SYDNEY HARBOUR TUNNEL: 6 MONTHLY COMPLIANCE EMISSIONS MONITORING

VENTIA PTY LTD

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Assured Environmental

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Project Reference ID: 14910

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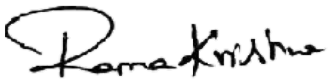

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Table 1: History of Revisions

Revision	Date	Issued to	Changes
R_0	13/06/2022	Jason Quarta	Initial report release.

ACCREDITED FOR COMPLIANCE TO ISO/IEC 17025 (TESTING)

The results of the tests, calibrations and/or measurements included in this document is traceable to Australian/national standards.

Accreditation number: 19703

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EXECUTIVE SUMMARY

Assured Environmental performed 6 monthly compliance air emissions monitoring for Ventia Pty Ltd at Sydney Harbour Tunnel Ventilation Facility on 17th and 18th of April 2023, in accordance with the New South Wales Environmental Protection Licence (Licence number – 4062), Monitoring was performed at two locations as listed below.

The relevant limits taken from condition L2.2 of EPL 4062 (licence version date 1-Sep-2022) are stated in the tables below.

Based on the comparison presented, the results of the monitoring undertaken has demonstrated compliance with the release limits provided in the site EPL for all parameters tested. The decision rule used is based on values obtained during testing without regard to uncertainty limits.

Table 2: Test summary results for Ventilation Outlet Sydney Harbour Tunnel

Parameter	Unit of measure		Test result PM		Test result PM	Licence limit
Site	-		Sydney Harbour Tunnel		Sydney Harbour Tunnel	-
Source	-		Northbound		South Bound	-
Date	dd/mm/yy		17/04/2023		18/04/2023	-
Time start	hh:mm		13:05		5:00	-
Time end	hh:mm		16:12		8:07	-
Exhaust air velocity	m/sec		23.46		27.45	-
Exhaust air temperature	°C		25.7		20.5	-
Exhaust air absolute pressure	mbar		1012		1012	-
Exhaust air moisture content	% v/v		1.67		2.00	-
Exhaust air density	kg/Nm^3		1.29		1.29	-
Exhaust air volume flow	Nm^3/sec-dry		125		148	-
Nitrogen Oxides (NOx as NO2)	mg/Nm^3		5.15		6.86	25
- Emission rate	g/sec		0.642		1.01	-
Carbon Monoxide (CO)	mg/Nm^3		3.73		1.80	40
- Emission rate	g/sec		0.464		0.266	-
Total Particulate Matter - PM	mg/Nm^3		0.152		0.099	1.1 [1]
- Emission rate	g/sec		0.0189		0.0146	-
VOCs - detectable species						
Formaldehyde	mg/Nm^3		0.0120	<	0.00304	-
Formaldehyde emission rate	g/sec		0.00149	<	0.000449	-
Acetaldehyde	mg/Nm^3		0.00598	<	0.00304	-
Acetaldehyde emission rate	g/sec		0.000744	<	0.000449	-
TVOC (as n-propane)	mg/Nm^3	<	0.604	<	1.02	4
TVOC (as n-propane) emission rate	g/sec	<	0.0751	<	0.150	-
Benzene	mg/Nm^3		0.00697		0.01046	-
Benzene emission rate	g/sec		0.000867		0.00155	-
Toluene	mg/Nm^3		0.0535		0.152	-
Toluene emission rate	g/sec		0.00665		0.0225	-
Ethyl Benzene	mg/Nm^3		0.00284		0.00948	
Ethyl Benzene emission rate	g/min		0.000354		0.00140	
m+p-Xylene	mg/Nm^3		0.00948		0.0332	-
m+p-Xylene emission rate	g/sec		0.00118		0.00490	-
o-Xylene	mg/Nm^3		0.00332		0.00948	-
o-Xylene emission rate	g/sec		0.000413		0.00140	-
1,3-butandiene	mg/Nm^3	<	0.00121	<	0.00266	-
1,3-butandiene emission rate	g/sec	<	0.000150	<	0.000392	-

[1] – Special averaging time 1 means: 1 hour, or the minimum sampling period specified in the relevant test method, whichever is the greater.

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GLOSSARY

Table 3: Abbreviations & Definitions

Abbreviation	Definition
%v/v	percent volume to volume ratio
<	The analytes tested for was not detected; the value stated is the reportable limit of detection
AE	Assured Environmental
Am^3	Gas volume in cubic metres at measured conditions
AS	Australian Standard
BH	Back half of sample train (filter holder and impingers) (referred to during sample recovery)
CARB	California Air Resources Board methods
CEMS	Continuous Emission Monitoring System
CO	Carbon monoxide
CO_2	Carbon dioxide
COC	Chain of custody
CSA	Cross sectional area
dd/mm/yyyy	day - month – year
DECC	Department of Environment & Climate Change
DP	Discharge point
dscm	dry standard cubic meters
ELS	EnviroLab Services
EPA	Environmental Protection Agency
EPL	Environmental Protection Licence
EWP	Elevated work platform
FH	Front half of sample train (probe and filter holder) (referred to during sample recovery)
g	Grams
g/g mole	gram per gram – mole
H_2O	Water
H2S	Hydrogen sulphide
H2SO3	Sulphuric acid
hh:mm	hours: minutes
ISO	International Standards Organisation
ISO17025	ISO for the General requirements for the competence of testing and calibration laboratories
kg	Kilograms
m	Metres
m/sec	metres per second
m^3	actual gas volume in cubic metres as measured
mbar	Millibars
MDL	Method detection limit
mg	Milligrams (10^{-3} grams)
min	Minute
mL	Millilitres
mm	Millimetres
mmH_2O	Millimetres of water
Mole	SI unit that measures the amount of substance
MRU	Gas analyser brand
N/A	Not applicable
NATA	National Association of Testing Authorities
NATO	North Atlantic Treaty Organisation
ng	Nanograms (10^{-9} grams)
NH_3	Ammonia
NIOSH	National institute for occupational safety and health (USA)
NM	Non-methane
Nm^3	Gas volume in dry cubic metres at standard temperature and pressure (0°C and 101.3 kPa)
NMI	National Measurement Institute
NO	Nitrogen monoxide
NO_2	Nitrogen dioxide
NPI	National Pollutant Inventory
NR	Not required on this occasion
NSW	New South Wales
O2	Oxygen

Abbreviation	Definition
°C	Degrees Celsius
OH&S	Occupational Health & Safety
OM	Other Method
OSHA	Occupational Safety and Health Act
PAH	Polycyclic Aromatic Hydrocarbon
PM	Particulate matter (total)
PM10	Particles with a diameter of 10 micrometres or less
PM2.5	Particles with a diameter of 2.5 micrometres or less
Ppb	Parts per billion
Ppm	Parts per million
PQL	Practical quantitation limit
PSD	Particle size distribution
Q1	Quarter 1
Q2	Quarter 2
Q3	Quarter 3
Q4	Quarter 4
QA	Quality assurance
QC	Quality control
RMS	Root mean square
SCAQMD	South Coast Air Quality Management District
Sec	Second
SI	Standards international
Sm^3	Gas volume in dry cubic metres at standard temperature and pressure (0°C and 101.3 kPa) and corrected to a standardised value.
SO_2	Sulphur dioxide
SO3	Sulphur trioxide
SSI	State Significant Infrastructure
STP	Standard temperature and pressure (0°C and 101.3 kPa)
TM	Test Method
TO	USEPA air toxics method
TWA	Time weighted average
USEPA	United States Environmental Protection Authority
UTM	Universal Transverse Mercator
VOC	Volatile organic compound

1 INTRODUCTION

Assured Environmental (AE) was appointed by Ventia Pty Ltd to conduct the 6 monthly compliance monitoring as required Environmental Protection Licence (EPL) number 4062, on the Ventilation Stack Outlet Southbound & Ventilation Stack Outlet Northbound release points.

The following measurements were performed:

- Solid Particles
- Carbon monoxide
- Oxides of Nitrogen
- VOC's & TVOC's

2 METHODOLOGY

The methodology for this project was selected based on the requirements of the Licence and with reference to the '*Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*' document. The methodology is listed in Table 4 below along with AE's NATA accreditation in relation to the work.

Table 4: Test scope[a]

PARAMETERS - CEMS	NSW EPA TM	Reference Test Method	NATA (ISO:17025)	Limit mg/m^3
Solid particles (total)	TM-15	AS4323.2	Yes	1.1
Carbon monoxide (CO)	TM-32	USEPA Method 10	Yes	40
Nitrogen oxides (NOx)	TM-11	USEPA Method 7E	Yes	25
Speciated VOCs[b]	TM-34	USEPA Method 18[c]	Yes	n/a
Total VOCs[d]	TM-34	USEPA Method 25A	Yes	4
Stack gas velocity	TM-2	USEPA Method 2	Yes	n/a
Volumetric flow rate	TM-2	USEPA Method 2	Yes	n/a
Moisture	TM-22	USEPA Method 4	Yes	n/a
Stack gas temperature	TM-22	USEPA Method 2	Yes	n/a

2.1 Analytical laboratories

To achieve a lower limit of detection, filters and sample rinses were analysed using a 6-point (0.001mg) balance. Sample weighing was performed inhouse by Assured Environmental (NATA ID. 19703).

[a] Refer to ADDENDUM for brief summaries of these methods.

[b] Single Summa canister sample for speciated Volatile Organic Compounds must include, but is not limited to, Benzene, Toluene, Xylenes, 1,3-Butadiene, Formaldehyde and Acetaldehyde. Does not include a spike recovery study.

[c] Single samples collected using Summa canisters over a period of 1-hour during peak traffic period. Formaldehyde and Acetaldehyde collected separately using a suitable sorbent tube at the same time as the Summa canister/s.

[d] Volatile organic compounds as n-propane equivalent.

2.2 Measurement uncertainty

There is an uncertainty associated with any scientific measurement, including stack emissions monitoring. The measurement uncertainty can be controlled with adherence to the reference methodology which includes utilising appropriate calibration standards with corresponding acceptable uncertainty reports.

Many source sampling methods do not outline exact procedures for establishing direct measurement uncertainty. In the absence of a defined procedure, the uncertainty budgets presented are based on estimations using ISO-GUM method.

Each individual source and test may have a unique associated uncertainty, due largely to the stack sample location in relation to the positioning requirements of AS4323.1 and whether it meets the ideal or non-ideal descriptions.

Table 5: Uncertainty budget

Sample location	Parameter	Reference method	Uncertainty ± %	Coverage factor	Confidence coefficient %
Ventilation Outlets Sydney Harbour Tunnel	Velocity	USEPA Method 2	10	2	95
	Temperature	USEPA Method 2	5	2	95
	Moisture content	USEPA Method 4	5	2	95
	Solid Particles	AS4323.2	50	2	95
	Formaldehyde& Acetaldehyde	USEPA Method 18	15	2	95
	VOC's	USEPA Method 18	15	2	95
	CO & NOx	USEPA Method 7E & 10C	10	2	95

3 PROCESS DESCRIPTION

The Sydney Harbour Tunnel is a twin-tube road tunnel in Sydney, Australia. The tunnel provides a vehicular crossing of Sydney Harbour to alleviate congestion on the Sydney Harbour Bridge. It is one of two tunnels under the harbour, the other being a set of rail tunnels for the Sydney Metro. The Sydney Harbour Tunnel section is vented through a ventilation facility known as the Ventilation stack outlets southbound and northbound.

3.1 Sampling Location

Access to the sampling locations is via ladders, the sample access points are located approximately 20 meters above ground level.

3.1.1 Sydney Harbour Tunnel Ventilation Facility – Ventilation Stack Outlet Southbound & Northbound

The sample points at the Ventilation Stack Outlet Southbound & Northbound contain five 55mm BSP sampling ports positioned along one face of the duct shown in Figure 1. Due to these small sampling ports, it is not possible to insert standard sampling probes.

Figure 1: Inside ventilation facility (left) & sampling port (right)[e]

[e] Existing Northbound and Southbound sampling ports are 55mm diameter and the recommended requirement of sampling port for isokinetic sampling is 4" or 100mm.

The sampling position was evaluated in accordance with AS 4323.1 to determine the total number sampling points, based on the cross-sectional area and effective distance from disturbances. It is noted that given the design of the structure and required exhaust duct size, meeting each requirement of the method is not possible. The assessment is summarised in the following tables and figures.

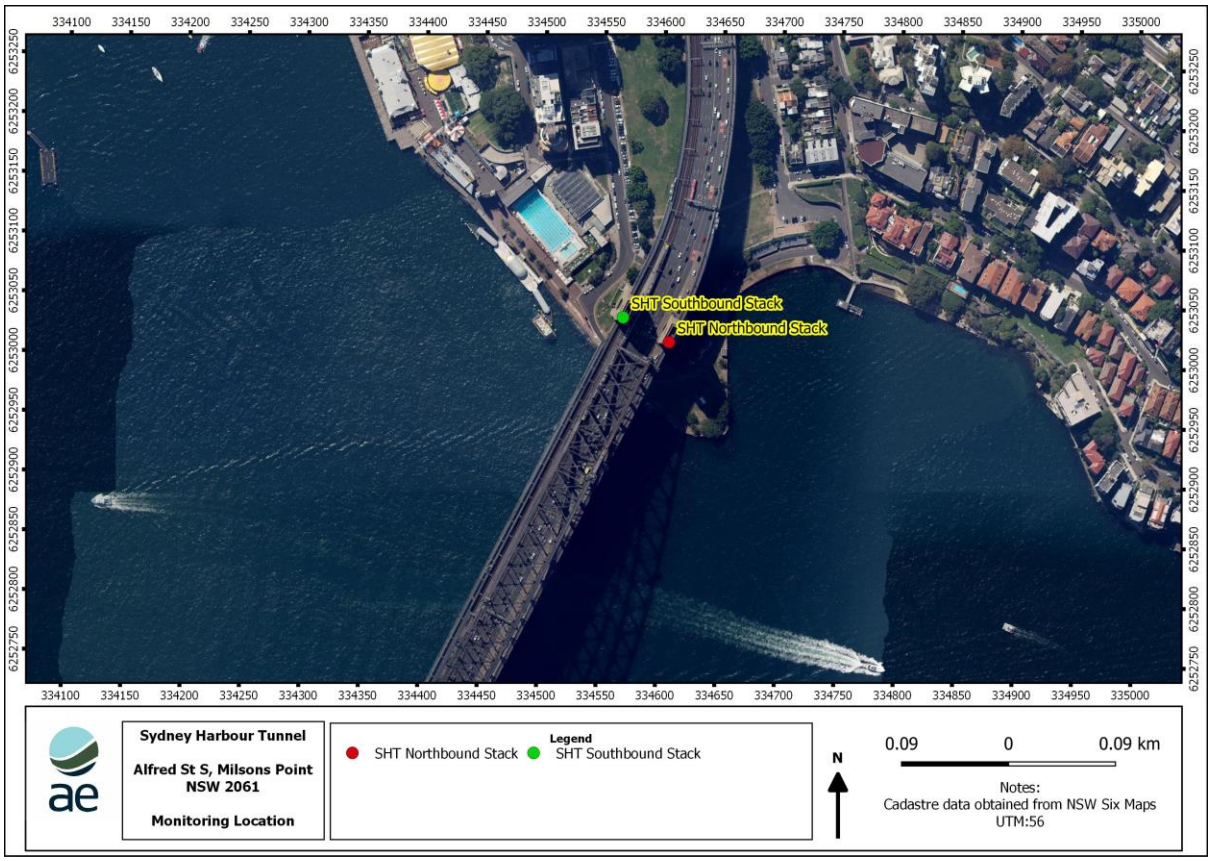

Figure 2: Sydney Harbour Tunnel Stack location

Table 6: Source description – Ventilation Outlet Sydney Harbour Tunnel

AS4323.1	Sample location	Northbound	Southbound
	Description	Tunnel Ventilation Facility	Tunnel Ventilation Facility
	Stack coordinates	UTM 56s:	UTM 56s:
	m	334615.09 m E	334583.00 m E
	Easting	6253047.38 m S	6253072.94 m S
	Stack Exit point from ground (m)	~40	~40
	Stack Shape	RECTANGULAR	RECTANGULAR
	Ideal Sampling Plane Assessment		
	Stack Diameter (m)	2.31	2.31
	Stack Cross Section Area (m^2)	5.91	5.91
	Distance to upstream disturbance (m) (from disturbance)	1.87	1.87
	Upstream Diameters (D)	0.81	0.81
	Distance to downstream disturbance (m) (from disturbance)	5.00	5.00
	Downstream diameters (D)	2.16	2.16
4.2.2 Table 1	Meets Requirements AS4323.1 Table 1	No	No
	Non-deal Sampling Plane Assessment		
	Assessment required?	No	No
	Total traverse point factors	1.27	1.27
	Non-conforming Sampling Plane Assessment		
4.2.2(a)	Gas flow in same direction	Yes	Yes
4.2.2(b)	Gas flow steady & evenly distributed (cyclonic or swirl <15°)	Yes	Yes
4.2.2(c)	Temperature difference between points <10%, and each point <10% of average	Yes	Yes
4.2.2(d)	Ratio of highest to lowest differential pressure & ratio highest to lowest velocity	2.76	1.90
		1.66	1.38
4.2.2(e)	Minimum differential pressure	20.0	43.5
	Gas temperature above dewpoint	Yes	Yes
	Sampling Plane Type		
4.2.2, 4.2.3, 4.2.4	Sampling plane type	Non-conforming	Non-conforming
	Alternative sampling plane available?	No	No
	Number of Sample Points Adopted		
	Port size (mm)	55	55
	Port Thread Type	BSP	BSP
	Number of traverses	5	5
	Number of points per traverse	5	5
	Total number of traverse points	25	25
	Flow & temperature compliance check	Yes	Yes

4 QUALITY ASSURANCE & QUALITY CONTROL (QA/QC)

Assured Environmental operates within a quality system based upon the requirements of ISO17025. Our quality system defines specific procedures and methodologies to ensure any project undertaken by Assured Environmental is conducted with the highest level of quality given the specific confines of each project. The overall objective of our QA/QC procedures is to representatively sample and accurately analyse components in the gas streams and therefore report valid measurements of emission concentrations.

To ensure representativeness of field work, our quality procedures target:

1. Correct sampling locations
2. Sample time
3. Frequency of samples and
4. Method selection & adherence

To ensure representativeness of lab work, our quality procedures target:

1. Sample preservation
2. Chain of custody (COC)
3. Sample preparation and
4. Analytical techniques

Assured Environmental maintains strict quality assurance throughout all its sampling programs, covering on-site 'field work' and the analytical phase of our projects. Our QA program covers the calibration of all sampling and analytical apparatus where applicable and the use of spikes, replicate sample and reference standards. The test methodologies used for this project are outlined in the methods section of this document. Field test data has been recorded and calculated using direct entry into Microsoft Excel spreadsheets following the procedures of the appropriate test methods. Determination of emission concentrations has been performed using the same Microsoft Excel spreadsheets which are partially supplied as an attachment to this report. More detailed information can be supplied upon request.

QA/QC checks for this project will use validation techniques and criteria appropriate to the type of data and the purpose of the measurement to approve the test report. Records of all data will be maintained. Complete chain of custody (COC) procedures has been followed to document the entire custodial history of each sample. The COC forms also served as a laboratory sheet detailing sample ID and analysis requirements.

Table 7: Sampling data QA/QC checklist

Sampling Data QA/QC Checklist	Comment
Use of appropriate test methods	Yes
'Normal' operation of the process being tested	Yes – as instructed by client
Use of properly operating and calibrated test equipment	Yes
Use of high purity reagents	Yes
Performance of leak checks post sample (at least)	Yes

Table 8: Laboratory data QA/QC checklist

Laboratory Data QA/QC Checklist	Comment
Use of appropriate analytical methods	Yes
Use of properly operating and calibrated analytical equipment	Yes
Precision and accuracy comparable to that achieved in similar projects	Yes
Accurate reporting	Yes

5 RESULTS

The results of the measurements are presented below along with other pertinent data associated with the tests.

Table 9: Site Sample Data Sheet Summary

Source Data				
Client			Ventia Pty Ltd	Ventia Pty Ltd
Site			Sydney Harbour Tunnel	Sydney Harbour Tunnel
Sample Point			Northbound	South Bound
Reference Method			AS4323.2 - ISOKINETIC	AS4323.2 - ISOKINETIC
Test Parameters			PM	PM
Process conditions			Exhaust Fan 15 Forward	Exhaust Fan 23 Forward
Historical Data & Hardware Information - Manual Sample				
Run Start Date		dd-mm-yyyy	17/04/2023	18/04/2023
Project ID			14910	14910
Run ID			-1	-2
Run Start Time	Ti	hh:mm	13:05	5:00
Run Stop Time	Tf	hh:mm	16:12	8:07
Console Serial Number			sn474	SN474
Meter Calibration Factor	(Y)		0.989	0.989
Orifice Coefficient		(DH@)	47.23	47.23
Pitot Tube Coefficient	(Cp)		0.84	0.84
Actual Nozzle Diameter	(Dna)	mm	4.46	3.25
Stack Test Data				
Actual Sampling Time	(Q)	minutes	187.5	187.5
Average Meter Temperature	(tm)avg	oC	23.58	22.42
Average Stack Temperature	(ts)avg	oC	25.66	20.48
Barometric Pressure	(Pb)	mb	1012	1012
Stack Static Pressure	(Pstatic)	mm H2O	3.50	3.50
Absolute Stack Pressure	(Ps)	mb	1012	1012
Sample Volumes				
Actual Meter Volume	(Vm)	m3	3.8353	2.5398
Standard Meter Volume	(Vm)std	Nm3	3.5414	2.3477
Moisture Content Data				
Water vapour concentration	(Bws(calc))	%	1.67	2.00
Stack Gas Density Analysis Data				
Dry Gas Molecular Weight	(Md)	kg/Nm3	1.29	1.29
Dry Gas Molecular Weight	(Md)	g/g-mole	28.84	28.84
Wet Stack Gas Molecular Weight	(Ms)	g/g-mole	28.66	28.62
Volumetric Flow Rate Data (at Sample Plane)				
Average Stack Gas Velocity	(vs)	m/sec	23.46	27.45
Equivalent Stack Diameter	Ds	m	2.31	2.31
Stack Cross-Sectional Area	(As)	m2	5.914	5.914
Upstream distance (from disturbance)	B	m	1.87	1.87
Downstream distance (from disturbance)	A	m	5.00	5.00
Actual Stack Flow Rate	(Qaw)	m3/min	8,322	9,738
Wet Standard Stack Flow Rate	(Qsw)	Nm3/min-wet	7,600	9,050
Dry Standard Stack Flow Rate	(Qsd)	Nm3/min-dry	7,473	8,868
Percent of Isokinetic Rate	(I)	%	95.6	100.7
Particulate Matter (PM) Concentration				
Total Mass of Particulates	(mn)	g	0.00054	0.00023
Stack PM Concentration	(cs)	mg/Nm3	0.152	0.099
Particulate Emission Rate	(E)	g/min	1.1364	0.8783
Instrumental Analyser - Historical Data & Hardware Information				
Analyser serial number, make & model		value	AE009 Trailer 2	AE009 Trailer 2
Analyser Run Start Time	Ti	hh:mm	13:05	5:00
Analyser Run Stop Time	Tf	hh:mm	16:12	8:10
Analyser Total Sampling Time	(Q)	hh:min	3:07	3:10
Instrumental Analyser Raw Data Averages				
Oxides of Nitrogen	(NOx)	ppm	2.51	3.34
Carbon Monoxide	(CO)	ppm	2.98	1.44
Average Oxides of Nitrogen (USEPA Method 7E - instrumental analyser)				
Nitrogen Oxides (NOx as NO2)	(Conc)	mg/Nm3	5.15	6.86
Nitrogen Oxides (NOx as NO2)	(E)	g/min	38.5	60.8
Average Carbon Monoxide (USEPA Method 10 - instrumental analyser)				
Carbon Monoxide (CO)	(Conc)	mg/Nm3	3.73	1.80
Carbon Monoxide (CO)	(E)	g/min	27.8	15.9
OTHER ANALYTES (VOC's ,Acetaldehyde& Formaldehyde)				
Formaldehyde	(Conc)	mg/Nm3	0.0120	< 0.0030
Formaldehyde emission rate	(E)	g/min	0.0893	< 0.0269
Acetaldehyde	(Conc)	mg/Nm3	0.0060	< 0.0030
Acetaldehyde emission rate	(E)	g/min	0.0446	< 0.0269
TVOC (as propane)	(Conc)	mg/Nm3	< 0.6036	< 1.0178
TVOC (as propane) emission rate	(E)	g/min	< 4.505	< 9.019
Benzene	(Conc)	mg/Nm3	0.0070	0.0105
Benzene emission rate	(E)	g/min	0.0520	0.0927
Toluene	(Conc)	mg/Nm3	0.0535	0.1522
Toluene emission rate	(E)	g/min	0.3991	1.3485
Ethyl Benzene	(Conc)	mg/Nm3	0.0028	0.0095
Ethyl Benzene emission rate	(E)	g/min	0.0212	0.0840
m&p xylene	(Conc)	mg/Nm3	0.0095	0.0332
m&p xylene emission rate	(E)	g/min	0.0707	0.2939
o xylene	(Conc)	mg/Nm3	0.0033	0.0095
o xylene emission rate	(E)	g/min	0.0248	0.0840
1,3-Butadiene	(Conc)	mg/Nm3	< 0.0012	< 0.0027
1,3-Butadiene emission rate	(E)	g/min	< 0.0090	< 0.0235
QA				
Pre leak test	leak rate	m3/min @ kPA	0 @ 30	0 @ 15
Post Leak Test	leak rate	m3/min @ kPA	0 @ 36	0 @ 18

Table 10: Speciated VOC's Data Sheet Summary

Speciated VOC's	Units	Method	Northbound	Southbound
Propylene	mg/m3	TO15	0.008	0.008
Dichlorodifluoromethane	mg/m3	TO15	< 0.003	< 0.013
Chloromethane	mg/m3	TO15	0.001	0.002
1,2-Dichlorotetrafluoroethane	mg/m3	TO15	< 0.004	< 0.019
Vinyl chloride	mg/m3	TO15	< 0.001	< 0.004
1,3-Butadiene	mg/m3	TO15	< 0.001	< 0.003
Bromomethane	mg/m3	TO15	< 0.002	< 0.008
Chloroethane	mg/m3	TO15	< 0.001	< 0.004
Ethanol	mg/m3	TO15	0.0	0.06
Acrolein	mg/m3	TO15	< 0.01	< 0.03
Trichlorofluoromethane(Freon 11)	mg/m3	TO15	< 0.003	< 0.017
Acetone	mg/m3	TO15	0.18	0.26
Isopropyl Alcohol	mg/m3	TO15	0.024	0.05
1,1-Dichloroethene	mg/m3	TO15	< 0.002	< 0.009
1,1,2-Trichlorotrifluoroethane	mg/m3	TO15	< 0.004	< 0.032
Methylene chloride(Dichloromethane)	mg/m3	TO15	0.61	0.99
Carbon Disulfide	mg/m3	TO15	< 0.02	< 0.05
trans-1,2-dichloroethene	mg/m3	TO15	< 0.002	< 0.009
MTBE	mg/m3	TO15	< 0.002	< 0.007
1,1- Dichloroethane	mg/m3	TO15	< 0.002	< 0.009
Vinyl Acetate	mg/m3	TO15	< 0.002	< 0.007
MEK	mg/m3	TO15	0.02	< 0.05
Hexane	mg/m3	TO15	0.10	0.185
cis-1,2-Dichloroethene	mg/m3	TO15	< 0.002	< 0.009
Ethyl Acetate	mg/m3	TO15	< 0.002	< 0.007
Chloroform	mg/m3	TO15	< 0.003	< 0.013
Tetrahydrofuran	mg/m3	TO15	< 0.002	< 0.005
1,1,1-Trichloroethane	mg/m3	TO15	< 0.003	< 0.016
1,2-Dichloroethane	mg/m3	TO15	< 0.002	< 0.009
Benzene	mg/m3	TO15	0.007	0.010
Carbon tetrachloride	mg/m3	TO15	< 0.003	< 0.021
Cyclohexane	mg/m3	TO15	< 0.002	< 0.006
Heptane	mg/m3	TO15	< 0.002	< 0.009
Trichloroethene	mg/m3	TO15	< 0.003	< 0.016
1,2-Dichloropropane	mg/m3	TO15	< 0.003	< 0.012
1,4-Dioxane	mg/m3	TO15	< 0.002	< 0.007
Bromodichloromethane	mg/m3	TO15	< 0.004	< 0.025
Methyl Methacrylate	mg/m3	TO15	< 0.002	< 0.009
MIBK	mg/m3	TO15	< 0.02	< 0.09
cis-1,3-Dichloropropene	mg/m3	TO15	< 0.002	< 0.011
trans-1,3-Dichloropropene	mg/m3	TO15	< 0.002	< 0.011
Toluene	mg/m3	TO15	0.05	0.15
1,1,2-Trichloroethane	mg/m3	TO15	< 0.003	< 0.016
Methyl Butyl Ketone	mg/m3	TO15	< 0.002	< 0.009
Dibromochloromethane	mg/m3	TO15	< 0.005	< 0.015
Tetrachloroethene	mg/m3	TO15	0.007	< 0.025
1,2-Dibromoethane	mg/m3	TO15	< 0.004	< 0.032
Chlorobenzene	mg/m3	TO15	< 0.003	< 0.012
Ethylbenzene	mg/m3	TO15	0.003	0.009
m-& p-Xylene	mg/m3	TO15	0.01	0.03
Styrene	mg/m3	TO15	< 0.002	< 0.010
o-Xylene	mg/m3	TO15	0.003	0.009
Bromoform	mg/m3	TO15	< 0.006	< 0.059
1,1,2,2-Tetrachloroethane	mg/m3	TO15	< 0.004	< 0.025
4-ethyl toluene	mg/m3	TO15	< 0.003	< 0.013
1,3,5-Trimethylbenzene	mg/m3	TO15	< 0.003	< 0.013
1,2,4-Trimethylbenzene	mg/m3	TO15	0.00	0.016
1,3-Dichlorobenzene	mg/m3	TO15	< 0.003	< 0.020
Benzyl chloride	mg/m3	TO15	< 0.003	< 0.015
1,4-Dichlorobenzene	mg/m3	TO15	< 0.003	< 0.020
1,2-Dichlorobenzene	mg/m3	TO15	< 0.003	< 0.020
1,2,4-Trichlorobenzene	mg/m3	TO15	< 0.004	< 0.030
Naphthalene	mg/m3	TO15	< 0.003	< 0.015
Hexachloro-1,3-butadiene	mg/m3	TO15	< 0.006	< 0.062
TOTAL VOC as n-propane	mg/m3	TO15	< 0.604	< 1.018
TOTAL VOC as n-propane emission rate	g/min	TO15	< 4.505	< 9.019

6 CONCULSION

Assured Environmental performed air emissions monitoring for Ventia Pty Ltd on the 17th and 18th of April 2023, in accordance with the New South Wales Environmental Protection Licence (EPL) number – 4062. In reference to condition L2.2 of EPL 4062;

- Solid particles for both ventilation points was below 1.1mg/Nm^3.
- Carbon monoxide for both ventilation points was below 40mg/Nm^3.
- Nitrogen oxides for both ventilation points was below 25mg/Nm^3.
- VOCs as n-propane for both ventilation points was below 4mg/Nm^3.

Based on the comparison presented, the results of the monitoring undertaken has demonstrated compliance with the release limits provided in the site EPL for all parameters tested. The decision rule used is based on values obtained during testing without regard to uncertainty limits.

7 ADDENDUM

7.1 Infrastructure Approval - EF20/104

Table 11: Condition A2.1 of Infrastructure Approval

Pollutant	Units of measure	Frequency[6]	Method[1]
Solid Particles	$\mu g/m^3$	Quarterly	TM15
PM_{10}	$\mu g/m^3$	Quarterly	OM-5
PM $_{2.5}$[5]	$\mu g/m^3$	Quarterly	OM-5
CO	mg/m^3	Continuous	CEM-4
VOC	mg/m^3	Continuous	CEM-8
Speciated VOC[3]	mg/m^3	Annual	OM-2
PAH[4]	$\mu g/m^3$	Annual	OM-6
Parameter	Units of measure	Frequency	Method[1]
Flow rate	M^3/s	Continuous	CEM-6
Moisture	%	Continuous	TM-22
Temperature	K	Continuous	TM-2
Other	Units of measure	Frequency	Method[1]
Sampling locations	NA	NA	TM-1

Note:

1 NSW EPA, 2001, Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales

2 Standards Australia, 2001, AS3580.9.8-2001, Methods for the Sampling and Analysis of Ambient Air – Determination of Suspended Particulate Matter – PM_{10} Continuous Direct Mass Method using Tapered Element Oscillating Microbalance Analyser

3 Must include, but not limited to; Benzene, Toluene, Xylenes, 1,3-Butadiene, Formaldehyde and Acetaldehyde

4 Must include, but not limited to; 16 USEPA priority PAHs, namely; Naphthalene, Phenanthrene, Benz(a)anthracene, Benzo(a)pyrene, Acenapthylene, Anthracene, Chrysene, Indeno(1,2,3-cd)pyrene, Acenaphthene, Fluoranthene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Fluorene, Pyrene, Benzo(k)fluoranhtene, Benzo(g,h,i)perylene.

5 Appropriately modified to include size selective inlet for PM2.5 or as otherwise approved by the Director-General.

6 Frequency of monitoring can be varied with approval from the Director-General.

7.2 EPL 21374 Air Monitoring Requirements

7.3 Condition L2.2 of EPL 4602

L2.2 Air Concentration Limits

POINT 2,3

Pollutant	Units of measure	100 percentile concentration limit	Reference conditions	Oxygen correction	Averaging period
Carbon monoxide	milligrams per cubic metre	40	Dry, 273K,101.3 kPa		1 hour
Nitrogen Oxides	milligrams per cubic metre	25	Dry, 273k, 101.3kPa		1 hour
Solid Particles	milligrams per cubic metre	1.1	Dry, 273k, 101.3kPa		1 hour, or the minimum sampling period specified
volatile organic compounds as n-propane equivalent	milligrams per cubic metre	4.0	Dry, 273k, 101.3kPa		1 hour

7.4 Condition M2.2 & 2.3 of EPL 4602

M2 Requirement to monitor concentration of pollutants discharged

M2.1 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 opposite in the other columns:

M2.2 Air Monitoring Requirements

POINT 1

Pollutant	Units of measure	Frequency	Sampling Method
Carbon monoxide	parts per million	Continuous	CEM-4

POINT 2,3

Pollutant	Units of measure	Frequency	Sampling Method
Carbon monoxide	milligrams per cubic metre	Every 6 months	TM-32

Nitrogen Oxides	milligrams per cubic metre	Every 6 months	TM-11
Solid Particles	milligrams per cubic metre	Every 6 months	TM-15
Speciated organic compounds	milligrams per cubic metre	Every 6 months	TM-34
volatile organic compounds as n-propane equivalent	milligrams per cubic metre	Every 6 months	TM-34

M2.3 For the purpose of the Table above, Speciated Organic Compounds must include, but are not limited to, Benzene, Toluene, Xylenes, 1,3-Butadiene, Formaldehyde and Acetaldehyde
Note: The frequency of the monitoring will be reviewed in two years.

7.5 Sample Method Summaries

7.5.1 Velocity, Volume Flow Rate & Temperature (USEPA Method 2)

Gas velocity and volume flow rate were determined in accordance with USEPA Method 2 – Determination of stack gas velocity and volumetric flow rate (type-s pitot tube). Velocity profiles were obtained across the sampling location using a calibrated S-type pitot tube, a Testo digital manometer, a type K thermocouple, and a Fluke thermocouple indicator.

Positions for velocity pressure and temperature measurement were determined in accordance with AS4323.1. Gas velocity and volume flow rate was then calculated in accordance with USEPA Method 2.

7.5.2 Gas Molecular Weight (USEPA Method 3)

A gas sample is extracted from a stack by one of the following methods: (1) single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analysed for percent CO2 and percent O2.

7.5.3 Moisture Content (USEPA Method 4)

A measured volume of stack gas was bubbled through a series of chilled impingers each containing 100mls of water and then drawn through a silica gel tube in accordance with US EPA Method 4 - "Determination of Moisture Content in Stack Gases".

The total change in volume of water in the impingers and the weight change of the silica gel tube were used to calculate the percentage moisture in the stack.

7.5.4 Total Solid Particles

Monitoring for solid particles was conducted in accordance with Australian Standard 4323.2 - 1995 "Stationary Source Emissions, Method 2: Determination of Total Particulate Matter - Isokinetic Manual Sampling - Gravimetric Method".

Stack gas was withdrawn isokinetically through a nozzle, which had a sharp and tapered leading edge. Particulate matter was collected on a pre-weighed quartz filter located in a holder downstream of the nozzle. Gases were then conditioned (for removal of moisture) and finally metered for flow rate and sample volume.

The weight change of the filter was determined using an Ohaus electronic balance (with a current NATA endorsed certification), and this figure used to calculate the concentration of particulate matter.

7.5.5 Speciated VOCs – USEPA Method 18/USEPA TO-15

This method applies to ambient concentrations of VOCs above 0.5 ppbv and typically requires VOC enrichment by concentrating up to one litre of a sample volume.

TO-15 was developed for the sampling and the analysis of VOCs in ambient air. Samples are collected in a certified passivated steel canister that is evacuated to approximately -30 inches Mercury. Samples may be collected either as grab samples or as temporal samples, sampling times from less than one minute to greater than 24 hours, by using a flow restricting device.

The atmosphere is sampled by introduction of air into a specially prepared stainless-steel canister (Summa canister). A pump ventilated sampling line is used during sample collection to ensure sample from the source being tested is delivered undiluted to the canister. After the air sample is collected, the canister valve is closed, an identification tag is attached to the canister, and the canister is transported to the laboratory for analysis.

The sample is released by thermal desorption and carried onto a gas chromatographic column for separation and analysis via a high-resolution gas chromatograph (GC) coupled to a mass spectrometer.

7.5.6 Speciated VOCs – USEPA Method 18 (Aldehydes & Ketones)

Sampling and analysis for formaldehyde and acetaldehyde (Ethanal) was conducted using aldehydes & ketones DNPH sorbent tubes, the USEPA Method 18 adsorbent tube approach was used as a guide. A measured volume of stack gas was drawn through a DNPH adsorption tube, trapping aldehydes & ketone present in the gas. Samples were analysed using Carbonyls determined by derivatisation with DNPH and subsequent HPLC analysis.