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3rd February 2017

NRW Reference: PAN-000849

Dear Mr White,

We are responding to your Schedule 5 notice dated 9th January 2017

Application reference: PAN-000849
Applicant: Radnor Hills Mineral Water Company Ltd
Facility: Radnor Hills, Heartsease, Knighton, Powys, LD7 1LU

H1 Environmental Risk Assessment – Emissions to Air

Contents

Introduction

Thank you for your Schedule 5 notice requiring further information on our environmental permit application, dated 17th October 2016. We understand that your Schedule requires:

- The H1 environmental risk assessment to be resubmitted to include the parameter of 'Nitrogen Dioxide', and
- Confirmation of the parameters and emission limits related to the oil heater.

This letter therefore seeks to answer and provide clarification of these points. As discussed this report has been able to be based on monitoring data for emissions and so is much improved on the earlier estimated emission parameters.

There are five air release points, four from boilers run on natural gas used for the generation of steam used in the process, and also a single oil-fired heater providing heat for bottle blowing. These are shown below.

Figure 1 – Air Release Points

Number	Description	Location or Grid Reference	Activity or Activities	Effective Height metres	Efflux Velocity m/s	Total Flow m3/hr
e.g.	A1	North stack		150	25	5,000
1	B1	SO 34307 72464	Steam generation	4	7	361
2	B2	SO 34401 72466	Steam generation	5	6.2	858
3	B3	SO 34391 72464	Steam generation	4	13.2	284
4	B4	SO 34324 72458	Steam generation	4	8.6	397
5	O1	SO 34366 72429	Heat for bottle blowing	4	5.4	126

To model the potential effects of air emissions from these release points, emissions monitoring was conducted during the week commencing 16th January 2017 to inform the inputs to a H1 Risk Assessment model. The monitoring reports are available on request to support the assessment.

Three different scenarios have been modelled and are presented in this letter. All three scenarios use the same input data for Short Term effects (the actual monitoring results), however vary in the assumptions used for calculation of Long Term effects and different effective stack heights. This is described below:

1. **Scenario One** takes the on-time of the boilers into consideration, by multiplying the Long Term emissions data by the percentage load of the boilers. These are based on operational hours as follows across a year:
    a. B1 – 57%
    b. B2 – 80%
    c. B3 – 17%
    d. B4 – 57%
    e. O1 – 58%

    Short Term effects are from actual measured data.

2. **Scenario Two** assumes 100% use of the boilers annually (and therefore constant emissions) and so directly uses the results of the monitoring data for both Long and Short Term effects. This provides a theoretical maximum (and therefore an overestimate) of the Long Term emissions.

3. **Scenario Three** assumes boiler duty as per Scenario 1 and reduces the effective stack height of B2 to 0m (using the other assumptions from Scenario One). The stack for B2 is slightly shorter than the eaves of the roof of the building it is adjacent to. In the H1 Annex F guidance, it states that if a release point is lower than the roof height of a building it is within 5m? of, the release height should be considered to be 0m.

4. **Scenario Four** also assumes boiler duty as per Scenario 1 but includes only emission point B2. This is the largest source of emissions. Because the emission points are not close together and therefore unlikely to have a combined impact, we have modelled the effect of B2 on its own. The assumptions used have been as per Scenario Three (i.e. assumed 0m effective height).

Under all scenarios, emissions of oxides of nitrogen are presented as nitrogen dioxide, as nitrogen oxide converts to nitrogen dioxide over time. To calculate Short Term effects, 50% of nitrogen oxides were assumed to convert to nitrogen dioxide, as found in Environmental Risk Assessment guidance[1].

[1] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#screen-out-insignificant-pecs

Scenario One

This scenario takes into account the load of the boilers by multiplying the measured data by the percentage on-time of each boiler in order to calculate Long Term effects. Short Term effects are calculated using the measured data. We believe this to the be most accurate approximation of likely effects.

Figure 1.2 – Air Emissions Inventory (NO_2), Boilers 1 – 4, Scenario One

Source	Percentage on-time	Long Term effects (using operational % of measured)		Short Term effects (using 50% of measured)		Annual Rate (tpa)
		Concentration (mg/m^3)	Release Rate (g/s)	Concentration (mg/m^3)	Release Rate (g/s)	
B1	57%	91.2	0.009	80	0.008	0.29
B2	80%	208	0.05	130	0.031	1.56
B3	17%	30.6	0.00241	90	0.007	0.08
B4	57%	132.24	0.015	116	0.0125	0.46

Figure 1.3 - Air Emissions Inventory (Oil-Fired Heater), Scenario One

Substance	Long Term effects (using operational % of measured)		Short Term effects		Annual Rate (tpa)
	Concentration (mg/m^3)	Release Rate (g/s)	Concentration (mg/m^3)	Release Rate (g/s)	
Sulphur Dioxide	0.7	0.00002	1.2	0.00004	0.00044
Nitrogen Dioxide	86.42	0.00306	74.5	0.00264	0.056
Carbon Monoxide	6.96	0.00026	12	0.00044	0.0047
Particulates	1.16	0.00004	2	0.00007	0.00077

Using the data presented in the Figures above, the following outputs were obtained from the H1 model.

Figure 1.4 – Calculate Process Contributions of Emissions to Air, Scenario One

		Long Term			Short Term		
Number	Substance	EAL µg/m3	PC µg/m3	* Modelled PC µg/m3	EAL µg/m3	PC µg/m3	* Modelled PC µg/m3
1	Sulphur Dioxide (1 Hour Mean)		0.00204		350	0.103	
1	Nitrogen Dioxide	40	7.50		200	147	
3	Carbon monoxide		0.0265		10000	1.14	
4	Particulates (PM10) (24 hr Mean)	40	0.00407		50	0.181	

Figure 1.5 – Screen Out Insignificant Emissions to Air, Scenario One

				Long Term			Short Term		
Number	Substance	Long Term EAL µg/m3	Short Term EAL µg/m3	PC µg/m3	% PC of EAL %	> 1% of EAL?	PC µg/m3	% PC of EAL %	> 10% of EAL?
1	Sulphur Dioxide (1 H	-	350	0.00204	-		0.103	0.0294	**No**
1	Nitrogen Dioxide	40.0	200	7.50	18.8	**Yes**	147	73.4	**Yes**
3	Carbon monoxide	-	10,000	0.0265	-		1.14	0.0114	**No**
4	Particulates (PM10) (	40.0	50.0	0.00407	0.0102	**No**	0.181	0.361	**No**

Sulphur dioxide, carbon monoxide and particulates can be screened out at this point as they are shown to have likely insignificant impact.

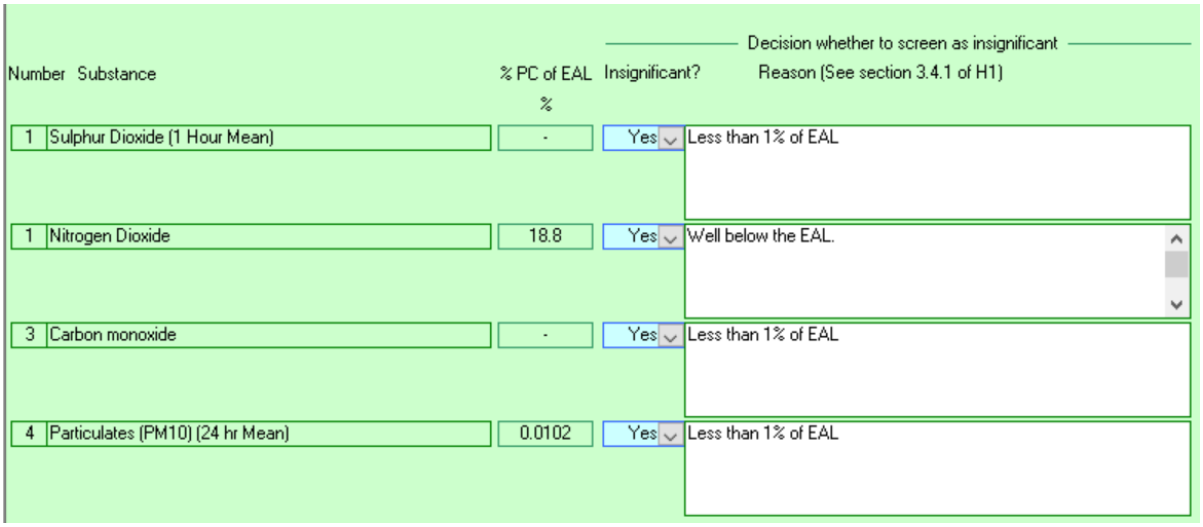
While nitrogen dioxide is shown to exceed 1% and 10% of the relevant EALs, all emission PCs are below the EALs and therefore it is not considered that further modelling is required as the assessment is using real-time monitored data.

Figure 1.6 – Identify Need for Detailed Modelling of Emissions to Air, Scenario One

			Long Term				Short Term	
Number	Substance	Air Bkgrnd Conc. µg/m3	PC µg/m3	% PC of headroom (EAL - Bkgrnd)	PEC µg/m3	% PEC of EAL %	PC µg/m3	% PC of headroom (EAL - Bkgrnd)
	e.g.	12						
1	Nitrogen Dioxide	6	7.50	22.0	13.5	33.8	147	78.1

The contribution of air background nitrogen dioxide is 6 µg/m^3. Air Background Concentration data were obtained from the Defra LAQM Background Maps.

Figure 1.7 – Deposition from Air to Land, Scenario One



			Decision whether to screen as insignificant	
Number	Substance	% PC of EAL %	Insignificant?	Reason (See section 3.4.1 of H1)
1	Sulphur Dioxide (1 Hour Mean)	-	Yes	Less than 1% of EAL
1	Nitrogen Dioxide	18.8	Yes	Well below the EAL.
3	Carbon monoxide	-	Yes	Less than 1% of EAL
4	Particulates (PM10) (24 hr Mean)	0.0102	Yes	Less than 1% of EAL

Figures 1.8 and 1.9 graphically show the contribution of each release point to the EAL.

Figure 1.8 – Air Short Term Effects, Scenario One

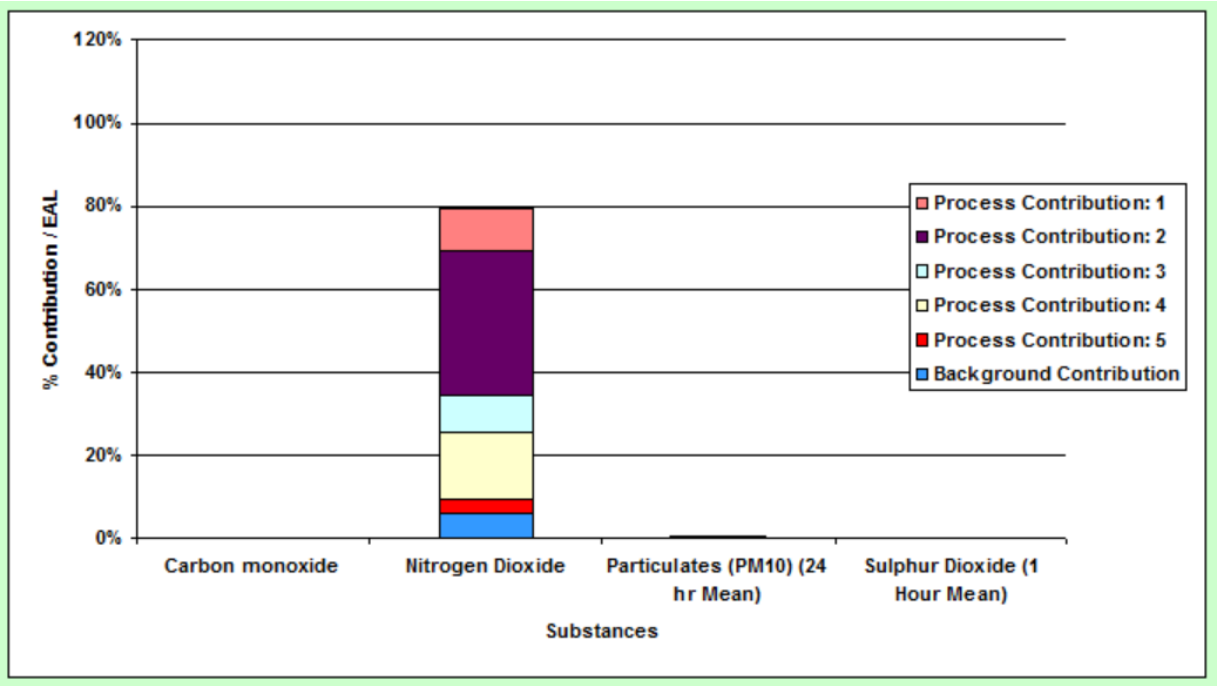
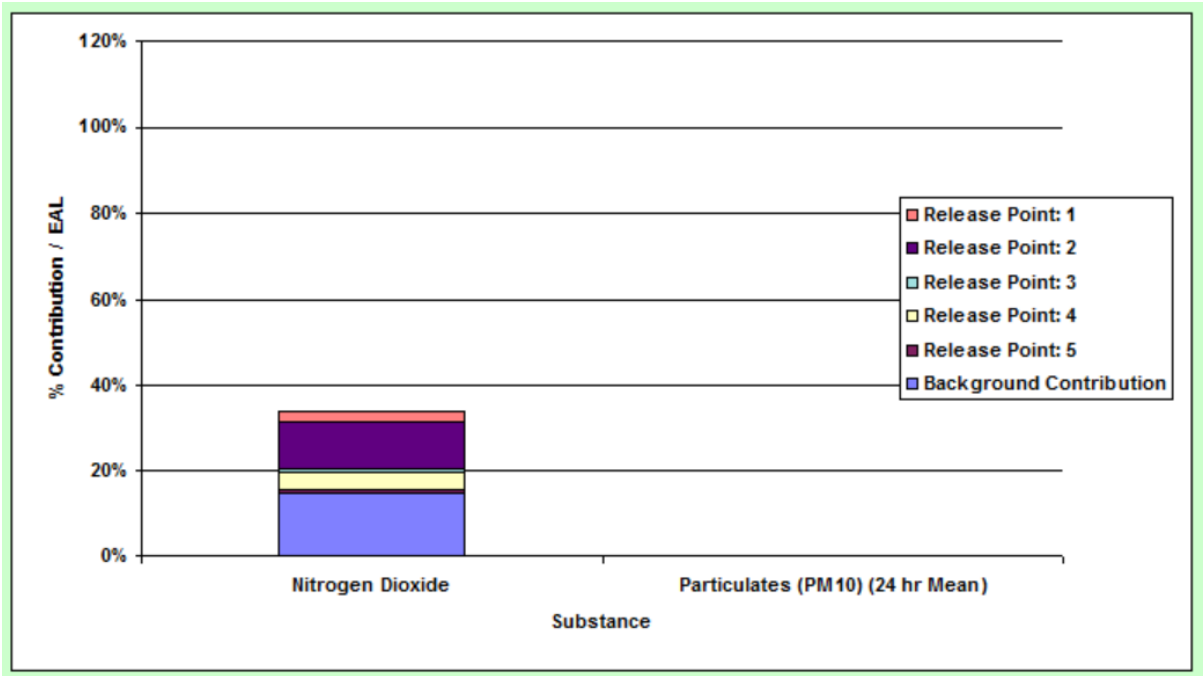


Figure 1.9 – Air Long Term Effects, Scenario One



Scenario Two

This scenario assumes 100% load on the boilers, directly using the monitoring data and 50% of NO_x as NO_2, and stack heights as actual.

Figure 2.2 – Air Emissions Inventory (NO_2), Boilers 1 – 4, Scenario Two

Source	Long Term effects (assuming 100% load)		Short Term effects (using 50% of measured)		Annual Rate (tpa)
	Concentration (mg/m^3)	Release Rate (g/s)	Concentration (mg/m^3)	Release Rate (g/s)	
B1	160	0.016	80	0.008	0.51
B2	260	0.062	130	0.031	1.95
B3	180	0.014	90	0.007	0.45
B4	232	0.025	116	0.0125	0.81

Figure 2.3 – Air Emissions Inventory (Oil-Fired Heater), Scenario Two

Substance	Long Term effects (assuming 100% load)		Short Term effects		Annual Rate (tpa)
	Concentration (mg/m^3)	Release Rate (g/s)	Concentration (mg/m^3)	Release Rate (g/s)	
Sulphur Dioxide	1.2	0.00004	1.2	0.00004	0.0013
Nitrogen Dioxide	149	0.00528	74.5	0.00264	0.167
Carbon Monoxide	12	0.00044	12	0.00044	0.014
Particulates	2	0.00007	2	0.00007	0.0023

Using the data presented in the Figures above, the following outputs were obtained from the H1 model.

Figure 2.4 – Calculate Process Contributions of Emissions to Air, Scenario Two

Number	Substance	Long Term EAL µg/m3	Long Term PC µg/m3	Long Term * Modelled PC µg/m3	Short Term EAL µg/m3	Short Term PC µg/m3	Short Term * Modelled PC µg/m3
1	Sulphur Dioxide (1 Hour Mean)		0.00407		350	0.103	
1	Nitrogen Dioxide	40	11.8		200	147	
3	Carbon monoxide		0.0448		10000	1.14	
4	Particulates (PM10) (24 hr Mean)	40	0.00712		50	0.181	

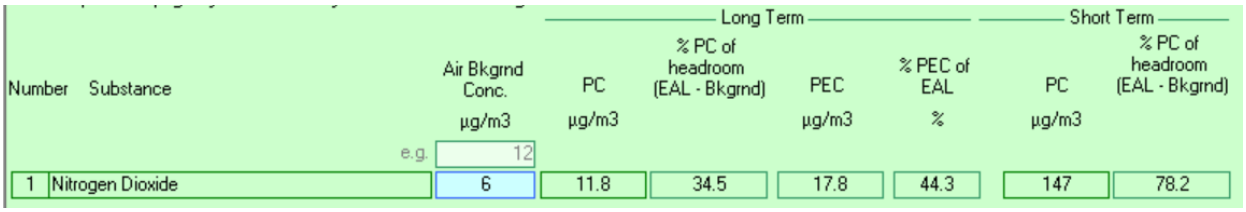
Figure 2.5 – Screen Out Insignificant Emissions to Air, Scenario Two

Number	Substance	Long Term EAL µg/m3	Short Term EAL µg/m3	Long Term PC µg/m3	Long Term % PC of EAL %	Long Term > 1% of EAL?	Short Term PC µg/m3	Short Term % PC of EAL %	Short Term > 10% of EAL?
1	Sulphur Dioxide (1 H	-	350	0.00407	-		0.103	0.0294	**No**
1	Nitrogen Dioxide	40.0	200	11.8	29.3	**Yes**	147	73.5	**Yes**
3	Carbon monoxide	-	10,000	0.0448	-		1.14	0.0114	**No**
4	Particulates (PM10) (	40.0	50.0	0.00712	0.0178	**No**	0.181	0.361	**No**

Sulphur dioxide, carbon monoxide and particulates can be screened out at this point as they are shown to have likely insignificant impact.

While nitrogen dioxide is shown to exceed 1% and 10% of the relevant EALs, all emission PCs are below the EALs and therefore it is not considered that further modelling is required.

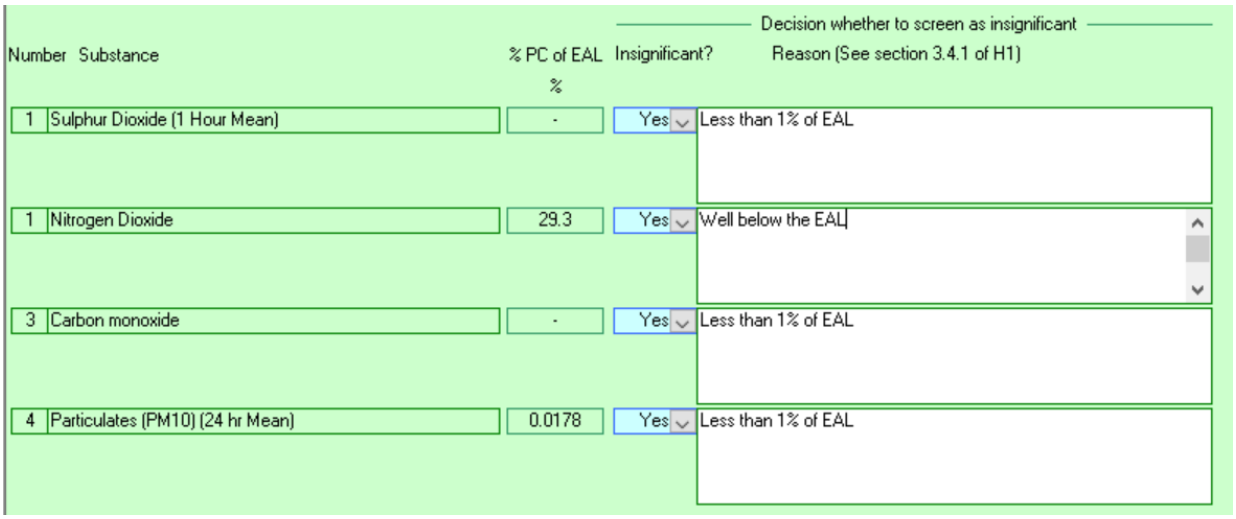
Figure 2.6 – Identify Need for Detailed Modelling of Emissions to Air, Scenario Two



Number	Substance	Air Bkgrnd Conc. µg/m3	Long Term PC µg/m3	Long Term % PC of headroom (EAL - Bkgrnd)	Long Term PEC µg/m3	Long Term % PEC of EAL %	Short Term PC µg/m3	Short Term % PC of headroom (EAL - Bkgrnd)
		e.g. 12						
1	Nitrogen Dioxide	6	11.8	34.5	17.8	44.3	147	78.2

The contribution of air background nitrogen dioxide is 6 µg/m^3. Air Background Concentration data were obtained from the Defra LAQM Background Maps.

Figure 2.7 – Deposition to Land from Air, Scenario Two



Number	Substance	% PC of EAL %	Decision whether to screen as insignificant: Insignificant?	Reason (See section 3.4.1 of H1)
1	Sulphur Dioxide (1 Hour Mean)	-	Yes	Less than 1% of EAL
1	Nitrogen Dioxide	29.3	Yes	Well below the EAL
3	Carbon monoxide	-	Yes	Less than 1% of EAL
4	Particulates (PM10) (24 hr Mean)	0.0178	Yes	Less than 1% of EAL

Figures 2.8 and 2.9 graphically show the contribution of each release point to the EAL.

Figure 2.8 – Air Short Term Effects, Scenario Two

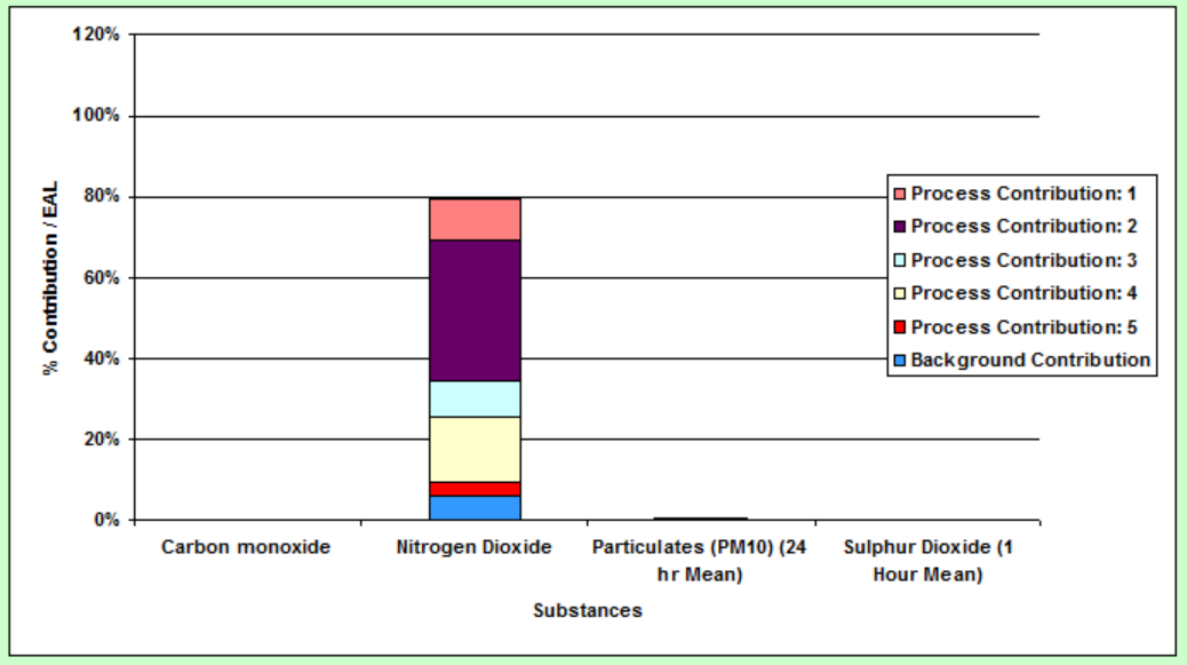
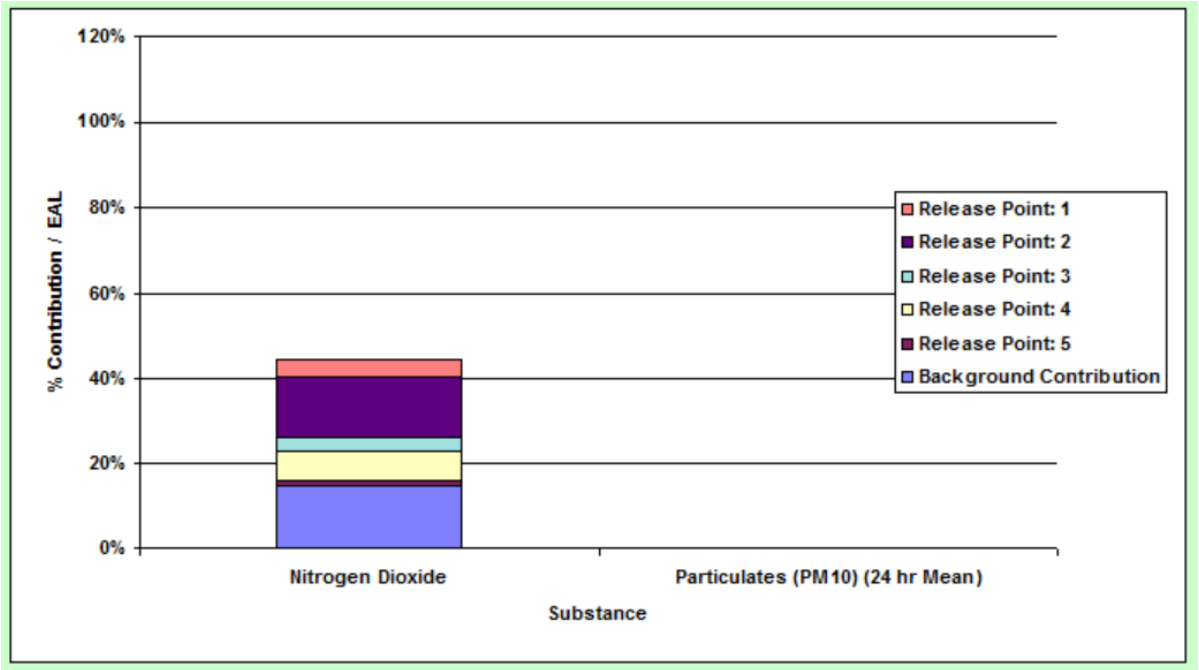


Figure 2.9 – Air Long Term Effects, Scenario Two



Scenario Three

This scenario uses the same assumptions as Scenario One (using percentage on-time of the boilers to rationalise the Long Term effects) however uses 0 m as the effective stack height for boiler 2, as this stack is slightly shorter than the eaves of the building it is adjacent to.

Figure 3.2 – Air Emissions Inventory (NO_2), Boilers 1 – 4, Scenario Three

Source	Percentage on-time	Long Term effects (using operational % of measured)		Short Term effects (using 50% of measured)		Annual Rate (tpa)
		Concentration (mg/m^3)	Release Rate (g/s)	Concentration (mg/m^3)	Release Rate (g/s)	
B1	57%	91.2	0.009	80	0.008	0.29
B2	80%	208	0.05	130	0.031	1.56
B3	17%	30.6	0.00241	90	0.007	0.08
B4	57%	132.24	0.015	116	0.0125	0.46

Figure 3.3 - Air Emissions Inventory (Oil-Fired Heater), Scenario Three

Substance	Long Term effects (using operational % of measured)		Short Term effects (using 50% of measured)		Annual Rate (tpa)
	Concentration (mg/m^3)	Release Rate (g/s)	Concentration (mg/m^3)	Release Rate (g/s)	
Sulphur Dioxide	0.7	0.00002	1.2	0.00004	0.00044
Nitrogen Dioxide	86.42	0.00306	74.5	0.00264	0.056
Carbon Monoxide	6.96	0.00026	12	0.00044	0.0047
Particulates	1.16	0.00004	2	0.00007	0.00077

Using the data presented in the Figures above, the following outputs were obtained from the H1 model.

Figure 3.4 – Calculate Process Contributions of Emissions to Air, Scenario Three

		Long Term			Short Term		
Number	Substance	EAL µg/m3	PC µg/m3	* Modelled PC µg/m3	EAL µg/m3	PC µg/m3	* Modelled PC µg/m3
1	Sulphur Dioxide (1 Hour Mean)		0.00204		350	0.103	
1	Nitrogen Dioxide	40	10.4		200	198	
3	Carbon monoxide		0.0265		10000	1.14	
4	Particulates (PM10) (24 hr Mean)	40	0.00407		50	0.181	

Figure 3.5 – Screen Out Insignificant Emissions to Air, Scenario Three

				Long Term			Short Term		
Number	Substance	Long Term EAL µg/m3	Short Term EAL µg/m3	PC µg/m3	% PC of EAL %	> 1% of EAL?	PC µg/m3	% PC of EAL %	> 10% of EAL?
1	Sulphur Dioxide (1 H	-	350	0.00204	-		0.103	0.0294	**No**
1	Nitrogen Dioxide	40.0	200	10.4	26.0	**Yes**	198	99.3	**Yes**
3	Carbon monoxide	-	10,000	0.0265	-		1.14	0.0114	**No**
4	Particulates (PM10) (	40.0	50.0	0.00407	0.0102	**No**	0.181	0.361	**No**

Sulphur dioxide, carbon monoxide and particulates can be screened out at this point as they are shown to have likely insignificant impact.

While nitrogen dioxide is shown to exceed 1% and 10% of the relevant EALs, all emission PCs are below the EALs and therefore it is not considered that further modelling is required.

Figure 3.6 – Identify Need for Detailed Modelling of Emissions to Air, Scenario Three

			Long Term				Short Term	
Number	Substance	Air Bkgrnd Conc. µg/m3	PC µg/m3	% PC of headroom (EAL - Bkgrnd)	PEC µg/m3	% PEC of EAL %	PC µg/m3	% PC of headroom (EAL - Bkgrnd)
	e.g.	12						
1	Nitrogen Dioxide	6	10.4	30.6	16.4	41.0	198	106

The contribution of air background nitrogen dioxide is 6 µg/m^3. Air Background Concentration data were obtained from the Defra LAQM Background Maps.

Figure 3.7 – Deposition from Air to Land, Scenario Three

			Decision whether to screen as insignificant	
Number	Substance	% PC of EAL %	Insignificant?	Reason (See section 3.4.1 of H1)
1	Sulphur Dioxide (1 Hour Mean)	-	Yes	Less than 1% of EAL
1	Nitrogen Dioxide	26.0	Yes	Well below the EAL.
3	Carbon monoxide	-	Yes	Less than 1% of EAL
4	Particulates (PM10) (24 hr Mean)	0.0102	Yes	Less than 1% of EAL

Figures 3.8 and 3.9 graphically show the contribution of each release point to the EAL.

Figure 3.8 – Air Short Term Effects, Scenario Three

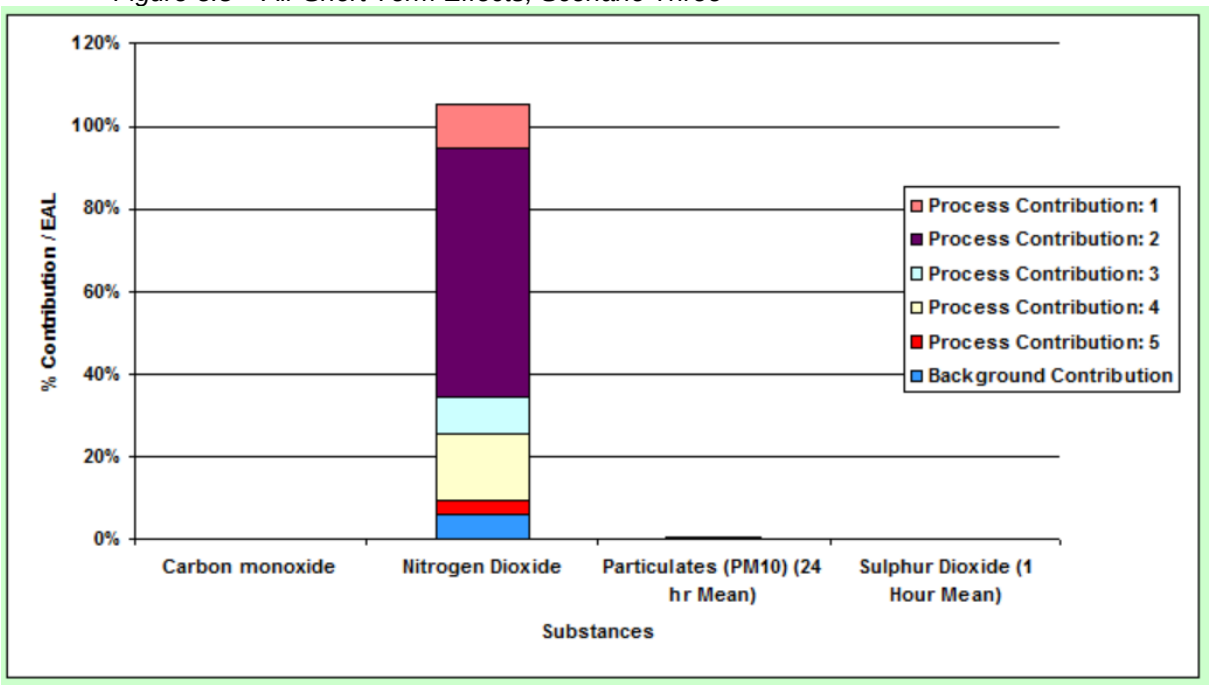
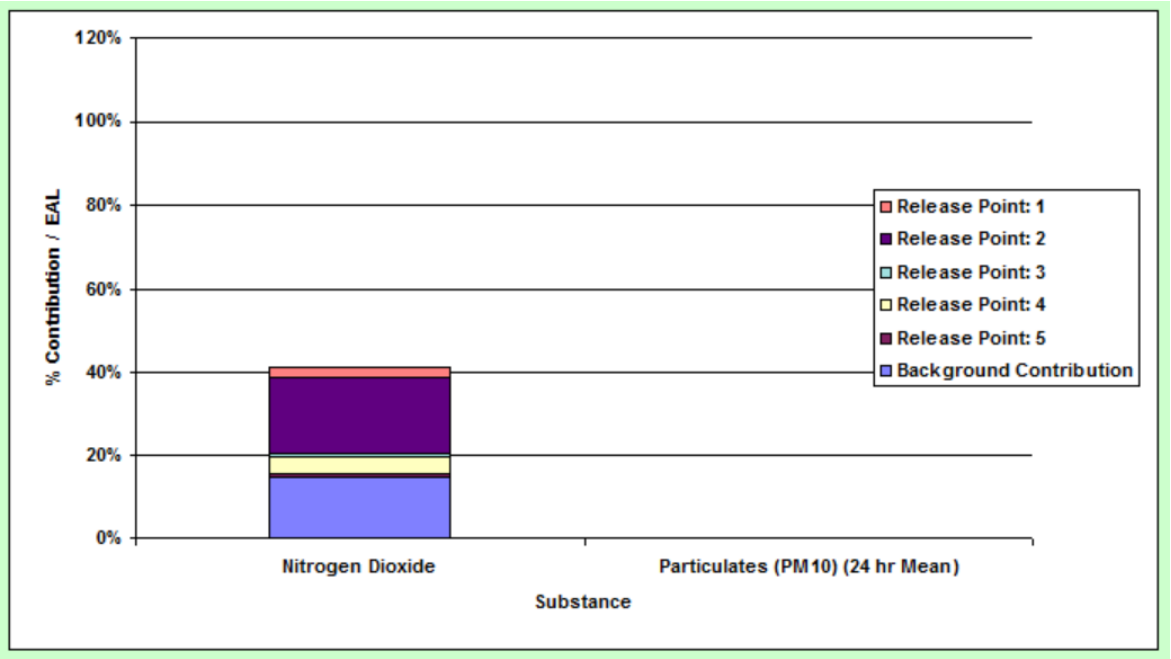


Figure 3.9 – Air Long Term Effects, Scenario Three



Scenario Four

This Scenario includes only emission point B2 (at 0m effective height). This is the largest source of emissions. Because the emission points are not close together and therefore unlikely to have a significant combined impact, we have modelled the effect of B2 on its own. The assumptions used have been as per Scenario Three.

Figure 4.2 – Air Emissions Inventory (NO_2), Boiler 2, Scenario Four

Source	Percentage on-time	Long Term effects (using operational % of measured)		Short Term effects (using 50% of measured)		Annual Rate (tpa)
		Concentration (mg/m^3)	Release Rate (g/s)	Concentration (mg/m^3)	Release Rate (g/s)	
B2	80%	208	0.05	130	0.031	1.56

Using the data presented in the Figure above, the following outputs were obtained from the H1 model.

Figure 4.3 – Calculate Process Contributions of Emissions to Air, Scenario Four

		Long Term			Short Term		
Number	Substance	EAL µg/m3	PC µg/m3	* Modelled PC µg/m3	EAL µg/m3	PC µg/m3	* Modelled PC µg/m3
1	Nitrogen Dioxide	40	7.41		200	121	

Figure 4.4 – Screen Out Insignificant Emissions to Air, Scenario Four

				Long Term			Short Term		
Number	Substance	Long Term EAL µg/m3	Short Term EAL µg/m3	PC µg/m3	% PC of EAL %	> 1% of EAL?	PC µg/m3	% PC of EAL %	> 10% of EAL?
1	Nitrogen Dioxide	40.0	200	7.41	18.6	**Yes**	121	60.5	**Yes**

While nitrogen dioxide is shown to exceed 1% and 10% of the relevant EALs, all emission PCs are below the EALs and therefore it is not considered that further modelling is required as the assessment is using real-time monitored data.

Figure 4.5 – Identify Need for Detailed Modelling of Emissions to Air, Scenario Four

			Long Term				Short Term	
Number	Substance	Air Bkgrnd Conc. µg/m3	PC µg/m3	% PC of headroom (EAL - Bkgrnd)	PEC µg/m3	% PEC of EAL %	PC µg/m3	% PC of headroom (EAL - Bkgrnd)
		e.g. 12						
1	Nitrogen Dioxide	6	7.41	21.8	13.5	33.6	121	64.4

The contribution of air background nitrogen dioxide is 6 µg/m³. Air Background Concentration data were obtained from the Defra LAQM Background Maps.

Figure 4.6 – Deposition from Air to Land, Scenario Four

			Decision whether to screen as insignificant	
Number	Substance	% PC of EAL %	Insignificant?	Reason (See section 3.4.1 of H1)
1	Nitrogen Dioxide	18.6	Yes	Well below the EAL.

Figures 4.7 and 4.8 graphically show the contribution of each release point to the EAL.

Figure 4.7 – Air Short Term Effects, Scenario Four

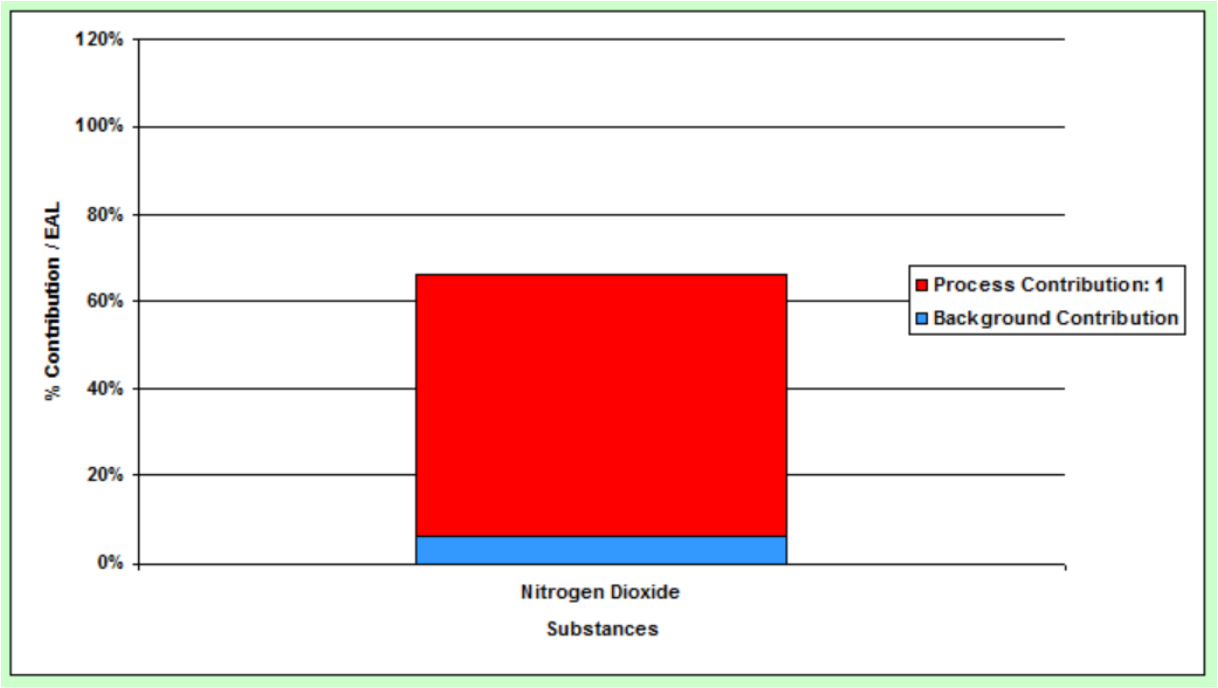
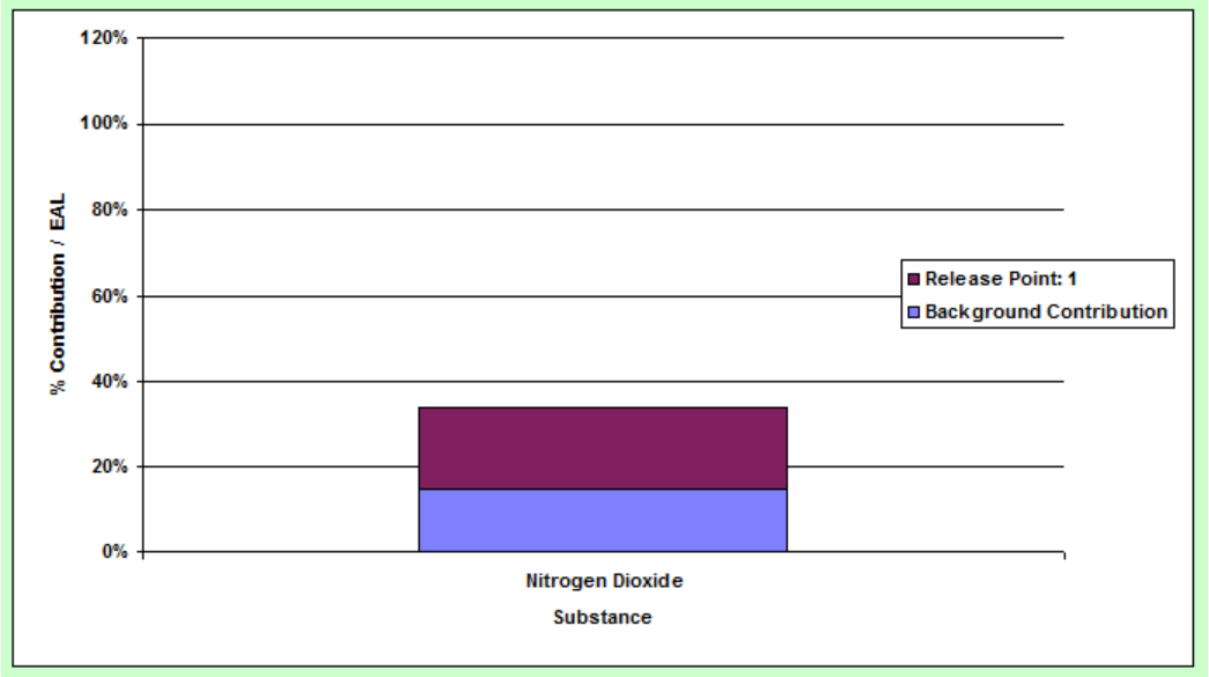


Figure 4.8 – Air Long Term Effects, Scenario Four



Conclusions

Scenario	Assumptions	Conclusions	Further modelling suggested?
One	Long Term – takes into account annual boiler usage. Short Term – 50% of measured NO_x value.	SO_2, CO and PM screened out as insignificant (< 1% / 10% of EAL) for both Short and Long Term. NO_2 PC below EAL for both Short and Long Term.	No
Two	Long Term – as per monitoring data, so assuming 100% boiler load. Short Term – 50% of measured NO_x value.	SO_2, CO and PM screened out as insignificant (< 1% / 10% of EAL) for both Short and Long Term. NO_2 PC below EAL for both Short and Long Term.	No
Three	Long Term – takes into account annual boiler usage. Short Term - 50% of measured NO_x value. Effective stack height of B2 as 0m.	SO_2, CO and PM screened out as insignificant (< 1% / 10% of EAL) for both Short and Long Term. NO_2 PC below EAL for both Short and Long Term. If background NO_2 is considered, overall emissions are just above the short term EAL.	No
Four	B2 as the only emission point. Long Term – takes into account annual boiler usage. Short Term - 50% of measured NO_x value. Effective stack height of B2 as 0m.	NO_2 PC below EAL for both Short and Long Term.	No

We believe the above is a fair assessment of the likely impact. Since the screening approach is conservative we expect a realistic Short Term ground level concentration (GLC) to be below the EAL (including background levels), as Boiler 2 stack height is at the eaves and it is a larger boiler with a good stack emission velocity and temperature.

The five emission points are not close together (as per *RH7 Air Emission Positions 2.0*) so the combination of their emissions is less likely. This is also supported with the Screening Analysis of Boiler 2 on its own which predicts a PC of 121 µg/m^3.

We do not feel the need for more detailed monitoring at this point as all modelled PCs fall below the relevant EALs.

We trust that this appropriately responds to your queries on this point and provides clarification. Please let us know if you have any further queries.

Yours sincerely,

Via email

John Henry Looney

Managing Director

Email jh.looney@sustainabledirection.com
Mobile 07817 809018