

Proposed Crematorium
Grevatts Lane, Yapton, West Sussex

Air Quality Assessment

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Air Quality Assessment

Revision	Date	Notes	Author	Checked	Approved
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1 INTRODUCTION

1.1 Entran Ltd has been commissioned to undertake an assessment of the likely local air quality impacts arising from the operation of a proposed new crematorium in Yapton, West Sussex. The location of the Proposed Development is presented in Figure 1.1.

1.2 The key pollutants considered in this assessment are:

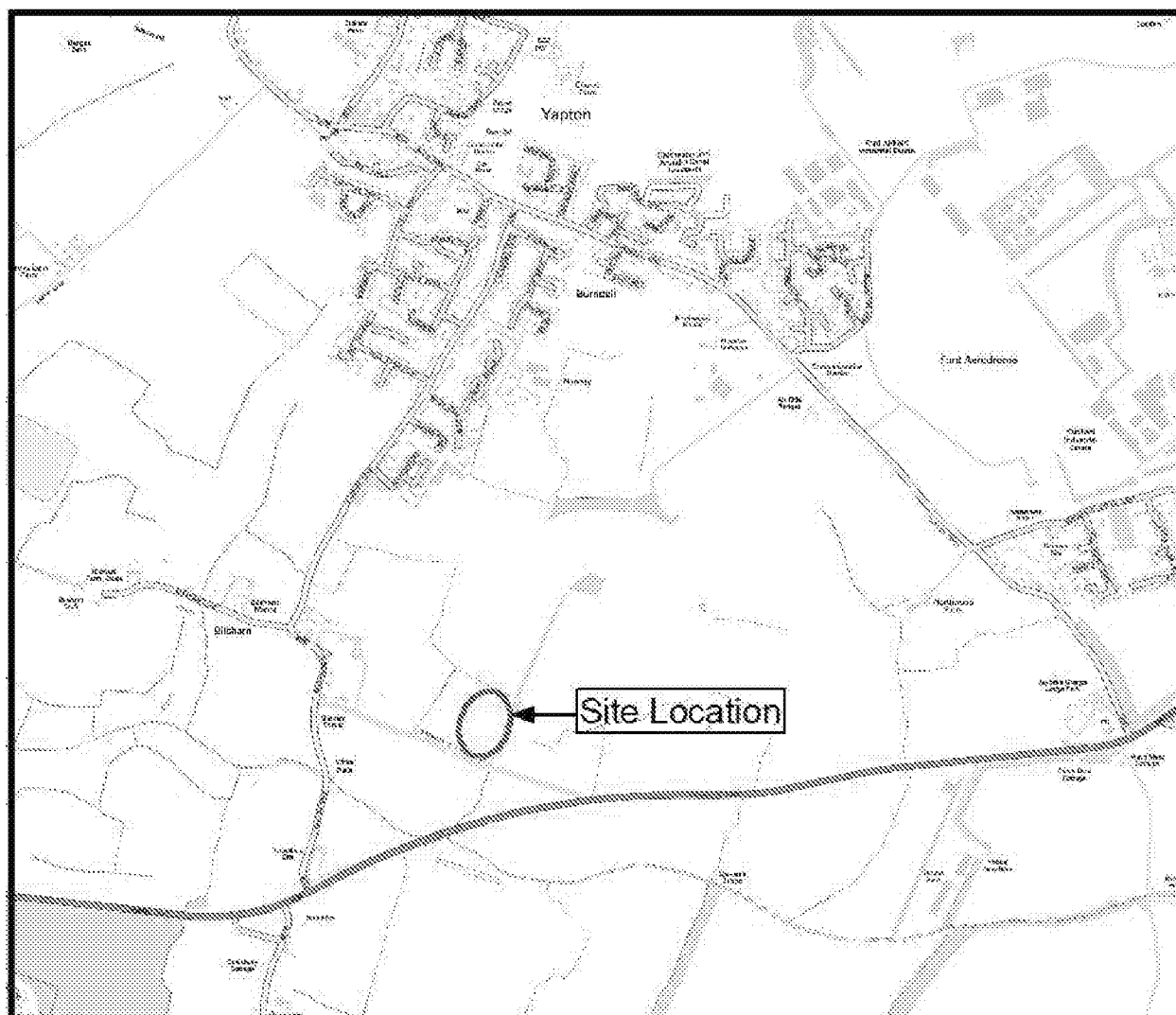
- ¿ oxides of nitrogen (NO_x as NO₂);
- ¿ carbon monoxide (CO);
- ¿ sulphur dioxide (SO₂);
- ¿ hydrogen chloride (HCl);
- ¿ particulate matter (as PM₁₀ and PM_{2.5});
- ¿ mercury (Hg);
- ¿ organic compounds, expressed as carbon; and
- ¿ dioxins and furans (PCDD/Fs).

1.3 Predicted ground-level concentrations of these pollutants are compared with relevant air quality standards and guidelines for the protection of health and sensitive habitat sites.

1.4 A glossary of common air quality terminology is provided in Appendix A.



Figure 1.1: Site Location





2 LEGISLATION AND POLICY

The European Directive on Ambient Air and Cleaner Air for Europe

2.1 European Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008, sets legally-binding Europe-wide limit values for the protection of public health and sensitive habitats. The Directive streamlines the European Union's air quality legislation by replacing four of the five existing Air Quality Directives within a single, integrated instrument.

2.2 The pollutants included are sulphur dioxide (SO₂), nitrogen dioxide (NO₂), particulate matter of less than 10 micrometres (1 µm) in aerodynamic diameter (PM₁₀), particulate matter of less than 2.5 µm in aerodynamic diameter (PM_{2.5}), lead (Pb), carbon monoxide (CO), benzene (C₆H₆), ozone (O₃), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

Air Quality Strategy for England, Scotland, Wales & Northern Ireland

2.3 The Government's policy on air quality within the UK is set out in the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland (AQS) published in July 2007¹, pursuant to the requirements of Part IV of the Environment Act 1995. The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK. The AQS is designed to be an evolving process that is monitored and regularly reviewed.

2.4 The AQS sets standards and objectives for ten main air pollutants to protect health, vegetation and ecosystems.

2.5 The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on medical and scientific evidence reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO). These are general concentration limits, above which sensitive members of the public (e.g. children, the elderly and the unwell) might experience adverse health effects.

¹ Department for Environment, Food and Rural Affairs (2007), The Air Quality Strategy for England, Scotland, Wales and Northern Ireland



2.6 The air quality objectives (AQO) are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedences of the standard over a given period.

2.7 For some pollutants there is both a long-term (annual mean) standard and a short-term standard. In the case of NO₂, the short-term standard is for a 1-hour averaging period, whereas for PM₁₀ it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants (e.g. temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road).

Air Quality (England) Regulations

2.8 Many of the objectives in the AQS were made statutory in England with the Air Quality (England) Regulations 2000² and the Air Quality (England) (Amendment) Regulations 2002 (the Regulations)³ for the purpose of Local Air Quality Management (LAQM).

2.9 The Air Quality Standards Regulations 2010⁴ have adopted into UK law the limit values required by EU Directive 2008/50/EC and came into force on the 10th June 2010. These regulations prescribe the 'relevant period' (referred to in Part I2V of the Environment Act 1995) that local authorities must consider in their review of the future quality of air within their area. The regulations also set out the air quality objectives to be achieved by the end of the 'relevant period'.

2.10 Ozone is not included in the Regulations as, due to its trans-boundary nature, mitigation measures must be implemented at a national level rather than at a local authority level.

2.11 The EALs, air quality standards and objectives for the pollutants considered in the assessment are presented in Appendix B.

² The Air Quality (England) Regulations 2000 - Statutory Instrument 2000 No.928

³ The Air Quality (England) (Amendment) Regulations 2002 - Statutory Instrument 2002 No.3043

⁴ The Air Quality Standards Regulations 2010 - Statutory Instrument 2010 No. 1001



Local Air Quality Management (LAQM)

2.12 Part IV of the Environment Act 1995 also requires local authorities to periodically Review and Assess the quality of air within their administrative area. The Reviews have to consider the present and future air quality and whether any air quality objectives prescribed in Regulations are being achieved or are likely to be achieved in the future.

2.13 Where any of the prescribed air quality objectives are not likely to be achieved the authority concerned must designate that part an Air Quality Management Area (AQMA).

2.14 For each AQMA, the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the air quality objectives. Local authorities are not statutorily obliged to meet the objectives, but they must show that they are working towards them.

2.15 The Department of Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local authorities in their Review and Assessment work⁵. This guidance, referred to in this chapter as LAQM.TG(16), has been used where appropriate in the assessment.

National Planning Policy Framework

2.16 The National Planning Policy Framework (NPPF)⁶ sets out the Government's planning policies for England and how these are expected to be applied. At the heart of the NPPF is a presumption in favour of sustainable development. It requires Local Plans to be consistent with the principles and policies set out in the NPPF with the objective of contributing to the achievement of sustainable development.

2.17 The NPPF states that the planning system has three overarching objectives in achieving sustainable development including a requirement to :contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.~

⁵ Department for Environment, Food and Rural Affairs (DEFRA), (2016): Part IV The Environment Act 1995 Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(16).

⁶ Ministry of Housing, Communities and Local Government: National Planning Policy Framework (J uly 2018).



2.18 Under Section 15: Conserving and Enhancing the Natural Environment, the NPPF (paragraph 170) requires that :planning policies and decisions should contribute to and enhance the natural local environment by ũ preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible help to improve local environmental conditions such as air and water quality.~

2.19 In dealing specifically with air quality the NPPF (paragraph 181) states that :planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan~.

2.20 Paragraph 183 states that :the focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively.~



3 METHODOLOGY

Scope of the Assessment

3.1 The scope of the impact assessment for stack emissions from the Proposed Development has been determined in the following way:

- ¿ review of air quality data for the area surrounding the Site, including data from the Defra Air Quality Information Resource (UK-AIR);
- ¿ desk study to confirm the location of nearby areas that may be sensitive to changes in local air quality; and
- ¿ review of emission parameters for the Proposed Development and dispersion modelling using the Breeze AERMOD 7 dispersion model to predict ground-level concentrations of pollutants at sensitive human and habitat receptor locations.

Emissions

3.1 The key pollutants arising from the combustion process will be oxides of nitrogen (NO_x), CO and SO₂. The emissions from the plant will comply with the limits for abated cremators set out in the Defra Statutory Guidance for Crematoria⁷ (see Table 3.1).

Table 3.1: Emission Limits (273.15K, 11% O₂, 101.3 mb, dry)

Pollutant	Emission Limit
Mercury	50 µg/Nm ³
Hydrogen chloride	30 mg/Nm ³
Total particulate matter	20 mg/Nm ³
Carbon monoxide	100 mg/Nm ³
Organic compounds	20 mg/Nm ³
Dioxins and furans	0.1 ng/Nm ³ (ITE Q)

3.2 In addition, the technology suppliers (Facultative Technologies) have provided typical emission concentrations of 350 mg/Nm³ and 50 mg/Nm³ for NO_x and SO₂, respectively.

⁷ Process Guidance Note 5/2 (12), Statutory Guidance for Crematoria, September 2012



3.3 The input parameters for the proposed cremator are identified in Appendix C. The likely maximum operational profile of the facility is 8 hours per day, 5 days a week; the long-term mass emission rates have been scaled accordingly.

3.4 An initial D1 screening assessment was carried out for the process by the technology supplier (Appendix D), which indicates that stack height of 13m will be required at the Site which allows for future expansion to include an additional cremator.

3.5 Predicted ground level concentrations are compared with relevant air quality standards for the protection of health and critical levels / loads for the protection of sensitive ecosystems and vegetation.

Local Meteorological Data

3.6 The dispersion modelling has been carried out using five years (2013 to 2017) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. Data from meteorological station at Shoreham Airport (approximately 22 km east of the Site) has been used for the assessment, which is the most representative data currently available for the area.

3.7 Wind roses for each year of meteorological data are presented in Appendix E.

Building Downwash / Entrainment

3.8 The presence of buildings close to emission sources can significantly affect the dispersion of pollutants by leading to a phenomenon called downwash. This occurs when a building distorts the wind flow, creating zones of increased turbulence. Increased turbulence causes the plume to come to ground earlier than otherwise would be the case and result in higher ground level concentrations closer to the stack.

3.9 Downwash effects are only significant where building heights are greater than 30 to 40% of the emission release height. The downwash structures also need to be sufficiently close for their influence to be significant.

3.10 The crematorium buildings have been included in the model as a potential downwash structures.



Nitric Oxide to NO₂ Conversion

3.11 Oxides of nitrogen (NO_x) emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO₂. The proportion of NO converted to NO₂ depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O₃).

3.1 A conversion ratio of 70% NO_x:NO₂ has been assumed for comparison of predicted concentrations with the long-term objectives for NO₂. A conversion ratio of 35% has been utilised for the assessment of short-term impacts, as recommended by Environment Agency guidance⁸.

Sensitive Human Health Receptors

3.2 LAQM.TG(16) describes in detail typical locations where consideration should be given to pollutants defined in the Regulations. Generally, the guidance suggests that all locations 'where members of the public are regularly present' should be considered. At such locations, members of the public will be exposed to pollution over the time that they are present, and the most suitable averaging period of the pollutant needs to be used for assessment purposes.

3.3 For instance, on a footpath, where exposure will be transient (for the duration of passage along that path) comparison with short-term standard (i.e. 15-minute mean or 1-hour mean) may be relevant. In a school, or adjacent to a private dwelling, however; where exposure may be for longer periods, comparison with long-term (such as 24-hour mean or annual mean) standards may be most appropriate. In general terms, concentrations associated with long-term standards are lower than short-term standards owing to the chronic health effects associated with exposure to low level pollution for longer periods of time.

3.4 The location of the sensitive receptors selected for the assessment is presented in Table 3.2 and Figure 3.1.

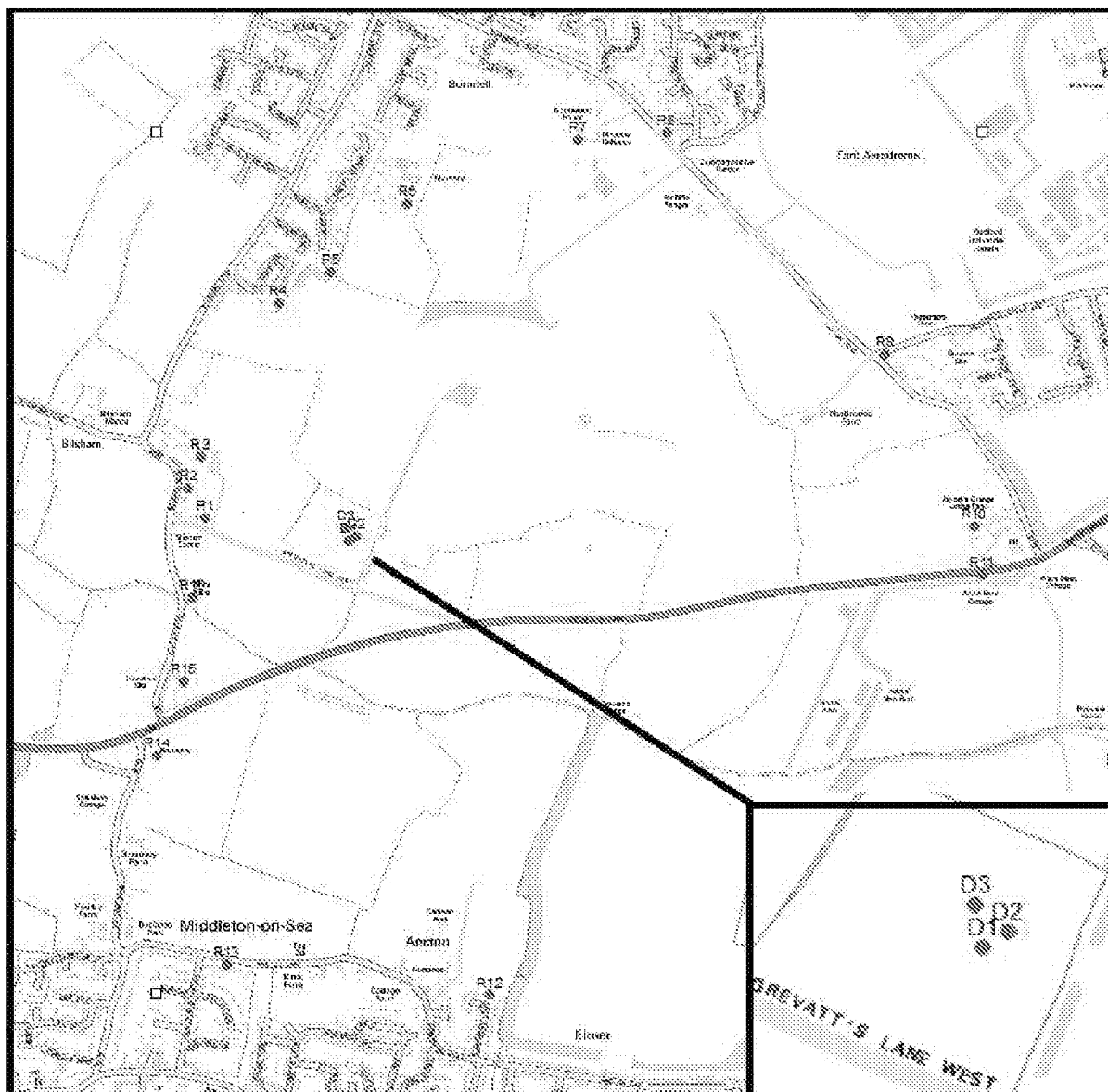
⁸ Environment Agency AQMAU, Conversion Rates for NO_x and NO₂.



Table 3.2: Sensitive Receptors

ID	Receptor	Type	Easting	Northing
R 1	Bilsham Cottage	Residential	497652.13	101778.69
R 2	84 Bilsham Road	Residential	497607.75	101852.47
R 3	Little Meadow	Residential	497638.78	101932.97
R 4	16 Taylors Close	Residential	497832.91	102313.36
R 5	West View Drive	Residential	497962.63	102392.11
R 6	Primrose Lodge	Residential	498154.97	102561.64
R 7	Paynters Croft	Residential	498579.47	102721.66
R 8	10 Miles Close	Residential	498800.5	102740.01
R 9	Southdown Cottage	Residential	499345.09	102186.22
R 10	Jaybelle Grange Lodge Park	Short Term	499566.56	101758.48
R 11	Apple Barn Cottage	Residential	499586.75	101637.28
R 12	24 Sunnymead Close	Residential	498359.97	100590.86
R 13	Grasmere, Ancton Lane	Residential	497701.88	100666.12
R 14	Brambles	Residential	497530.38	101187.36
R 15	Ryebank Travellers Site	Residential	497596	101370.56
R 16	1 White Rails	Residential	497616.91	101579.52
D1	Waiting Room	Short Term (Proposed)	498008.19	101722.3
D2	Chapel	Short Term (Proposed)	498025.91	101733.6
D3	Office	Short Term (Proposed)	498003.09	101754.4

Figure 3.1: Sensitive Receptor Locations



3.5 Pollutant concentrations have been predicted at both discrete receptor locations and over a 2km by 2km Cartesian grid of 25 m resolution.



Ecological Receptors

3.6 The EA risk assessment guidance states that the impact of emissions to air on vegetation and ecosystems should be assessed for the following habitat sites within 10 km of the source:

- ¿ Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive⁹;
- ¿ Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive¹⁰; and
- ¿ Ramsar Sites designated under the Convention on Wetlands of International Importance¹¹.

3.7 Within 2 km of the source the following habitat sites should be assessed:

- ¿ Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act;
- ¿ National Nature Reserves (NNR);
- ¿ Local Nature Reserves (LNR);
- ¿ local wildlife sites (LWS) and potential wildlife sites (PWS);
- ¿ Sites of Importance for Nature Conservation (SINC) and
- ¿ ancient woodland.

3.8 Only one designated ecological habitat is located within the relevant distances of the Site. This is the Pagham Harbour Ramsar Site and SPA, of which only a small section is located within a 10km radius of the Site. A receptor has been included in the model within this designated site at the closest point to the Site. Details of LWS within the vicinity of the Site were not available, therefore the impact on LWSs has been assessed by considering the impact at the location where the highest concentration is predicted within the 2km grid. This will ensure a worst case assessment is completed.

⁹ Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

¹⁰ Council Directive 79/409/EEC on the conservation of wild birds

¹¹ Ramsar (1971), The Convention of Wetlands of International Importance especially as Waterfowl Habitat



3.9 The modelled ground level pollutant concentrations are used to predict deposition rates, using typical deposition velocities. A summary of typical NO₂ and SO₂ dry deposition velocities is presented in Table 3.4.

Table 3.4: Dry Deposition Velocity (m/s)

Pollutant	Grassland	Woodland
Nitrogen Dioxide (NO ₂)	0.0015	0.0030
Sulphur Dioxide (SO ₂)	0.012	0.024

3.10 The predicted nitrogen deposition rates assume a 100% NO_x: NO₂ conversion. This represents a worst-case for the assessment since nitric oxide (NO) has a lower deposition velocity than NO₂ and consequently results in lower deposition rates.

3.11 Predicted ground level concentrations and acidification / nitrogen deposition rates are compared with relevant air quality standards for human health and critical levels and critical loads for the protection of sensitive ecosystems and vegetation (see Appendix F).

Significance Criteria

Human Health Receptors

3.12 The significance of the predicted long-term impact at human health receptors is determined in accordance with the EPUK / IAQM planning guidance¹² in combination with the professional judgement of the author. The impact at individual receptors depends on the predicted change in the pollutant concentration compared with the relevant air quality standard or objective and existing air quality as illustrated in Table 3.5.

¹² EPUK/IAQM(2017), Land-Use Planning & Development Control: Planning for Air Quality, January 2017



Table 3.5: Significance Descriptors for Individual Receptors (Long-Term Impacts)

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL) (a)			
	1	2-5	5-10	>10
75% or less of AQAL	Negligible	Negligible	S light adverse	Moderate adverse
76-94% of AQAL	Negligible	S light adverse	Moderate adverse	Moderate adverse
95-102% of AQAL	S light adverse	Moderate adverse	Moderate adverse	Substantial adverse
103-109% of AQAL	Moderate adverse	Moderate adverse	Substantial adverse	Substantial adverse
110% or more of AQAL	Moderate adverse	Substantial adverse	Substantial adverse	Substantial adverse
(a) A change in concentration of less than 0.5% of the AQAL is considered insignificant, however changes between 0.5% and 1% are rounded up to 1%.				

3.13 Short-term impacts of less than 10% of the AQAL are described as negligible, regardless of existing air quality. Where the short-term process concentrations are 11-20% of the AQAL the severity of the impact is described as slight adverse. Impacts of 21-50% and over 51% are described as moderate and substantial adverse, respectively.

Ecological Receptors

3.14 The Environment Agency's environmental risk assessment guidance¹³ specifies criteria to enable the potential significance of an impact to be determined. The criteria are outlined in Table 3.6 below.

¹³ <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>



Table 3.6: Significance Criteria for Ecological Sites

Ecological Habitat	Stage One	Stage Two
SPAs, SACs, Ramsar sites or SSSIs	The impact is considered insignificant if - Short term PC < 10% short term critical level; and - Long term PC < 1% long term critical level	The impact is considered to be insignificant if Long term PC > 1% and PEC < 70% of the long term critical level.
Local Nature Sites (ancient woodlands, local wildlife sites, national and local nature reserves)	The impact is considered to be insignificant if: - Short term PC < 100% short term critical level; and - Long term PC < 100% long term critical level	



4 BASELINE CONDITIONS

Local Air Quality Management

4.1 The Proposed Development is located within the administrative area of Arun District Council (ADC).

4.2 ADC undertakes frequent review and assessments of air quality and produces Annual Status Reports in accordance with the requirements of Defra.

4.3 The Proposed Development does not lie within an Air Quality Management Area (AQMA). The nearest AQMAs to the Site are over 12km from the Site, in Stockbridge and Chichester and are unlikely to be significantly affected by emissions from the crematorium.

Nitrogen Dioxide, Carbon Monoxide, Particulate Matter, Sulphur Dioxide and Total Organic Carbon (as Benzene)

4.4 ADC does not currently monitor air quality using continuous automatic monitors. Concentrations of NO₂ across the district are measured using a network of diffusion tubes. None of the diffusion tubes are located in a background location, the closest monitoring location to the Site is a roadside monitor in Yapton (Yap03). In 2017 the NO₂ concentration measured in this location was 16.91 g/m³ which is well below the relevant AQS objective level.

4.5 Due to the lack of suitable air quality monitoring undertaken in the vicinity of the Site, background pollutant concentrations have been obtained from the Defra UK Background Air Pollution maps¹⁴ for use in the assessment. These 1 km grid resolution maps are derived from a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automated and non-automated sites.

4.6 The latest background maps for NO_x, NO₂, PM₁₀ and PM_{2.5} were issued in November 2017 and are based on 2015 monitoring data. The CO, SO₂ and benzene mapped concentrations are based on 2001 monitoring data. For CO and benzene, factors are available to project the concentrations to future years¹⁵. No reduction in SO₂ since 2001 is assumed.

¹⁴ <http://uk-air.defra.gov.uk/data/laqm-background-home>

¹⁵ <http://laqm.defra.gov.uk/tools-monitoring-data/year-adjustment.html>



4.7 The average background concentrations obtained from the four 1 km squares surrounding the Site have been used as background concentrations throughout the study area. A summary is presented in Table 4.1.

Table 4.1: Mapped Annual Mean Background Concentrations ($\mu\text{g}/\text{m}^3$)

Pollutant	Annual Mean	AQAL
Nitrogen Dioxide (NO_2)	7.4	40
Particles (PM_{10})	13.0	40
Particles ($\text{PM}_{2.5}$)	8.3	25
Sulphur Dioxide (SO_2)	2.3	n/a
Carbon Monoxide (CO)	102.5	n/a
Benzene (C_6)	0.19	5

Hydrogen Chloride

4.8 Ambient monitoring of Hydrogen Chloride is carried out as part of the Defra Acid Gases and Aerosols Network (AGANET) at a number of, predominantly rural, locations around the UK.

4.9 For the purposes of the assessment, the 2011 to 2015 average HCl concentration (which is the latest available data) measured at the nearest rural background location of $0.40 \mu\text{g}/\text{m}^3$ is assumed to provide a reasonable estimate of the background concentration at the Site and nearby sensitive receptors.

Mercury

4.10 Defra currently monitors mercury at a number of locations as part of the Rural Automatic Mercury Network.

4.11 The annual average mercury concentration measured at the nearest rural site between 2016 and 2018 was $1.5 \text{ ng}/\text{m}^3$. For the purposes of the assessment this concentration is assumed to provide a reasonable estimate of the existing concentration in the vicinity of the Proposed Development.

Dioxins and Furans

4.12 Monitoring of PCDD/Fs is currently carried out by Defra at six locations in the UK (Hazelrigg, High Muffles, London, Manchester, Auchencorth Moss and Weybourne) as part of the Toxic Organic Micropollutants (TOMPs) Network.



4.13 To provide an indication of the range of PCDD/F concentrations that occur in the UK, a summary of the annual mean concentrations measured between 2014 and 2016 is presented in Table 4.2.

Table 4.2: UK PCDD/Fs Concentrations (fg TEQ/m³)

Metal	Type	2014	2015	2016
London	Urban background	2.87	4.35	20.75
Manchester	Urban background	16.95	5.95	12.25
Auchencorth Moss	Rural background	0.01	<0.01	0.15
High Muffles	Rural background	1.44	1.06	3.7
Hazelrigg	Rural background	2.59	5.29	4.58
Weybourne	Rural background	1.62	1.42	17.78

4.14 In general, the concentration of dioxins and furans at rural locations is considerably lower than at urban locations.

4.15 The average concentration measured at the four rural background monitoring sites from 2014 to 2016 is 3.3 fg/m³ and is assumed to be reasonably representative of the baseline dioxin and furan concentration at the Site and nearby sensitive receptors.



5 ASSESSMENT OF IMPACT

Human Health Impacts

Introduction

5.1 Predicted process concentrations (PC) for the five years of meteorological data are presented as the maximum off-site ground level concentration (GLC) predicted across the grid and the maximum for each of the discrete receptors identified in Table 3.2.

5.2 In order to predict the long-term predicted environmental concentrations (PECs), annual mean background concentrations identified in Section 4 have been combined with the predicted long-term PC. To predict the short-term PECs, in accordance with the EA's Air Emissions Risk Assessment Guidance the predicted short-term PC is added to the short-term background concentrations which is assumed to be twice that of the annual average background concentration. The exception to this is the 24-hour mean PM₁₀ concentrations, for which the long-term background concentrations have been added in accordance with advice provided in LAQM.TG(16).

5.3 The maximum PEC is compared with the relevant air quality standard and the significance of the impact determined in accordance with the EPUK / IAQM criteria outlined in Table 3.5.

Nitrogen Dioxide

5.4 The predicted annual mean and 99.8th percentile of 1-hour mean ground level NO₂ process concentrations are presented in Table 5.1.

Table 5.1: Predicted NO₂ Concentrations (ng/m³)

Receptor	Annual Mean		99.8 th Percentile of 1-Hour Means	
	PC	PC (% AQAL)	PC	PC (% AQAL)
Maximum GLC	-	-	8.10	4.05
R1: Bilsham Cottage	0.013	0.03	1.61	0.80
R2: 84 Bilsham Road	0.013	0.03	1.35	0.68
R3: Little Meadow	0.018	0.04	1.61	0.80
R4: 16 Taylors Close	0.009	0.02	1.03	0.52
R5: West View Drive	0.009	0.02	0.92	0.46
R6: Primrose Lodge	0.008	0.02	0.76	0.38



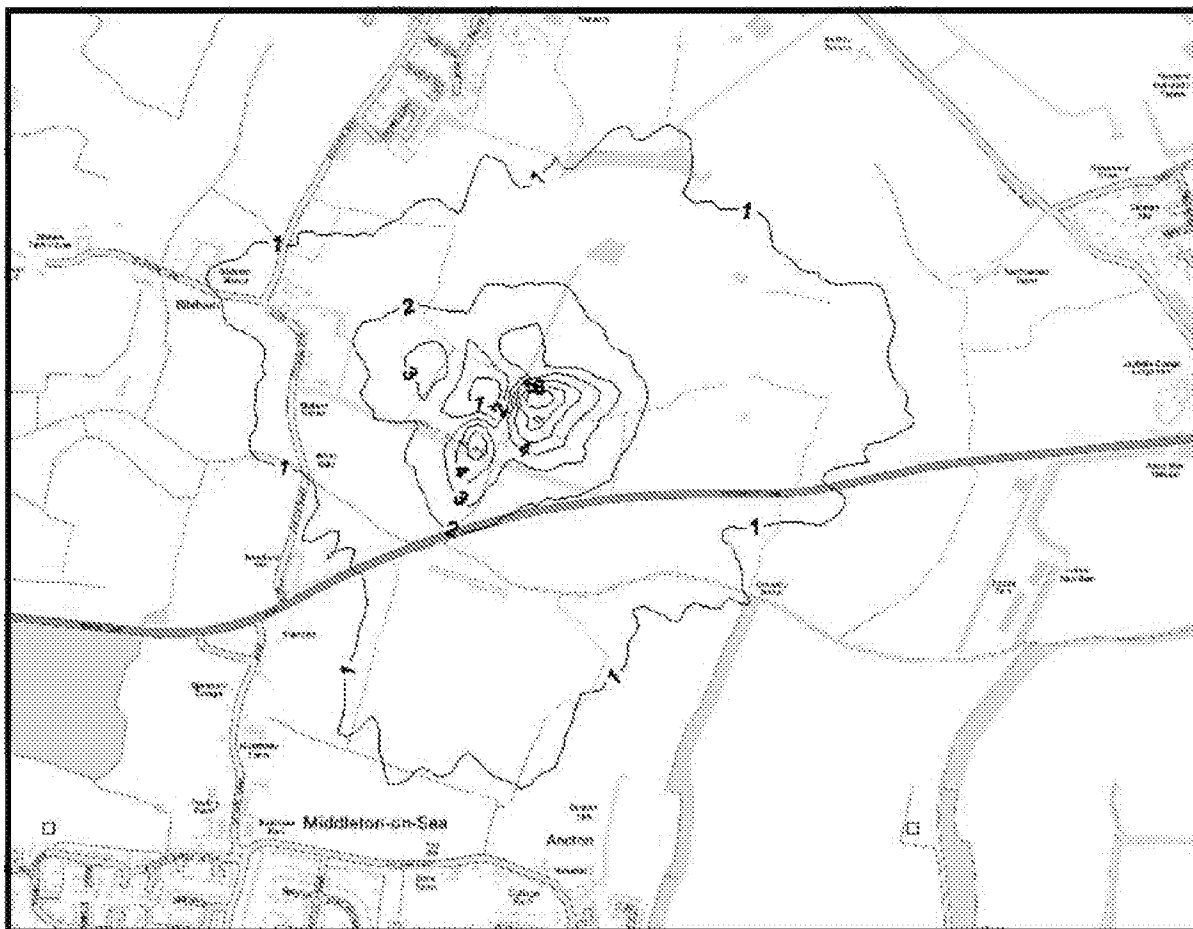
Receptor	Annual Mean		99.8 th Percentile of 1-Hour Means	
	PC	PC (% AQAL)	PC	PC (% AQAL)
R 7: Paynters Croft	0.006	0.02	0.60	0.30
R8: 10 Miles Close	0.006	0.01	0.57	0.29
R9: Southdown Cottage	0.009	0.02	0.66	0.33
R10: J aybelle Grange Lodge Park	-	-	0.72	0.36
R 11: Apple Barn Cottage	0.008	0.02	0.75	0.37
R 12: 24 Sunnymead Close	0.008	0.02	0.76	0.38
R 13: Grasmere, Ancton Lane	0.011	0.03	0.85	0.43
R 14: Brambles	0.011	0.03	0.98	0.49
R 15: Ryebank Travellers Site	0.015	0.04	1.24	0.62
R16: 1 White Rails	0.017	0.04	1.39	0.69
D1: Waiting Room	-	-	1.37	0.69
D2: Chapel	-	-	0.66	0.33
D3: Office	-	-	0.12	0.06
AQAL	40.0		200	
Background	7.4		14.8	
Maximum PEC	7.418		22.9	
Maximum PEC (% AQAL)	18.5%		11.5%	
Notes				
1. No long term exposure at receptors R 10, D1, D2 and D3 or at max location within the grid, therefore annual mean standard not applicable at these locations				

5.5 The results indicate that there will be no exceedances of the relevant AQALs, which are the AQS annual objective level of 40 μ g/m³ and the hourly NO₂ objective level of 200 μ g/m³, as a result of the operation of the Proposed Development.

5.6 The maximum annual mean NO₂ PC arising from the Proposed Development is a concentration of 0.018 μ g/m³ which is 0.04% of the objective level. In accordance with the criteria outlined in the EPUK / IAQM guidance as presented in Table 3.5, the impact is considered to be negligible.

5.7 The maximum hourly mean NO₂ PC arising from the Proposed Development is a concentration of 1.61 μ g/m³ at a selected sensitive receptor which is 0.8% of the relevant objective level and 8.1 μ g/m³ at the maximum off site location within the grid which is 4.1% of the objective level. In accordance with the criteria outlined in the EPUK / IAQM guidance, which states that an

Figure 5.2: Predicted 99.8th Percentile of 1-Hour Mean NO₂ Process Concentrations (ng/m³)



Carbon Monoxide (CO)

5.9 The predicted maximum 1-hour and 8-hour mean ground level CO concentrations are presented in Table 5.2.

Table 5.2: Predicted CO Concentrations (ng/m³)

Receptor	Maximum 8-Hour Mean		Maximum 1-Hour Mean	
	PC	PC (% AQAL)	PC	PC (% AQAL)
Maximum GLC	4.10	0.041	8.38	0.03
R1: Bilsham Cottage	0.78	0.008	2.24	0.01
R2: 84 Bilsham Road	0.89	0.009	1.74	0.01
R3: Little Meadow	1.18	0.012	1.81	0.01
R4: 16 Taylors Close	0.59	0.006	1.64	0.01
R5: West View Drive	0.48	0.005	1.27	0.00
R6: Primrose Lodge	0.36	0.004	1.22	0.00



Receptor	Maximum 8-Hour Mean		Maximum 1-Hour Mean	
	PC	PC (% AQAL)	PC	PC (% AQAL)
R7: Paynters Croft	0.30	0.003	0.92	0.00
R8: 10 Miles Close	0.31	0.003	0.89	0.00
R9: Southdown Cottage	0.34	0.003	0.91	0.00
R10: Jaybelle Grange Lodge Park	0.32	0.003	0.82	0.00
R11: Apple Barn Cottage	0.33	0.003	0.88	0.00
R12: 24 Sunnymead Close	0.40	0.004	0.91	0.00
R13: Grasmere, Ancton Lane	0.53	0.005	0.96	0.00
R14: Brambles	0.49	0.005	1.10	0.00
R15: Ryebank Travellers Site	0.76	0.008	1.30	0.00
R16: 1 White Rails	0.88	0.009	1.65	0.01
D1: Waiting Room	0.84	0.008	2.58	0.01
D2: Chapel	0.58	0.006	2.60	0.01
D3: Office	0.09	0.001	0.38	0.00
AQAL	10,000		30,000	
Background	205		205	
Maximum PEC	209.10		213.38	
Maximum PEC (% AQAL)	2.09%		0.71%	

5.10 The results indicate that there will be no exceedances of the relevant AQALs, which are the AQS 8-hour objective level of 10000_l g/m³ and the hourly EAL of 30,000_l g/m³, as a result of the operation of the Proposed Development.

5.11 The maximum predicted 8-hour and 1-hour PCs are less than 10% of the relevant AQAL, therefore the significance of the impact is negligible.

Sulphur Dioxide (SO₂)

5.12 Predicted SO₂ process concentrations are presented in Table 5.3.



Table 5.3: Predicted SO₂ Concentrations (mg/m³)

Receptor	99.2 nd Percentile of 24-Hour Means		99.7 th Percentile of 1-Hour Means		99.9 th Percentile of 15-Minute Means	
	PC	PC (% AQAL)	PC	PC (% AQAL)	PC	PC (% AQAL)
Maximum GLC	-	-	3.22	0.92	5.06	1.90
R 1: Bilsham Cottage	0.17	0.34	0.62	0.18	0.96	0.36
R 2: 84 Bilsham Road	0.19	0.39	0.53	0.15	0.91	0.34
R 3: Little Meadow	0.24	0.48	0.63	0.18	1.00	0.38
R 4: 16 Taylors Close	0.08	0.15	0.38	0.11	0.69	0.26
R 5: West View Drive	0.09	0.17	0.35	0.10	0.67	0.25
R 6: Primrose Lodge	0.07	0.14	0.27	0.08	0.57	0.21
R 7: Paynters Croft	0.05	0.10	0.21	0.06	0.42	0.16
R 8: 10 Miles Close	0.04	0.09	0.22	0.06	0.43	0.16
R 9: Southdown Cottage	0.05	0.09	0.25	0.07	0.43	0.16
R 10: Jaybelle Grange Lodge Park	0.06	0.12	0.27	0.08	0.49	0.18
R 11: Apple Barn Cottage	0.05	0.11	0.26	0.08	0.50	0.19
R 12: 24 Sunnymead Close	0.07	0.15	0.27	0.08	0.44	0.16
R 13: Grasmere, Ancton Lane	0.07	0.14	0.33	0.10	0.50	0.19
R 14: Brambles	0.09	0.18	0.37	0.11	0.64	0.24
R 15: Ryebank Travellers Site	0.14	0.29	0.49	0.14	0.73	0.28
R 16: 1 White Rails	0.16	0.31	0.54	0.15	0.84	0.32
D1: Waiting Room	0.19	0.37	0.54	0.15	0.83	0.31
D2: Chapel	0.05	0.10	0.15	0.04	0.64	0.24
D3: Office	0.02	0.03	0.05	0.01	0.08	0.03



AQAL	125	350	266
Background	4.6	4.6	4.6
Maximum PEC	4.8	7.8	9.7
Maximum PEC (% AQAL)	9.7%	2.2%	3.6%

5.13 The results indicate that there will be no exceedances of the relevant AQALs, which are the AQS 24-hour, 1-hour and 15-minute objective levels of 125 μ g/m³, 350 μ g/m³ and 266 μ g/m³ respectively, as a result of the operation of the Proposed Development.

5.14 The maximum predicted ground level SO₂ PCs are less than 10% of the relevant air quality standards and are therefore of negligible significance.

Particulate Matter (as PM₁₀)

5.15 Predicted annual mean and 90.4th percentile of 24-hour mean ground level PM₁₀ process concentrations are presented in Table 5.4. The predictions assume that 100% of the particulate matter is emitted from the stack is PM₁₀.

Table 5.4: Predicted PM₁₀ Concentrations (mg/m³)

Receptor	Annual Mean		90.4 th Percentile of 24-Hour Means	
	PC	PC (% AQAL)	PC	PC (% AQAL)
Maximum GLC	-	-	0.193	0.387
R 1: Bilsham Cottage	0.0011	0.003	0.013	0.026
R 2: 84 Bilsham Road	0.0011	0.003	0.013	0.027
R 3: Little Meadow	0.0015	0.004	0.018	0.037
R 4: 16 Taylors Close	0.0007	0.002	0.009	0.019
R 5: West View Drive	0.0008	0.002	0.011	0.021
R 6: Primrose Lodge	0.0007	0.002	0.008	0.016
R 7: Paynters Croft	0.0005	0.001	0.007	0.013
R 8: 10 Miles Close	0.0005	0.001	0.006	0.012
R 9: Southdown Cottage	0.0007	0.002	0.008	0.016
R 10: Jaybelle Grange Lodge Park	-	-	0.010	0.020
R 11: Apple Barn Cottage	0.0006	0.002	0.010	0.019
R 12: 24 Sunnymead Close	0.0007	0.002	0.010	0.021



Receptor	Annual Mean		90.4 th Percentile of 24-Hour Means	
	PC	PC (% AQAL)	PC	PC (% AQAL)
R 13: Grasmere, Ancton Lane	0.0009	0.002	0.012	0.024
R 14: Brambles	0.0009	0.002	0.014	0.028
R 15: Ryebank Travellers Site	0.0012	0.003	0.019	0.038
R 16: 1 White Rails	0.0014	0.003	0.020	0.040
D1: Waiting Room	-	-	0.029	0.057
D2: Chapel	-	-	0.002	0.003
D3: Office	-	-	0.002	0.003
AQAL	40		50	
Background	13.0		13.0	
Maximum PEC	13.004		13.03	
Maximum PEC (% AQAL)	32.5%		26.1%	

5.16 The results indicate that there will be no exceedances of the relevant AQALs, which are the AQS annual mean and 24-hour mean objective levels of 40 μ g/m³ and 50 μ g/m³ respectively, as a result of the operation of the Proposed Development.

5.17 In accordance with the significance criteria provided in the EPUK / IAQM guidance the impact of the operation of the Proposed Development on long and short term PM₁₀ concentration is considered to be of negligible significance.

Particulate Matter (as PM_{2.5})

5.18 Predicted annual mean ground-level PM_{2.5} process concentrations are presented in Table 5.5. The predictions assume that 100% of the particulate matter emitted from the stack is PM_{2.5}.

Table 5.5: Predicted PM_{2.5} Concentrations (μ g/m³)

Receptor	Annual Mean	
	PC	PC (% AQAL)
Maximum GLC	-	-
R 1: Bilsham Cottage	0.0011	0.004
R 2: 84 Bilsham Road	0.0011	0.004
R 3: Little Meadow	0.0015	0.006



Receptor	Annual Mean	
	PC	PC (% AQAL)
R4: 16 Taylors Close	0.0007	0.003
R5: West View Drive	0.0008	0.003
R6: Primrose Lodge	0.0007	0.003
R7: Paynters Croft	0.0005	0.002
R8: 10 Miles Close	0.0005	0.002
R9: Southdown Cottage	0.0007	0.003
R10: Jaybelle Grange Lodge Park	0.0007	0.003
R11: Apple Barn Cottage	0.0006	0.003
R12: 24 Sunnymead Close	0.0007	0.003
R13: Grasmere, Ancton Lane	0.0009	0.004
R14: Brambles	0.0009	0.004
R15: Ryebank Travellers Site	0.0012	0.005
R16: 1 White Rails	0.0014	0.005
D1: Waiting Room	-	-
D2: Chapel	-	-
D3: Office	-	-
AQAL	25	
Background	8.3	
Maximum PEC	8.306	
Maximum PEC (% AQAL)	33.2%	

5.19 The results indicate that there will be no exceedances of the relevant AQAL, which is the AQS annual mean objective level of 25 $\mu\text{g}/\text{m}^3$, as a result of the operation of the Proposed Development.

5.20 In accordance with the significance criteria outlined in the EPUK / IAQM guidance, the impact of the operation of the Proposed Development on concentrations of $\text{PM}_{2.5}$ are of negligible significance.

Total Organic Compounds (as C_6H_6)

5.21 Predicted annual mean ground-level C_6H_6 concentrations are presented in Table 5.6.



Table 5.6: Predicted C₆H₆ Concentrations (ng/m³)

Receptor	Annual Mean		1-Hour Mean	
	PC	PC (% AQAL)	PC	PC (% AQAL)
Maximum GLC	-	-	1.67	0.86
R1: Bilsham Cottage	0.0011	0.02	0.45	0.23
R2: 84 Bilsham Road	0.0011	0.02	0.35	0.18
R3: Little Meadow	0.0015	0.03	0.36	0.19
R4: 16 Taylors Close	0.0007	0.01	0.33	0.17
R5: West View Drive	0.0008	0.02	0.25	0.13
R6: Primrose Lodge	0.0007	0.01	0.24	0.13
R7: Paynters Croft	0.0005	0.01	0.18	0.09
R8: 10 Miles Close	0.0005	0.01	0.18	0.09
R9: Southdown Cottage	0.0007	0.01	0.18	0.09
R10: Jaybelle Grange Lodge Park	-	-	0.16	0.08
R11: Apple Barn Cottage	0.0006	0.01	0.17	0.09
R12: 24 Sunnymead Close	0.0007	0.01	0.18	0.09
R13: Grasmere, Ancton Lane	0.0009	0.02	0.19	0.10
R14: Brambles	0.0009	0.02	0.22	0.11
R15: Ryebank Travellers Site	0.0012	0.02	0.26	0.13
R16: 1 White Rails	0.0014	0.03	0.33	0.17
D1: Waiting Room	-	-	0.52	0.26
D2: Chapel	-	-	0.52	0.27
D3: Office	-	-	0.08	0.04
AQAL	5		195	
Background	0.19		0.38	
Maximum PEC	0.191		2.05	
Maximum PEC (% AQAL)	3.83%		1.05%	

5.22 The results indicate that there will be no exceedances of the relevant AQALs, which are the AQS annual mean objective level of 51 g/m³ and hourly mean EAL of 1951 g/m³, as a result of the operation of the Proposed Development.



5.23 In accordance with the significance criteria provided in the EPUK / IAQM guidance the impact of the operation of the Proposed Development on long and short-term VOC concentration is considered to be of negligible significance.

Hydrogen Chloride (HCl)

5.24 The maximum predicted 1-hour mean ground-level HCl process concentrations are presented in Table 5.7.

Table 5.7: Predicted HCl Concentrations (mg/m³)

Receptor	1-Hour Mean	
	PC	PC (% AQAL)
Maximum GLC	2.52	0.34
R1: Bilsham Cottage	0.67	0.09
R2: 84 Bilsham Road	0.52	0.07
R3: Little Meadow	0.54	0.07
R4: 16 Taylors Close	0.49	0.07
R5: West View Drive	0.38	0.05
R6: Primrose Lodge	0.37	0.05
R7: Paynters Croft	0.28	0.04
R8: 10 Miles Close	0.27	0.04
R9: Southdown Cottage	0.27	0.04
R10: Jaybelle Grange Lodge Park	0.25	0.03
R11: Apple Barn Cottage	0.26	0.04
R12: 24 Sunnymead Close	0.27	0.04
R13: Grasmere, Ancton Lane	0.29	0.04
R14: Brambles	0.33	0.04
R15: Ryebank Travellers Site	0.39	0.05
R16: 1 White Rails	0.50	0.07
D1: Waiting Room	0.78	0.10
D2: Chapel	0.78	0.10
D3: Office	0.11	0.02
AQAL	750	
Background	0.80	
Maximum PEC	3.32	
Maximum PEC (% AQAL)	0.44%	



5.25 The results indicate that there will be no exceedances of the relevant AQAL, which is the hourly mean EAL of 7501 g/m³, as a result of the operation of the Proposed Development.

5.26 The predicted maximum 1-hour mean ground level HCl concentrations are less than 10% of the EAL, therefore the significance of the impact is negligible.

Mercury (Hg)

5.27 Predicted annual mean ground-level Hg concentrations are presented in Table 5.8.

Table 5.8: Predicted Hg Concentrations (ng/m³)

Receptor	Annual Mean		1-Hour Mean	
	PC	PC (% AQAL)	PC	PC (% AQAL)
Maximum GLC	-	-	0.0036	0.048
R1: Bilsham Cottage	0.000003	0.001	0.0010	0.013
R2: 84 Bilsham Road	0.000003	0.001	0.0007	0.010
R3: Little Meadow	0.000004	0.002	0.0008	0.010
R4: 16 Taylors Close	0.000002	0.001	0.0007	0.009
R5: West View Drive	0.000002	0.001	0.0005	0.007
R6: Primrose Lodge	0.000002	0.001	0.0005	0.007
R7: Paynters Croft	0.000001	0.001	0.0004	0.005
R8: 10 Miles Close	0.000001	0.000	0.0004	0.005
R9: Southdown Cottage	0.000002	0.001	0.0004	0.005
R10: Jaybelle Grange Lodge Park	-	-	0.0004	0.005
R11: Apple Barn Cottage	0.000002	0.001	0.0004	0.005
R12: 24 Sunnymead Close	0.000002	0.001	0.0004	0.005
R13: Grasmere, Ancton Lane	0.000002	0.001	0.0004	0.006
R14: Brambles	0.000002	0.001	0.0005	0.006
R15: Ryebank Travellers Site	0.000003	0.001	0.0006	0.007
R16: 1 White Rails	0.000004	0.001	0.0007	0.009
D1: Waiting Room	-	-	0.0011	0.015
D2: Chapel	-	-	0.0011	0.015
D3: Office	-	-	0.0002	0.002



AQAL	0.25	7.5
Background	0.0015	0.003
Maximum PEC	0.001504	0.0066
Maximum PEC (% AQAL)	0.602%	0.09%

5.28 The results indicate that there will be no exceedances of the relevant AQALs, which are the annual and hourly mean EALs of 0.25 μ g/m³ and 7.5 μ g/m³ respectively, as a result of the operation of the Proposed Development.

5.29 In accordance with the significance criteria provided in the EPUK / IAQM guidance the impact of the operation of the Proposed Development on long and short-term Hg concentration is considered to be of negligible significance.

Dioxins and Furans

5.30 The predicted annual mean ground-level dioxin and furan process concentrations at identified sensitive receptor locations are presented in Table 5.9. The results are presented in femtograms (fg) per cubic metre (10⁻¹⁵ g/m³).

Table 5.9: Predicted Dioxin and Furan Concentrations (fg/m³)

Receptor	Annual Mean	
	PC	PC (% Background)
Maximum GLC	-	-
R 1: Bilsham Cottage	0.0058	0.18
R 2: 84 Bilsham Road	0.0059	0.18
R 3: Little Meadow	0.0079	0.24
R 4: 16 Taylors Close	0.0038	0.12
R 5: West View Drive	0.0042	0.13
R 6: Primrose Lodge	0.0036	0.11
R 7: Paynters Croft	0.0029	0.09
R 8: 10 Miles Close	0.0025	0.07
R 9: Southdown Cottage	0.0038	0.11
R 10: Jaybelle Grange Lodge Park	0.0039	0.12
R 11: Apple Barn Cottage	0.0035	0.11
R 12: 24 Sunnymead Close	0.0036	0.11
R 13: Grasmere, Ancton Lane	0.0049	0.15
R 14: Brambles	0.0048	0.15



R15: Ryebank Travellers Site	0.0068	0.21
R16: 1 White Rails	0.0074	0.23
D1: Waiting Room	-	-
D2: Chapel	-	-
D3: Office	-	-
Background	3.3 fg/m ³	

5.31 There are no assessment criteria for dioxins and furans. The predicted maximum contribution from the Proposed Development is 0.24% of the average background concentration measured at rural monitoring sites in the UK.

Ecological Impacts

Airborne Concentrations of NO_x and SO₂

5.32 Predicted maximum ground level concentrations of NO_x and SO₂ are compared with the relevant critical levels (CL) at the nearby sensitive ecological habitat in Tables 5.10 and 5.11.

Table 5.10: Predicted Airborne NO_x Concentrations as a Percentage of the Critical Level (ng/m³)

Habitat Site	Annual Mean			Daily Mean		
	PC	PC (as % CL)	PEC	PC	PC (as % CL)	PEC
Maximum (Local Wildlife Sites)	0.26	0.8	9.68	9.05	12.1	28.2
E1: Pagham Harbour (Ramsar Site & SPA)	0.0008	0.003	8.40	0.11	0.1	16.9
Critical Level	30			75		

Table 5.11: Predicted Annual Mean SO₂ Concentrations as a Percentage of the Critical Level (ng/m³)

Habitat Site	PC	PC (as % CL)	PEC
Maximum (Local Wildlife Sites)	0.04	0.19	2.34
E1: Pagham Harbour (Ramsar Site & SPA)	0.0001	0.0006	2.5001
Critical Level	20		



5.33 There are no predicted exceedences of the critical levels for NO_x or SO₂ at the identified sensitive habitat site or anywhere within the modelled grid.

5.34 The significance criteria provided by the EA states that for Ramsar and SPA sites, the impact can be considered to be insignificant if the long-term PC is less than 1% of the long-term Critical Level and the short-term PC is less than 10% of the short-term Critical Level. The impact of the operation of the Proposed Development at the Ramsar and SPA site is therefore considered to be insignificant.

5.35 The significance criteria provided for by the EA guidance states that for LWSs the impact can be considered to be insignificant if both the long and short-term PC is less than 100% of the relevant Critical Level. The impact on LWSs is therefore also considered to be insignificant.

Eutrophication

5.36 Predicted maximum nutrient nitrogen deposition rates are compared with the critical load for eutrophication in Table 5.12.

Table 5.12: Predicted Eutrophication Rates (kg N/ha/yr)

Habitat Site	Critical Load (CL)	PC	PC (as a %age of CL)
Pagham Harbour Ramsar Site and SPA	8 - 10	0.0001	0.001

5.37 The maximum predicted nitrogen deposition rate due to emissions from the Proposed Development are less than 0.001% of the critical load at the identified statutory habitat site, therefore the impact is considered to be negligible significance.

5.38 Predicted maximum acidification rates are compared with the relevant critical loads and background acidification rates in Table 5.13.

Table 5.13: Predicted Acidification Rates (keq/ha/yr)

Habitat Site	PC	PC (as a %age of the CLF)	PEC	PEC (as a %age of the CLF)
Pagham Harbour Ramsar Site and SPA	0.00004	0	1.02	78.5



5.39 The maximum predicted acidification rate due to emissions from the Proposed Development is effectively 0% of the critical load function at the most sensitive habitat within the identified statutory habitat site and therefore the impact is considered to be of negligible significance.



6 MITIGATION AND RESIDUAL EFFECTS

6.1 Air quality impacts associated with emissions from the crematorium are predicted to be negligible at the human and habitat receptor locations examined, therefore further mitigating measures are not considered necessary.



7 CONCLUSIONS

7.1 An assessment has been carried out to determine the local air quality impacts associated with the operation of the proposed crematorium.

7.2 Detailed air quality modelling using the AERMOD 7 dispersion model has been undertaken to predict the impacts associated with stack emissions from the cremator. In order to provide a conservative assessment of potential impacts, pollutant emissions have been assumed to occur at the Environment Agency's emission limits for abated cremators. A stack height of 13m was selected to ensure adequate dispersion of the exhaust gases.

7.3 Predicted maximum process concentrations at sensitive receptor locations are well within the relevant air quality standards for all pollutants considered. The significance of the impacts has been assessed as negligible in accordance with the significance criteria outlined in the EPUK / IAQM planning guidance.

7.4 At nearby sensitive habitat sites, the predicted process contributions are also negligible compared with the critical levels for airborne pollutant concentrations and critical loads for nutrient nitrogen deposition and acidification.

7.5 It is considered that air quality does not pose a constraint to the development of the Site as proposed.



APPENDIX A - AIR QUALITY TERMINOLOGY

Term	Definition
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedences within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
DEFRA	Department for Environment, Food and Rural Affairs.
Exceedence	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO ₂	Nitrogen dioxide.
NO _x	Nitrogen oxides.
O ₃	Ozone.
Percentile	The percentage of results below a given value.
PM ₁₀	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
ppb parts per billion	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppb means that for every billion (10 ⁹) units of air, there is one unit of pollutant present.
ppm parts per million	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppm means that for every billion (10 ⁶) units of air, there is one unit of pollutant present.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
1 g/m ³ micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 11 g/m ³ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.



Term	Definition
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.



APPENDIX B – ENVIRONMENTAL ASSESSMENT LEVELS

Table B1: Air Quality Standards and Environmental Assessment Levels

Pollutant	Averaging Period	EAL / AQ5 (mg/m ³)	Comments
Nitrogen Dioxide (NO ₂)	annual	40	UK AQO and EU Limit Value
	1-hour	200	UK AQO and EU Limit Value, not to be exceeded more than 18 times per annum, equivalent to the 99.8 th percentile of 1-hour means
Sulphur Dioxide (SO ₂)	24-hour	125	UK AQO and EU Limit Value, not to be exceeded more than 3 times per annum, equivalent to the 99.2 nd percentile of 24-hour means
	1-hour	350	UK AQO and EU Limit Value, not to be exceeded more than 24 times per annum, equivalent to the 99.7 th percentile of 1-hour means
	15-minute	266	UK AQO, not to be exceeded more than 35 times per annum, equivalent to the 99.9 th percentile of 15-minute means
Carbon Monoxide (CO)	8-hour	10,000	UK AQO and EU Limit Value
	1-hour	30,000	EAL
Particulate Matter (as PM ₁₀)	annual	40	UK AQO and EU Limit Value
	24-hour	50	UK AQO and EU Limit Value, not to be exceeded more than 35 times per annum, equivalent to the 90.4 th percentile of 24-hour means
Particulate Matter (as PM _{2.5})	annual	25 (a)	EU Limit Value
Benzene (C ₆ H ₆)	annual	5	AQO (England and Wales) and EU Limit Value
	1-hour	195	EAL
Hydrogen Chloride (HCl)	1-hour	750	EAL
Mercury (Hg)	annual	0.25	EAL
	1-hour	7.5	EAL
(a) Reducing to 20 µg/m ³ in 2020			



APPENDIX C – STACK EMISSION PARAMETERS

Table C1: Emission Parameters

Source ID	Main Stack	
Stack Height (m)	13.0	
Stack diameter (m)	0.35	
Temperature of release (K)	432.44	
Actual flow rate (Am³/s)	0.49 (a)	
Emission velocity at stack exit (m/s)	5.1	
Normalised flow rate (Nm³/s)	0.23 (b)	
Emission Concentration (mg/Nm³) (b)		
HCl	30	
CO	100	
PM	20	
Hg	0.05	
VOC	20	
NOx	350	
SO ₂	50	
PCDD/Fs	1.0 x 10 ⁻⁷	
Emission Rate (g/s)	Long-Term (c)	Short-Term
HCl	0.00165	0.00697
CO	0.00551	0.02322
PM	0.00110	0.00464
Hg	0.000003	0.00001
VOC	0.00110	0.00464
NOx	0.01930	0.08127
SO ₂	0.00276	0.01161
PCDD/Fs	5.51 x 10 ⁻¹²	2.32 x 10 ⁻¹²
(a) Actual flow rate at 432.44 K and 9.6% O ₂ , 101.3 kPa, 18.6% H ₂ O		
(b) Reference conditions: 273 K and 11% O ₂ , 101.3 kPa, dry gas		
(c) Assuming 2.080 operational hours per annum.		



APPENDIX D - STACK HEIGHT SCREENING (D1)

STACK HEIGHT CALCULATION using HMP Guidance Note D1

Contract Arun Crematorium

Contract No Including 350 mg/m³ NO_x, assuming 35% is NO₂

Comment Facultative Technologies Double Cremator Flue Gas Treatment System

Operator Tony Readman

Date 17-Dec-18

Building dimensions (m)		Height (m)	Width (m)	Dist (m)	Within 5Um
This is the building attached to the stack		9.86	20		
Other Buildings	Ceremonial Hall	9.86	20	17	yes

Summarised Calculation Result

Minimum height required	13.0 m	For multiple buildings, or for one building higher
5Um	17.3 m	than its width within a radius of 5U

Area category used in this calculation (where applicable)

4 Partially developed area

Stack diameter or circular eqv mm 350

	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Gas volume (Am ³ /h)	3537				
Moisture content (% v/v)	18.68				
Gas temperature (°C)	159.44				
Oxygen content (% dry v/v)	9.60				
Efflux velocity (m/s)	10.31				
1)<3d, 2)<Um/2, 3)<5Um, 4)>5Um	1				

Pollutants	14				
(mg/m ³ @ 11% O ₂ dry)	PG5/2(12)				
Hydrogen chloride	30				
Sulphur dioxide					
Hydrogen Fluoride					
Nitrogen dioxide	123				
Nitric oxide	148				
Carbon monoxide	100				
Particulate matter	20				
Ozone					
Cadmium					
Mercury	0.05				
Metals					
Volatile Organic Compounds	20				



Background conc	User Defined		
Hydrogen chloride		0.0161 mg/m ³	from D1 tables for area 4
Sulphur dioxide		0.00219 mg/m ³	from DEFRA, 2019
Hydrogen Fluoride		0.0098 mg/m ³	from D1 tables for area 4
Nitrogen dioxide		0.0460 mg/m ³	from DEFRA, 2019
Nitric oxide		0.1000 mg/m ³	from D1 tables for area 4
Carbon monoxide		0.1010 mg/m ³	from DEFRA, 2019
Particulate matter		0.0131 mg/m ³	from DEFRA, 2019
Ozone		0.1300 mg/m ³	from D1 tables for area 4
Cadmium		mg/m ³	
Mercury		1.66E-06 mg/m ³	from CEH
Metals		1.076E-05 mg/m ³	from CEH
Volatile Organic Compounds		0.0002 mg/m ³	from DEFRA, 2019

Short term guideline (mg/m ³)	User Defined	1	2	3	4	5
Hydrogen chloride	0.750	0.101	0.101	0.101	0.101	0.101
Sulphur dioxide	0.350	0.440	0.440	0.440	0.440	0.440
Hydrogen Fluoride	0.160	0.063	0.063	0.063	0.063	0.063
Nitrogen dioxide	0.200	0.200	0.200	0.200	0.200	0.200
Nitric oxide	4.400	1.000	1.000	1.000	1.000	1.000
Carbon monoxide	14.286	57.000	57.000	57.000	57.000	57.000
Particulate matter	0.085	0.300	0.300	0.300	0.300	0.300
Ozone	0.171	0.180	0.180	0.180	0.180	0.180
Cadmium	0.003	0.001	0.001	0.001	0.001	0.001
Mercury	0.008	0.004	0.004	0.004	0.004	0.004
Metals	0.000					
Volatile Organic Compounds	0.353					

Discharge rate g/s	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Gas volume (Nm ³ /s @11% O ₂)	0.576	0.000	0.000	0.000	0.000
Hydrogen chloride	0.017	0.000	0.000	0.000	0.000
Sulphur dioxide	0.000	0.000	0.000	0.000	0.000
Hydrogen Fluoride	0.000	0.000	0.000	0.000	0.000
Nitrogen dioxide	0.071	0.000	0.000	0.000	0.000
Nitric oxide	0.086	0.000	0.000	0.000	0.000
Carbon monoxide	0.058	0.000	0.000	0.000	0.000
Particulate matter	0.012	0.000	0.000	0.000	0.000
Ozone	0.000	0.000	0.000	0.000	0.000
Cadmium	0.000	0.000	0.000	0.000	0.000
Mercury	0.000	0.000	0.000	0.000	0.000
Metals	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds	0.012	0.000	0.000	0.000	0.000



Pollution index	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Hydrogen chloride	23.553	0.000	0.000	0.000	0.000
Sulphur dioxide	0.000	0.000	0.000	0.000	0.000
Hydrogen Fluoride	0.000	0.000	0.000	0.000	0.000
Nitrogen dioxide	458.358	0.000	0.000	0.000	0.000
Nitric oxide	19.884	0.000	0.000	0.000	0.000
Carbon monoxide	4.062	0.000	0.000	0.000	0.000
Particulate matter	160.882	0.000	0.000	0.000	0.000
Ozone	0.000	0.000	0.000	0.000	0.000
Cadmium	0.000	0.000	0.000	0.000	0.000
Mercury	3.842	0.000	0.000	0.000	0.000
Metals	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds	32.706	0.000	0.000	0.000	0.000

	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Total acid indices	23.553	0.000	0.000	0.000	0.000
Overall index per flue (m ³ /s)	458.358	0.000	0.000	0.000	0.000
Heat released (MW) {0.03-100}	0.117	0.000	0.000	0.000	0.000
Factor a	-0.933				
Factor b	0.485				
Momentum (m ³ /s ²) {1-20000}	6.568	0.000	0.000	0.000	0.000
Factor x	-2.866				
Factor y	5.390				
Factor z	-2.745				

Calc.buoyancy height 2.28 m
 Minimum buoyancy height 1.30 m
 Uncorr.buoyancy height $U_b =$ 2.28 m

Calc.momentum height 3.47 m
 Minimum momentum height 1.50 m
 Uncorr.momentum height $U_m =$ 3.47 m

Min(U_b, U_m) 2.28 m
 U_m/U_b 1.52 m
 Calculated height 12.47 m

Corrected height (m) 12.47 m
 Minimum stack height required is 13.00 m
 "5 U_m " (m) 17.33 m

Efflux Velocity (ref D1 - 6.1.1)	Flue 1 m/s	Flue 2 m/s	Flue 3 m/s	Flue 4 m/s	Flue 5 m/s
Discharge Heat release	10.1	0.0	0.0	0.0	0.0
Discharge Momentum	9.8	0.0	0.0	0.0	0.0
Minimum Efflux Velocity Required	10.1	0.0	0.0	0.0	0.0



STACK HEIGHT CALCULATION using HMIP Guidance Note D1

Contract Arun Crematorium
Contract No 0
Comment Facultative Technologies Double Cremator Flue Gas Treatment System
Operator Tony Readman
Date 17-Dec-18

Data sources used in the calculation

Crematorium dimensions, drawings and geographic location

Building dimensions were taken from clients architect drawings and/or actual measurement

Geographic location is from clients data and, internet based, Ordnance Survey published maps

The crematorium location is taken as: X 498013 (standard 6 figure OS reference)
Y 101760 (standard 6 figure OS reference)
what3words compliant claps skip

Flue Gas Volume and conditions

Flue gas volume, temperature, oxygen content, moisture content and efflux velocity are derived from in house heat and mass balance calculations.

Gas flows are based on maximum cremation rate without burner input

Pollutant emission levels

Emission concentrations are assumed to be at the maximum allowed, for regulated substances, under the relevant legislation or guidance.

Cremation equipment is covered by Process Guidance Note 5/2(12)

Area Category

D1 include five area types for estimation of background pollutant levels.

These are generally used for pollutant species where no other information is available

The D1 category used is area 4, Partially developed area



Background concentrations

Background concentration data is available, from DEFRA, for the following species:

Sulphur dioxide	2001 data
Nitrogen dioxide	2019 data
Carbon monoxide	2001 data
Particulate matter	2019 data
Mercury	CEH Annual Mean, Detling
Metals	CEH Annual Mean, Detling
Volatile Organic Compounds	2001 data

The remaining species use the relevant data from D1, using the area category

Sulphur dioxide, Nitrogen dioxide, carbon monoxide, particulate matter and volatile organic compounds

Data source:	UK Air Quality Archive
	https://uk-air.defra.gov.uk/data/aqm-background-maps/year-2013
	Arum 5
	Local_Auth_Code 5
Grid Reference X	498500 (standard 6 figure OS reference)
(1km square centre) Y	101500 (standard 6 figure OS reference)
	geo_area 6
	EU_zone_agglom_01 31
	Distance from subject site 552m

Sulphur dioxide	
Nitrogen dioxide	
Carbon monoxide	Adjusted to 2019 levels
Particulate matter	
Volatile Organic Compounds	
Assumed as Benzene	Adjusted to 2019 levels

Mercury and other metals

Data source:	UK Pollutant Deposition portal http://www.uk-pollutantdeposition.ceh.ac.uk/
	Detling
Grid Reference X	580150 (standard 6 figure OS reference)
	Y 159750 (standard 6 figure OS reference)
	Distance from subject site 101 km
Mercury	average (2005 & 2006)
Metals (as lead)	average (2004 to 2007)



Short Term Guidelines

Data source:

<https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>

Hydrogen chloride	750 $\mu\text{g}/\text{m}^3$	1 hourly EAL
Sulphur dioxide	350 $\mu\text{g}/\text{m}^3$	1 hourly AAD Limit value
Hydrogen Fluoride	160 $\mu\text{g}/\text{m}^3$	1 hourly EAL
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$	1 hourly TG16 Table 1.1
Nitric oxide	4400 $\mu\text{g}/\text{m}^3$	1 hourly EAL
Carbon monoxide	14286 $\mu\text{g}/\text{m}^3$	8 hourly TG16 Table 1.1
Particulate matter	85 $\mu\text{g}/\text{m}^3$	Daily Mean, converted to hourly basis
Ozone	171 $\mu\text{g}/\text{m}^3$	Short Term EAL converted to hourly
Cadmium	2.54 $\mu\text{g}/\text{m}^3$	Short Term EAL converted to hourly
Mercury	7.5 $\mu\text{g}/\text{m}^3$	1 hourly EAL
Metals (ass. Lead)	0.42 $\mu\text{g}/\text{m}^3$	Short Term EAL converted to hourly
VOC (ass. Benzene)	353 $\mu\text{g}/\text{m}^3$	1 hourly EAL

APPENDIX E - WIND ROSES (SHOREHAM AIRPORT)

Figure E1: 2013

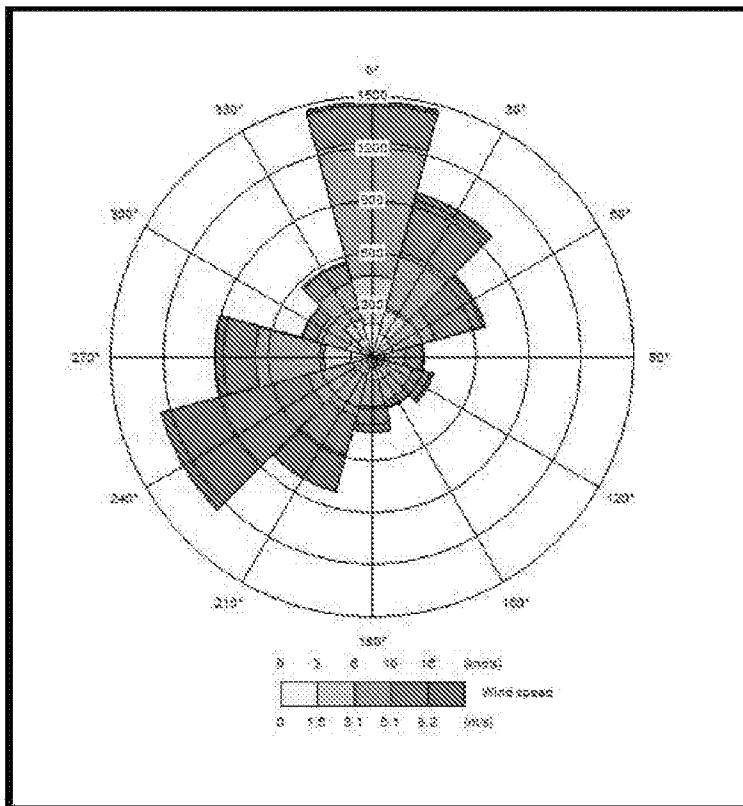


Figure E2: 2014

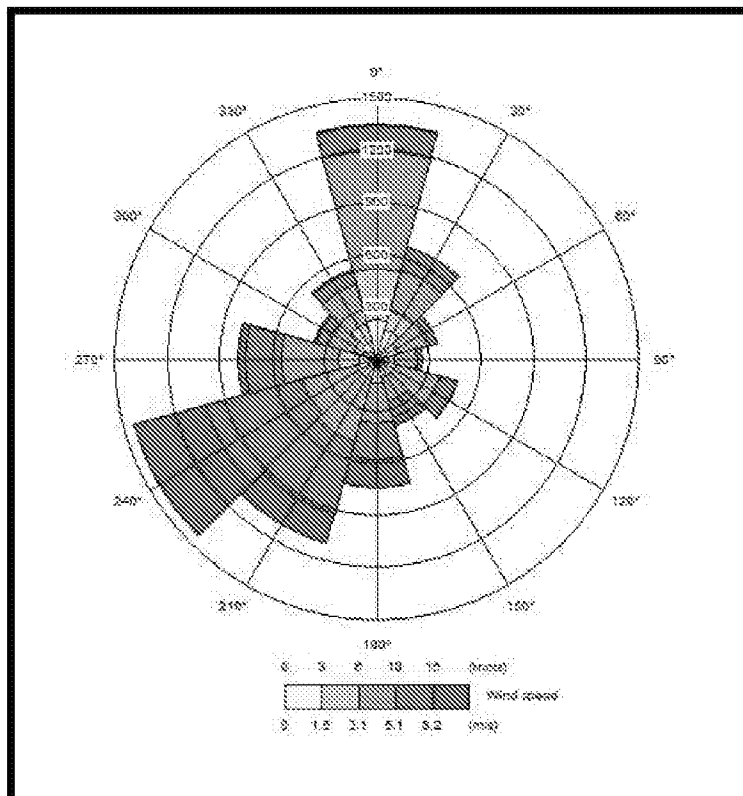


Figure E3: 2015

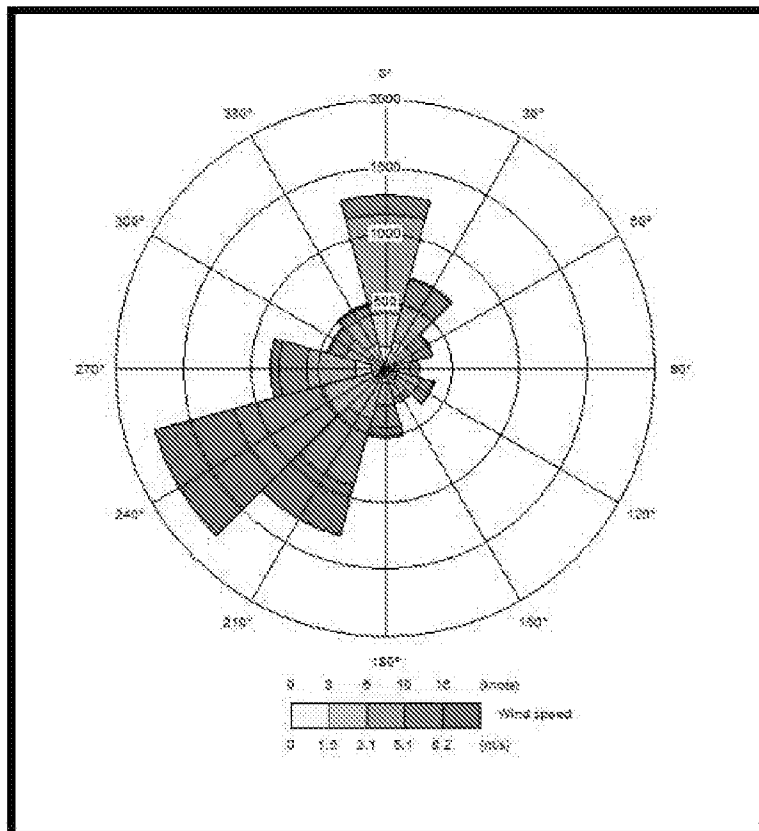


Figure E4: 2016

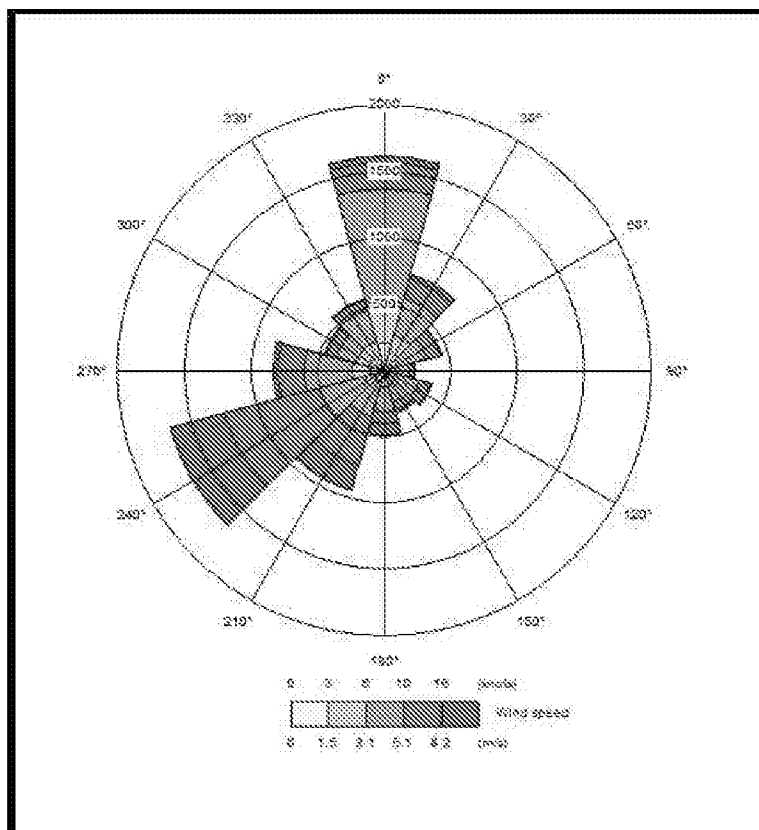
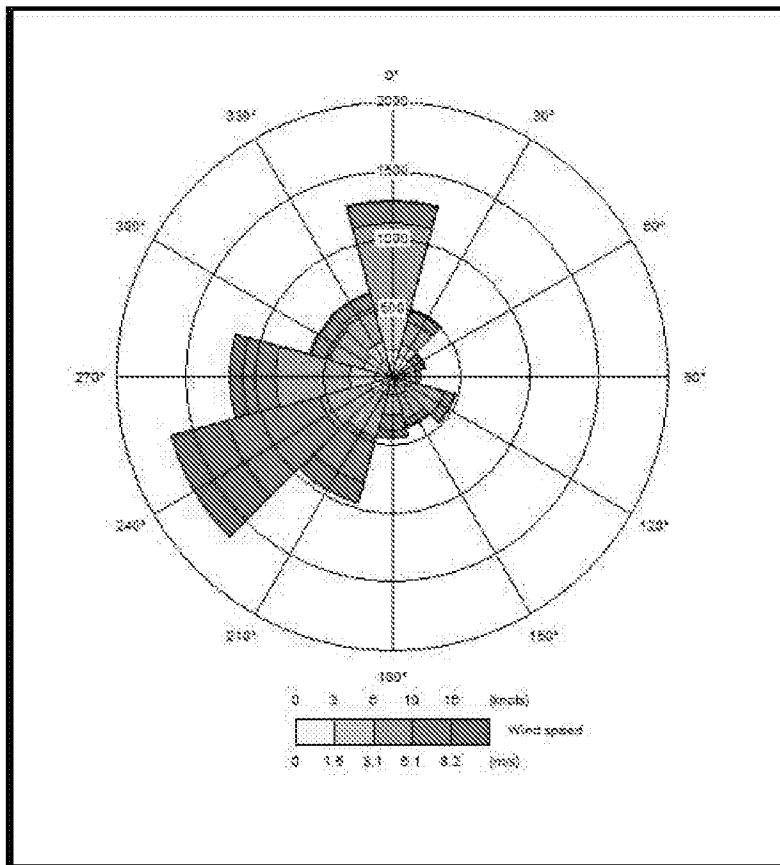


Figure E5: 2017





APPENDIX F - ENVIRONMENTAL ASSESSMENT LEVELS FOR THE PROTECTION OF VEGETATION AND ECOSYSTEMS

Critical Levels

Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals.

The critical levels for the protection of vegetation and ecosystems as defined by the EU Directive 2008/50/EC and the 2010 UK Air Quality Standards Regulations are summarised in Table F1.

Table F1: Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Averaging Period	Concentration (ng/m ³)
Oxides of Nitrogen (NO _x)	Annual Mean	30
	Daily Mean	75
Sulphur Dioxide (SO ₂)	Annual Mean	10 (sensitive habitats with lichen and bryophytes)
		20 (all other habitats)

Background NO_x and SO₂ concentrations for the identified habitat sites have been obtained from the Defra Background Maps and are summarised in Table F2.

Table F2: Annual Mean Background NO_x and SO₂ Concentrations (1 g/m³)

Habitat Site	NO _x	SO ₂
Pagham Harbour (Ramsar & SPA)	8.4	2.5
Local Wildlife Sites	9.6	2.3

Critical Loads

Critical loads refer to the threshold beyond which deposition of pollutants to water or land results in measurable damage to vegetation and habitats. This takes the form of either gravitational settling of particulate matter (dry deposition) or wet deposition, where atmospheric pollutants dissolve in water vapour and then precipitate to the ground (e.g. as rain, snow, fog etc.).

Critical loads for eutrophication (nutrient nitrogen deposition) and background nutrient nitrogen deposition rates have been obtained from APIS and are summarised in Table F3 for the identified habitat sites.



Table F3: Critical Loads (Eutrophication) and Background Nutrient Nitrogen Deposition

Habitat Site	Most Sensitive Habitat Type	Critical Load (kg N/ha/a)	Background N Deposition (kg N/ha/a)
Pagham Harbour (Ramsar & SPA)	Coastal Stable Dune Grassland - Acid Type	8 to 10	11.9

The background nutrient nitrogen deposition rates exceed the critical loads at the majority of the identified habitat sites.

For acidic deposition, the critical load of a habitat site is largely determined by the underlying geology and soils. The critical load of acidification is defined by a critical load function (CLF), which describes the relationship between the relative contributions of sulphur (S) and nitrogen (N) to the total acidification.

The critical load function is defined by the following parameters:

- ∫ CLmaxS, the maximum critical load of acidity for S, assuming there is no N deposition;
- ∫ CLminN, is the critical load of acidity due to nitrogen removal processes in the soil only (i.e. independent of deposition); and
- ∫ CLmaxN, is the maximum critical load of acidity for N, assuming there is no S deposition.

The critical loads for acidification for the most sensitive habitat type within the identified ecological habitats are presented in Table G4.

Table G4: Critical Loads (Acidification) and Background Nitrogen and Sulphur Acidification Rates

Habitat Site	Critical Load (keq/ha/a)			Background Acidification (keq/ha/a)		Background (as a %age of CLF)
	Max S	Min N	Max N	N	S	
Pagham Harbour (Ramsar & SPA)	0.9	0.4	1.3	0.85	0.17	78.5

The background acidification rates are within the relevant CLFs at the identified habitat site.