11 October 2021 1:41 PM
To: John Studdert <John.Studdert@manildra.com.au>
Subject: Odour complaint 6-8th October

Dear John
Thank you for taking my call today regarding a odour complaint received by the EPA.

I have spoken with the complainant ([redacted] – contact number [redacted]) who advised she was impacted by an offensive odour on the evening of 6 October (odour described as a cheesy whey smell). This odour persisted for the next two days, easing by mid afternoon on the 8th October. [redacted] advised that [redacted] neighbours had attributed the odour to Shoalhaven Starches, and "that no one reported odour impacts to the EPA or the company as nothing is ever done about it".

Can I please get you to investigate if there were any operations or activities from the licensed premises that may have resulted, at the date and time nominated, an odour as described by the complainant

As discussed, I have provided [redacted] with Shoalhaven Starches pollution incident contact number, and encouraged [redacted] to contact the licensee and EPA should she experience offensive odours that [redacted] feels come from the premises. [redacted] would welcome a discussion with you regarding the matter.

Many thanks
Janine

Janine Goodwin
Unit Head
Regulatory Operations Regional
NSW Environment Protection Authority
[redacted]

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The EPA acknowledges the traditional custodians of the land and waters where we work. As part of the world's oldest surviving culture, we pay our respect to Aboriginal elders past, present and emerging.
Report pollution and environmental