Air Quality Assessment of Emissions to Atmosphere Two Proposed Boilers WEPA UK Ltd: Bridgend Paper Mill, South Wales

P2402

A Report Prepared for
Earth & Marine Environmental Consultants Ltd

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1 INTRODUCTION

Earth & Marine Environmental Consultants Ltd (EAME) has commissioned Atmospheric Dispersion Modelling Ltd (ADM Ltd) to undertake an air quality risk assessment of emissions to the atmosphere from the two proposed boilers located at WEPA Bridgend paper mill.

The two proposed boilers are required to replace the existing CHP.

The two proposed boilers require a permit variation to operate. This Air Quality Assessment (AQA) is required to support an application for a variation to the existing Environmental Permit (EPR/EP3738NG) under the Environmental Permitting (England and Wales) Regulations 2016.

The existing Combine Heath and Power (CHP) Plant has a net thermal input of less than 50 MW and supplies the entire steam demand of the papermaking operation and approximately 50% of the electrical power of the mill. The CHP plant is natural gas-fired with the capacity for supplementary gas oil firing. The CHP plant comprises two gas turbines with a single 37 m stack and a shell boiler with a 30 m stack.

The two proposed boilers will be fuelled by natural gas, and therefore, the only atmospheric pollutants of concern are the oxide of nitrogen (NO_x) with emissions to the atmosphere via a single twin flue 30 m high stack.

This assessment assumes continuous full-load operation of both proposed boilers.

Figure 1.1 shows the location of the Bridgend Paper Mill site boundary (red line) and proposed boilers (green rectangle).

Figure 1.1 Location of Proposed Boilers (Green Rectangle) and Site Boundary (Red Line)

The ADMS 6.0 dispersion model has been used to make predictions of ground-level concentrations of the oxides of nitrogen (NO_x).

The remainder of this report is structured as follows:

- Section 2: describes the assessment criteria
- Section 3: presents and assesses the existing air quality
- Section 4: describes the modelling methodology
- Section 5: assessment of impacts
- Section 6: Sensitivity analysis
- Section 7: provides a summary and conclusions

About the Author

This air quality assessment and report was prepared by David Harvey, MBA BSc FIAQM, who has 30 years of experience in air quality. Mr Harvey is a Director of ADM Ltd, a company he founded in 1997 and is a Fellow of the Institute of Air Quality Management (FIAQM). Fellowship is for '*professionals who have had a distinguished career in the field of air quality*'.

2 ASSESSMENT AND SIGNIFICANCE CRITERIA

2.1 INTRODUCTION

This section presents the relevant air quality legislation and guidance. Also presented is a description of the pollutants assessed and the assessment and significance levels.

2.2 LEGAL CONTEXT AND GUIDANCE

2.2.1 EUROPEAN LEGISLATION

Local authorities currently have no statutory obligation to assess air quality against European limit values, which have been transposed into UK law but are encouraged to do so. To assist with longer-term planning and the assessment of development proposals in their local areas, Defra's Technical Guidance LAQM TG22 for Local Authorities provides guidance on assessing against the timeframe of the European limit values (which are transposed into UK legislation) (1).

Air Quality (Wales) Regulations 2000, as amended by the Air Quality (Wales) (Amendment) Regulations 2002, air quality objectives which, in most cases, are numerically synonymous with the European limit values.

These regulations are part of the broader framework for managing air quality across the UK. The key provisions of the regulations are:

Objective Setting: The regulations set specific objectives for the concentration of certain pollutants in ambient air at levels deemed safe for public health and the environment.

Monitoring Requirements: The regulations establish requirements for monitoring air quality in designated air quality management areas (AQMAs) across Wales.

Action Plans: Where air quality objectives are not being met, local authorities must develop and implement action plans to improve air quality within AQMAs.

Review and Reporting: The regulations require regular review and reporting on air quality by local authorities.

2.2.2 NATIONAL LEGISLATION AND GUIDANCE

The Environment Act 1995 requires the UK Government and the devolved administrations for Scotland and Wales to produce a national air quality strategy containing standards, objectives, and measures for improving ambient air quality and to keep these policies under review. The first Air Quality Strategy (AQS) was published in 1997 and has been updated several times. The most recent update for Wales was published in July 2007.

(1) DEFRA (August 2022) Local Air Quality Management, Technical Guidance (TG22).

The review conducted in 2023 concluded that the Air Quality Strategy (AQS) no longer met the ambitions to improve air quality in Wales. However, the air quality objectives referred to in the Strategy remain current.

The Clean Air Plan for Wales, published in 2020, sets the strategic direction across multiple policy areas for the next decade.

2.2.3 DEVELOPMENT CONTROL: PLANNING FOR AIR QUALITY

In January 2017, the Institute for Air Quality Management (IAQM) and Environmental Protection UK (EPUK) published an update to its guidance document that contains a framework for air quality consideration to be accounted for in local development control [(1)]. The EPUK/IAQM guidance has been considered when undertaking this assessment.

This guidance has been included, given that it can be useful, in addition to the guidance for assessment provided by the Environment Agency (EA) and Natural Resource Wales (NRW).

2.2.4 PLANNING POLICY

Given that this assessment is required to support an application for a permit variation from Natural Resources Wales (NRW), National and local planning policies are not directly relevant and are therefore not included.

(1) IAQM (2017) Land-Use Planning & Development Control: Planning for Air Quality.

2.3 DESCRIPTION OF POLLUTANTS

2.3.1 NITROGEN DIOXIDE (NO_2)

Where road traffic is the dominant source of air pollution, which is usually the case in urban environments, Local Authorities have found that the objectives for nitrogen dioxide (NO_2) and particulate matter (PM_{10}) are the most difficult to achieve. It is also generally the case that where annual average concentrations of nitrogen dioxide (NO_2) and particulate matter (PM_{10}) meet their respective objectives and where there are no significant local sources of air pollution, concentrations of all other pollutants in the air quality strategy will also be achieved.

Nitrogen dioxide (NO_2) is a reddish-brown gas (at sufficiently high concentrations). It occurs as a result of the oxidation of nitric oxide (NO), which in turn originates from the combination of atmospheric nitrogen (N_2) and oxygen (O_2) during combustion processes. In terms of ground-level concentrations in many parts of the United Kingdom, nitrogen dioxide (NO_2) concentrations are dominated by emissions from road transport.

The Air Quality Standards (Wales) Regulations 2010 transpose the Ambient Air Quality Directive (2008/50/EC) and the Fourth Daughter Directive (2004/107/EC) into Welsh legislation. The regulations include Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment.

Table 2.1 shows the assessment criteria used to assess the impacts on human health.

Table 2.1 Air Quality Standards Regulations 2010 Limit Values; Air Quality Assessment Level (AQAL)

Substance	**Averaging time**	**Assessment Criteria ($\mu g\ m^{-3}$)**
Nitrogen dioxide (NO_2)	Annual mean	40
	99.8th percentile of hourly means	200

The Critical Levels for protecting vegetation and ecosystems are shown in **Table 2.2.**

Table 2.2 Critical Levels for Protection of Vegetation and Ecosystems

Substance	Averaging time	Assessment Criteria ($\mu g\ m^{-3}$)
Oxides of Nitrogen (NO_x)	Annual mean	30
	Daily mean	75

2.4 SIGNIFICANCE CRITERIA

The impact refers to the change predicted to occur to the prevailing environment due to the proposed installation, often referred to as the process contribution (PC).

The significance of an impact is generally determined by the combination of the sensitivity and/or 'value' of the affected environmental receptor and the predicted 'extent' and/or 'magnitude' of the impact or change. The impact descriptors used in this assessment are taken from the IAQM/EPUK guidance for planning and air quality (1). The assessment of significance ultimately relies on professional judgement, although comparing the extent of the impact with criteria and standards specific to each environmental topic can guide this judgement.

Details of impact descriptors used in this assessment are shown in **Table 2.3.** It should be noted that the IAQM/EPUK impact descriptors refer to permanent changes in air quality brought about by a development and not short-term or temporary changes. They also refer to locations with relevant exposure and not necessarily the location of the maximum impact. The criteria, therefore, are only appropriate for changes to annual average concentrations at locations where there is relevant exposure, ie not generally the point of maximum impact.

Table 2.3 IAQM/EPUK Air Quality Impact Descriptors for Individual Receptors

Long-term Average Concentration at Receptor in Assessment Year	% Change in Concentration Relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL (a)	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
102%-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial
Note: Changes less than 0.5% are Negligible. (a) Air Quality Assessment Level (AQAL).				

The IAQM guidance on significance shown in **Table 2.3** is only applicable to

(1) IAQM (May 2017) Land-Use Planning & Development Control: Planning for Air Quality.

long-term/annual average impacts where there is relevant exposure.

For short-term impacts, the IAQM guidance states:

'Where such peak short-term concentrations from an elevated source are in the range 11-20% of the relevant AQAL, then their magnitude can be described as small, those in the range 21-50% medium and those above 51% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as slight, moderate and substantial respectively.'

National Resouces Wales (NRW) state that the H1 risk assessment software tool developed by the Environment Agency (EA) can be used [(1)].

The H1 risk assessment guidance includes a two-stage test for the insignificance of impacts:

Stage 1:

The H1 guidance states that the process contribution (PC) can be considered as insignificant if both of the following are achieved:

- The long-term PC is <1% of the long-term Environmental Assessment Level (EAL)
- The short-term PC is < 10% of the short-term Environmental Assessment Level (EAL)

The H1 guidance states:

If you meet both of these criteria you don't need to do any further assessment of the substance. If you don't meet them you need to carry out a second stage of screening to determine the impact of the PEC.

Stage 2:

The H1 guidance states that detailed modelling of emissions is needed for emissions that do not meet both of the following requirements:

- The long-term PEC is less than 70% of the long-term EAL
- The short-term PC is less than 20% of the short-term EAL minus twice the long-term background concentration

This is not to say that if these thresholds are exceeded, the process contribution (PC) is significant, just that it cannot be ruled out as being insignificant.

For protected conservation areas the guidance states:

If your emissions that affect SPAs, SACs, Ramsar sites or SSSIs meet both of the following criteria, they're insignificant - you do not need to assess them any further:

(1) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit .

- *the short term PC is less than 10% of the short term environmental standard for protected conservation areas*
- *the long term PC is less than 1% of the long term environmental standard for protected conservation areas*

If you do not meet these requirements you need to calculate the PEC and check the PEC against the standard for protected conservation areas.

You do not need to calculate PEC for short term targets.

If your short term PC exceeds the screening criteria of 10%, you need to do detailed modelling.

If your long term PC is greater than 1% and your PEC is less than 70% of the long term environmental standard, the emissions are insignificant – you do not need to assess them any further.

If your PEC is greater than 70% of the long term environmental standard, you need to do detailed modelling.

When there are local nature sites within the specified distance (2 km)

If your emissions meet both of the following criteria they're insignificant – you do not need to assess them any further:

- *the short term PC is less than 100% of the short term environmental standard for protected conservation areas*
- *the long term PC is less than 100% of the long term environmental standard for protected conservation areas*

3 AMBIENT AIR QUALITY DATA

3.1 INTRODUCTION

This section describes the ambient air quality in the region of the paper mill.

Bridgend County Borough Council has designated one Air Quality Management Area (AQMA) within their administrative area (Park Street, Bridgend AQMA). Because the Park Street AQMA is 8 km south of the paper mill, it is not relevant to this assessment.

3.2 MEASURED DATA

Bridgend County Borough Council measures ambient nitrogen dioxide (NO_2) concentrations at several locations, including three within 5 km of the paper mill.

Table 3.1 shows the measured annual average concentration of nitrogen dioxide (NO_2) from 2019 to 2022, along with the OS grid reference and distance from the installation. All three of these monitoring locations are classified as 'roadside'.

Table 3.1 Measured Annual Average Concentrations of Nitrogen Dioxide (NO_2, μg m^{-3}) for 2019 to 2022

Station Name/OS Grid Reference, Distance from Site (km)	OBC-128: Mill Street, Maesteg (3.3 km) 286218,189805	OBC-130: Mason Arms, Brynmenyn (4.5 km) 291386,184168	OBC-125: Commercial St, Maesteg (4.9 km) 285299,191136
2019	-	-	18.8
2020 [(a)]	11.0	-	19.3
2021	16.8	31.1	9.8
2022	8.8	29.0	14.5
Air Quality Assessment Level (AQAL)		**40**	
(a) Due to lower traffic levels during the Covid-19 pandemic lockdown, concentrations are reduced.			

Source: Bridgend CBC: Bridgend (June 2023) 2023 Air Quality Progress Report

Table 3.1 shows that the measured annual average concentration of nitrogen dioxide (NO_2) is in the range of 8.8 to 31.1 μg m^{-3}, less than the Air Quality Assessment Level (AQAL) of 40 μg m^{-3}. It is, however, considered that none of these roadside monitoring sites are in locations representative of the paper mill, given its rural location.

3.3 ESTIMATED BACKGROUND CONCENTRATIONS

The Department for Environment, Food and Rural Affairs (Defra) provides estimates of the background concentrations for several pollutants for many years on a 1 km grid resolution for the whole of the UK. The OS grid reference closest to the paper mill's proposed boilers is 287500,187500.

Table 3.2 summarises all the relevant annual average background pollutant concentrations used in this assessment and the data source.

Table 3.2 Estimated Annual Average Background Pollutant Concentrations for 2024 ($\mu g\ m^{-3}$)

Pollutant	Background Concentration	Air Quality Assessment Level (AQAL)	Percentage of AQAL (%)
Nitrogen dioxide (NO_2)	7.8	40 (human health)	20%
Oxides of Nitrogen (NO_x)	10.1	30 (vegetation)	34%

Table 3.2 shows that all the estimated background annual average concentrations of the oxides of nitrogen (NO_x) and nitrogen dioxide (NO_2) are considerably less than the Air Quality Assessment Levels (AQALs).

4 METHODOLOGY

4.1 INTRODUCTION

This section describes the methodology and assumptions made for the air quality assessment and the emissions data used.

4.2 EMISSIONS DATA

Table 4.1 shows the parameters that describe the physical properties of emissions from each proposed boiler, as required for defining the emissions in dispersion modelling terms.

Table 4.1 Emissions and Physical Properties

Parameter	
Type	Gas-fired boilers
Fuel	Gas
Number of stacks	1
Number of flues in each stack	2
OS Grid Reference (m)	287930,187021
Release height above ground level (m)	30
Actual volumetric flow rate per flue ($Am^3\ hr^{-1}$)	17,208
Actual volumetric flow rate per flue ($Am^3\ s^{-1}$)	4.78
Exhaust gas water (H_2O) content (% v/v)	9.15
Exhaust gas oxygen (O_2) content (% v/v, dry)	3.0
Flue diameter (m)	0.65
Exit velocity ($m\ s^{-1}$)	14.42
Flue gas emission temperature (deg C)	137
Normalised volumetric flow per flue ($Nm^3\ hr^{-1}$) [(a)]	10,418
Normalised volumetric flow per flue ($Nm^3\ s^{-1}$) [(a)]	2.89
Oxides of Nitrogen (NO_x) concentration ($mg\ Nm^{-3}$) [(a)]	100
Oxides of Nitrogen (NO_x) emission rate ($g\ s^{-1}$) per flue	0.29
(a) Corrected for: dry at 273 k; pressure; 101.3kPa (1 atmosphere), 3% O_2 (dry).	

The modelling assumes that both boilers operate continuously at full load.

Since the two boiler flues are within the windshield of one stack, the effective diameter modelled is 0.92 m with a combined total emission rate of 0.58 $g\ s^{-1}$.

4.3 RECEPTORS

Predictions of ground-level concentrations are made using a grid of receptors. The receptor grid is 4,000 m by 3,500 m, with a 25 m grid spacing. Predictions using a grid of receptors allow the maximum impact to be determined, and the predicted ground-level concentrations can be presented as contour plots.

For Local Air Quality Management (LAQM), the Air Quality Strategy Objectives (AQS) only apply where there is 'relevant exposure'. This is defined as being where members of the public are regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. For the annual average objective, locations of relevant exposure include residential properties, schools and hospitals.

In addition to predictions made using a grid of receptors, predictions are made at 25 specific receptors selected to represent locations with relevant exposure, such as residential properties. For consistency with previous modelling, the specific receptors used in this assessment are the same as those selected by SLR for their 2020 assessment of emissions from the whole instillation (1).

Table 4.3 presents details of the specific receptors included in the modelling selected because of their potential for 'relevant exposure'.

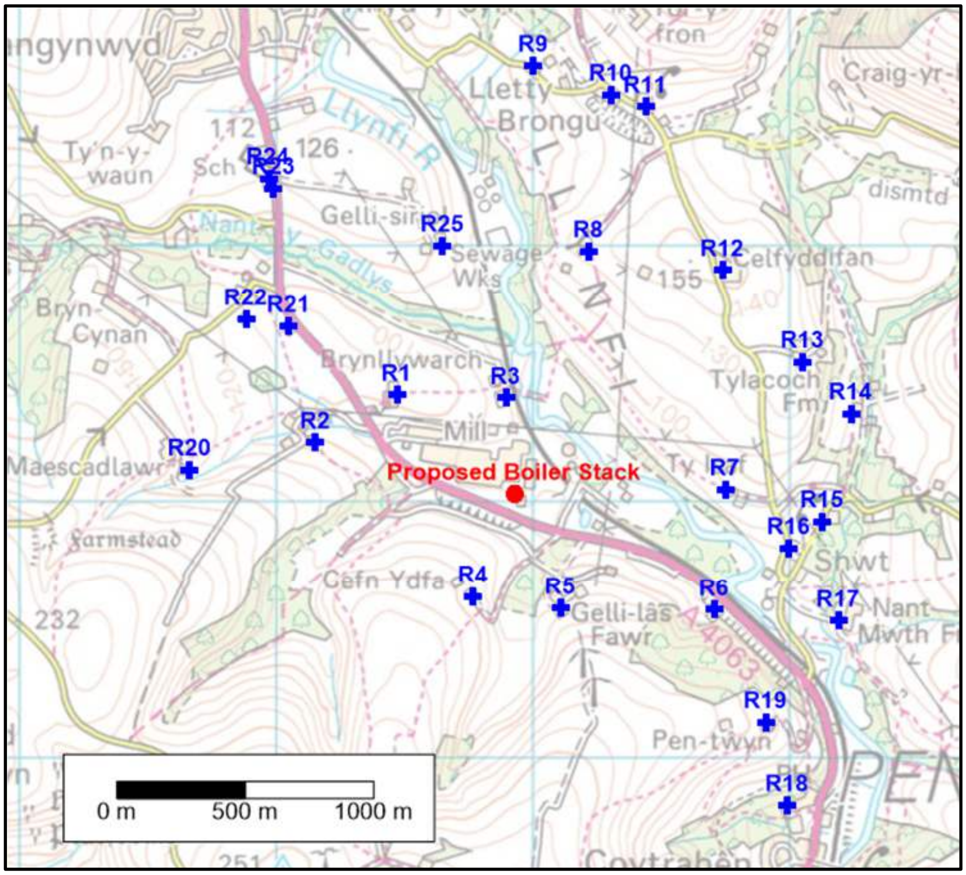
Table 4.3 Human Health Receptor Locations

No.	Description	Distance from Stack (km)	OS Grid Reference (m)
R1	Residential property off A4603	0.6	287469 187416
R2	Residential property off A4603	0.8	287152 187231
R3	Residential property off A4603	0.4	287893 187404
R4	Residential property off A4603	0.4	287767 186631
R5	Residential property off A4603	0.5	288106 186585
R6	Residential property off A4603	0.9	288706 186578
R7	Residential property off Green Field	0.8	288748 187049
R8	Residential property off Green Field	1.0	288216 187979
R9	Residential property at The Brackens	1.7	288001 188702
R10	Residential property at Lletty Brongu	1.6	288303 188589
R11	Residential property at Lletty Brongu	1.6	288437 188542
R12	Residential property off Green Field	1.2	288737 187906
R13	Residential property off Green Field	1.2	289050 187545
R14	Residential property off Green Field	1.3	289237 187344
R15	Residential property off Green Field	1.2	289126 186925
R16	Residential property at Shwt	1.1	288997 186820
R17	Residential property off A4603	1.4	289189 186534
R18	Residential property off Nicholls Rd	1.6	288990 185817
R19	Residential property off A4603	1.3	288905 186139
R20	Residential property off A4603	1.3	286662 187126
R21	Residential property off A4603	1.1	287048 187684
R22	Residential property off A4603	1.2	286881 187713
R23	Residential property off A4603	1.5	286989 188225
R24	School: Ysgol Gyfun Gymraeg	1.6	286968 188263
R25	Residential property off A4603	1.0	287647 188001

Figure 4.1 shows the locations of the human receptors.

(1) SLR (Feb 2020) Air Quality Impact Assessment Bridgend Paper Mill

Figure 4.1 Location of Human Health Receptors and Proposed Stack Location



In addition to the human health receptors, impacts at ecological sites require consideration.

For impacts on ecological sites, the H1 risk assessment guidance states that assessment is required for the following two groups of ecological sites [(1)].

Within 2 km of the instillation site:

- sites of special scientific interest (SSSIs)
- local nature sites (ancient woods, local wildlife sites and national and local nature reserves)

Within 10 km of the instillation site:

- special protection areas (SPAs)
- special areas of conservation (SACs)
- Ramsar sites (protected wetlands)

Figure 4.2 shows the location of the ecological sites within 2 km of the installation and the seven receptors selected to represent the maximum impacts of these sites.

(1) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit .

Figure 4.2 Ecological Sites with 2 km (Red Circle) and Selected Receptors

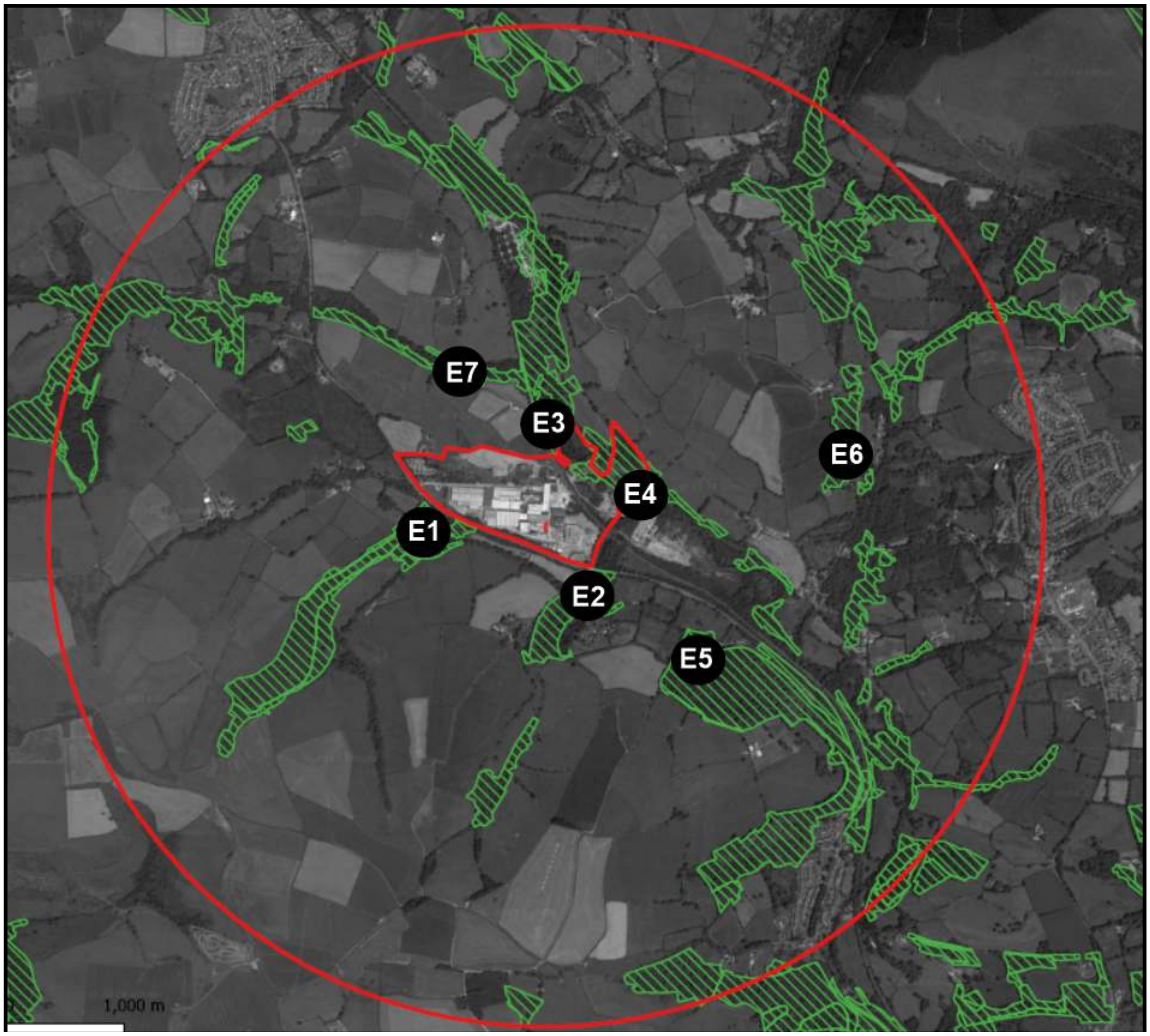
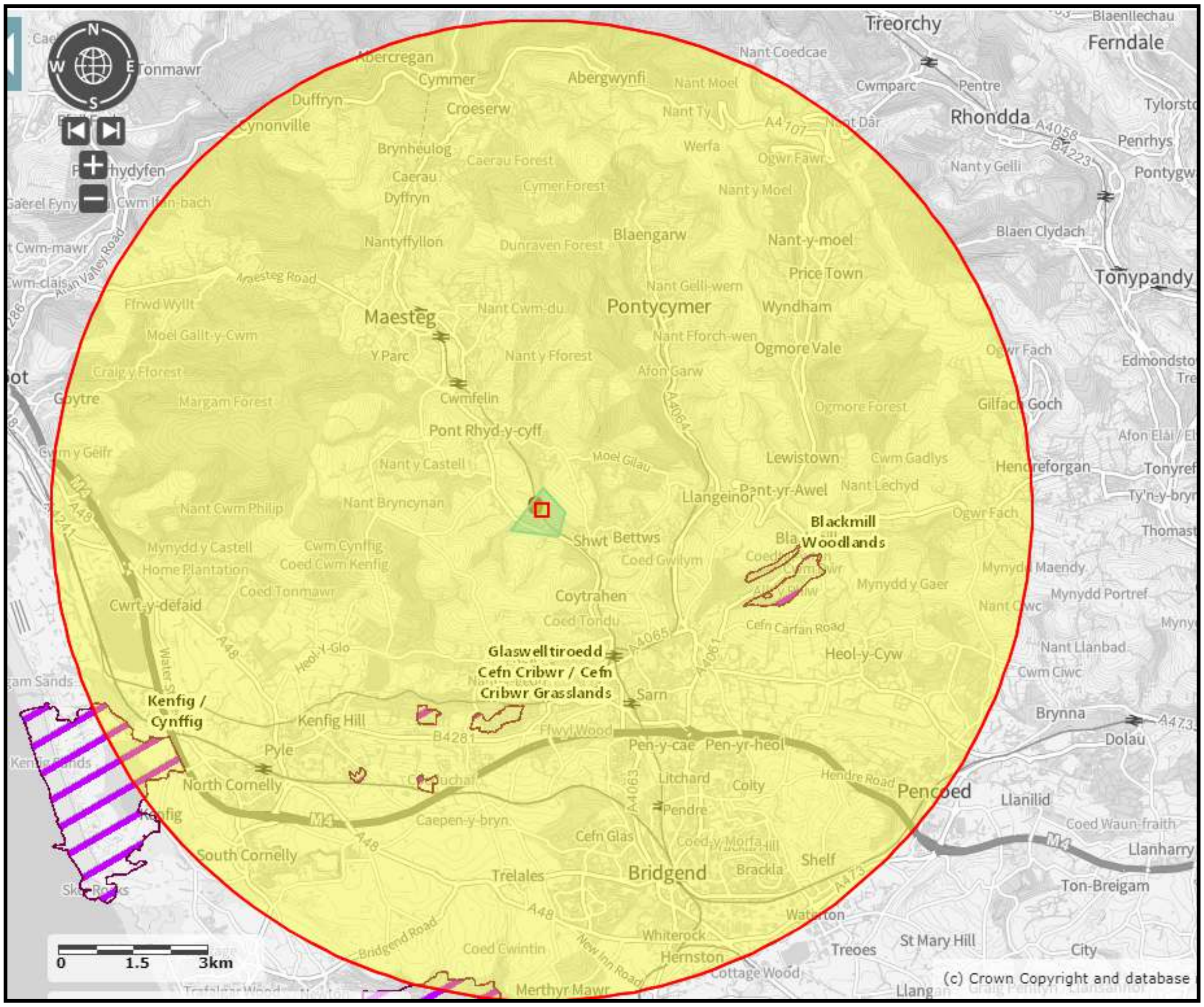


Figure 4.3 shows the relevant ecological sites (SPA, SAC, Ramsar) within 10 km of the installation.

Figure 4.3 SPA, SAC, Ramsar Sites with 10 km (Red Circle)



Source: Magic/defra.gov.uk

Table 4.4 presents details of the specific receptors selected to be representative of the ecological sites within 2 km and 10 km of the installation.

Table 4.3 Ecological Receptor Locations

No.	Description	Distance from Stack (km)	OS Grid Reference (m)
E1	Ancient woodland	0.4	287528 187071
E2	Ancient woodland	0.3	288132 186820
E3	Ancient woodland	0.3	287973 187376
E4	Ancient woodland	0.3	288258 187085
E5	Ancient woodland	0.7	288490 186594
E6	Ancient woodland	1.2	289088 187268
E7	Ancient woodland	0.7	287643 187686
E8	Kenfig / Cynffig (SAC: coastal grassland – acid)	9.2	280000 182300
E9	Glaswelltiroedd Cefn (SAC: non-med grassland)	3.9	287400 183150
E10	Blackmill Woodlands (SAC: woodland)	4.5	292330 186000

4.4 FACTORS AFFECTING DISPERSION

Several factors will affect how emissions disperse once released into the atmosphere. The four factors having the most significant effect on dispersion are:

- Physical characteristics of the emissions
- Climate
- Terrain
- Building downwash

4.4.1 PHYSICAL CHARACTERISTICS OF THE EMISSIONS

Provided that the exhaust gases have sufficient velocity to overcome the effects of stack tip downwash (which, under most meteorological conditions, is the case for velocities of 10 m s^{-1} or more), the physical characteristics of the flue gases will determine the amount of plume rise and hence the effect on ground level pollutant concentrations. The degree of plume rise depends on the greater of the thermal buoyancy or momentum effects and not necessarily a combination of the two effects.

4.4.2 CLIMATE

The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind speed, wind direction and atmospheric stability.

- **Wind direction** determines the broad transport of the plume and the sector of the compass into which the plume is dispersed.

- **Wind speed** can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise.

- **Atmospheric stability** is a measure of the turbulence of the air, particularly of the vertical motions present. Dispersion models, such as ADMS and AERMOD, do not allocate the degree of atmospheric turbulence into six discrete categories (eg A-F). These models use a parameter known as the Monin-Obukhov length, which, together with the wind speed, describes the atmosphere's stability.

4.4.3 BUILDING DOWNWASH

The presence of buildings can significantly affect the dispersion of atmospheric emissions. Wind blowing around a building distorts the flow and creates greater turbulence zones than if the building were absent. Increased turbulence causes greater plume mixing; the rise and trajectory of the plume may be depressed generally by the flow distortion. For elevated releases such as from stacks, building downwash leads to higher ground-level concentrations closer to the stack than those present if a building was not there. The effects of building downwash are usually only significant where the buildings are more than about 40% of the stack height.

The zone of influence is related to the dimensions of the buildings and is typically a horizontal distance of five times the building height.

Figure 4.4 shows the location and heights of buildings that will affect dispersion from the proposed boilers. In addition to the buildings shown in **Figure 4.4,** the 49.3 m high Department F building has been included in the modelling as it may affect dispersion.

Figure 4.4 **Location and Heights of Building that Will Affect Dispersion from the Proposed Boilers**

Table 4.4 shows the dimensions of the buildings included in the modelling.

Table 4.4 Dimensions of Buildings Included in the Modelling

Building	Centre (m)		Height (m) [a]	Length (m)	Width (m)	Angle (deg) [b]
Neptune Dep C	287876	187040	25.0	92.5	40	92
Jupiter MC House	287895	187086	20.0	122	27.5	92
JRS Warehouse D	287946	187165	15.0	24.2	110	92
Pulp Store/Workshop	287984	187082	8.5	50	72	92
Bale Handling	288040	187025	15.4	50	55	92
Department F	287674	187263	49.3	131	43	92
New boiler house	287931	187038	10.0	17	22.5	92

(a) Height above ground level.
(b) Angle building length makes to the north.

Section 6 includes a sensitivity analysis of the model-predicted concentration to building downwash effects.

4.4.4 NATURE OF THE SURFACE

Terrain

The effects of elevated terrain can affect dispersion and have been included in the modelling.

Roughness

The nature of the surface can have a significant influence on dispersion by affecting the vertical velocity profile (ie the rate of increase in wind speed for increasing heights above ground level). The amount of atmospheric turbulence also affects dispersion.

Considering the site's surrounding nature, the dispersion modelling has assumed a surface roughness length of 0.5 m.

Section 6 includes a sensitivity analysis of the model-predicted concentration to surface roughness.

4.5 SELECTION OF SUITABLE DISPERSION MODEL

The dispersion models widely used to predict ground-level pollutant concentrations are based on the concept of the time-averaged lateral and vertical concentration of pollutants in a plume being characterised by a Gaussian [1] distribution. Older models, such as ISC, characterise the atmosphere into several discrete stability classes. Dispersion models such as ADMS and AERMOD have been developed, which replace the description of the atmospheric boundary layer as being composed of discrete stability classes with an infinitely variable measure of the surface heat flux, which in turn influences the turbulent structure of the atmosphere and hence the dispersion of a plume.

(1) A Gaussian distribution has the appearance of a bell-shaped curve. The maximum concentration occurs on the centre line.

Two commercially available dispersion models described by the Environment Agency (EA) as being 'new generation' are:

- AERMOD: The US **A**merican Meteorological Society and **E**nvironmental Protection Agency **R**egulatory Model **I**mprovement Committee developed the dispersion **MOD**del called AERMOD, which incorporates the latest understanding of the atmospheric boundary layer.

- Atmospheric Dispersion Modelling System (ADMS): This dispersion model was developed by the UK consultancy CERC. The model allows for the skewed nature of turbulence within the atmospheric boundary layer.

In many respects, the models are quite similar and generate comparable predictions of ground-level concentrations in many situations.

The ADMS 6.0 dispersion model was selected for use in this assessment because it has been extensively validated and widely used for assessment work of this nature.

4.6 METEOROLOGICAL DATA

An essential input to the dispersion model is the meteorological data.

Cardiff Airport (22 km) is the closest observation station where complete data is available, while St Athan is at a similar distance (25 km). Given that both observing stations are located close to the coast and at a lower elevation than the site, there is doubt over how representative either data set would be. This assessment, therefore, uses Numerical Weather Prediction (NWP) data, which is increasingly being used, especially for locations where there are concerns about how representative observed data are. Five years of hourly meteorological data used for this assessment are from 2019 to 2023.

Figure 4.5 shows the windrose for the 2019 to 2023 NWP meteorological data used in this assessment.

Figure 4.5 Wind Rose from the NWP Data (2019-2023)

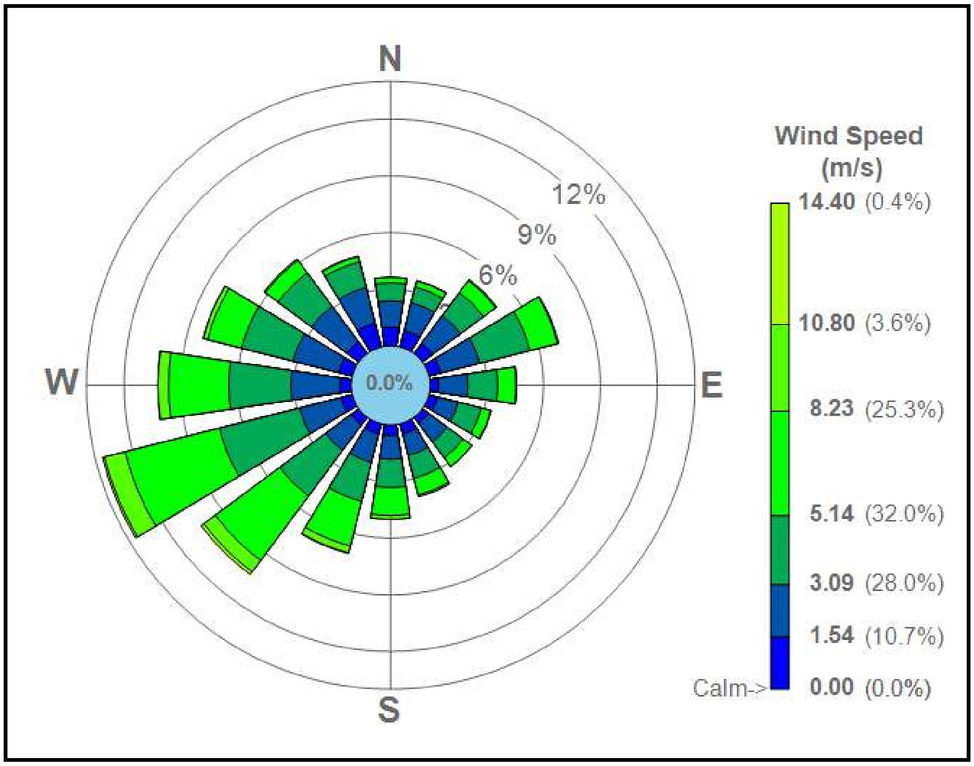


Figure 4.5 shows that the prevailing wind direction is from the west/west-south-west, which will transport emissions to the east.

Section 6 includes a sensitivity analysis of model-predicted concentrations to meteorological data.

4.7 PERCENTAGE OXIDATION OF NITRIC OXIDE (NO) TO NITROGEN DIOXIDE (NO_2)

Oxides of nitrogen (NO_x) emitted to the atmosphere due to gas combustion will consist mainly of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, nitric oxide (NO) is oxidised to nitrogen dioxide (NO_2), which concerns human health and other environmental impacts. The proportion of nitric oxide oxidised to nitrogen dioxide depends on several factors, and the oxidation is limited by the availability of oxidants, such as ozone (O_3).

Oxidation of 50% has been assumed for nitric oxide (NO) oxidation to nitrogen dioxide (NO_2) for short-term concentrations. For predictions of annual averages, it is assumed that 100% of nitrogen (NO_x) oxides are in the form of nitrogen dioxide (NO_2). These assumptions are recommended by the Environment Agency (EA) and are considered to be conservative [(1)].

(1) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#detailed-modelling.

5 PREDICTIONS AND ASSESSMENT OF IMPACTS

5.1 INTRODUCTION

This section presents the incremental increase in ground-level concentrations predicted to occur due to emissions to the atmosphere from the operation of the proposed boilers. The incremental increase is referred to as the Process Contribution (PC). The PC + the prevailing background concentration is the Predicted Environment Concentration (PEC). Predictions are presented, and the routine emissions to the atmosphere from the proposed boilers are assessed.

5.2 MODELLING AND ASSESSMENT OF EMISSIONS

5.2.1 HUMAN HEALTH

Table 5.1 shows the predicted annual average ground-level Process Concentration (PC) of nitrogen dioxide (NO_2) at the specific receptors and at the point of maximum off-site impact for each of the five years of meteorological data. The Predicted Environmental Concentrations (PEC) are also shown.

Table 5.1 ADMS 6.0 Predicted Process Contribution (PC) and Predicted Environmental Concentration (PEC) Annual Average Ground Level Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$) [(a)]

Location	Process Contribution (PC)						Predicted Environmental Concentration (PEC) [(b)]	Process Contribution (PC) as %age of AQAL (%)
	2019	2020	2021	2022	2023	Max.		
R1	0.14	0.09	0.09	0.14	0.11	**0.14**	7.9	0.4%
R2	0.11	0.07	0.08	0.08	0.06	**0.11**	7.9	0.3%
R3	0.21	0.23	0.23	0.30	0.24	**0.30**	8.1	0.8%
R4	0.10	0.08	0.12	0.07	0.08	**0.12**	7.9	0.3%
R5	0.10	0.11	0.14	0.13	0.11	**0.14**	7.9	0.4%
R6	0.15	0.13	0.15	0.13	0.14	**0.15**	8.0	0.4%
R7	0.23	0.24	0.19	0.19	0.25	**0.25**	8.0	0.6%
R8	0.07	0.07	0.08	0.09	0.07	**0.09**	7.9	0.2%
R9	0.03	0.03	0.03	0.04	0.03	**0.04**	7.8	0.1%
R10	0.03	0.03	0.04	0.04	0.03	**0.04**	7.8	0.1%
R11	0.04	0.04	0.04	0.05	0.04	**0.05**	7.8	0.1%
R12	0.08	0.08	0.08	0.08	0.09	**0.09**	7.9	0.2%
R13	0.12	0.14	0.10	0.12	0.13	**0.14**	7.9	0.3%
R14	0.12	0.13	0.09	0.11	0.13	**0.13**	7.9	0.3%
R15	0.12	0.11	0.11	0.09	0.13	**0.13**	7.9	0.3%
R16	0.14	0.13	0.14	0.11	0.15	**0.15**	8.0	0.4%
R17	0.11	0.09	0.11	0.09	0.11	**0.11**	7.9	0.3%
R18	0.05	0.04	0.05	0.04	0.04	**0.05**	7.8	0.1%
R19	0.06	0.05	0.06	0.06	0.05	**0.06**	7.9	0.2%
R20	0.05	0.04	0.05	0.04	0.03	**0.05**	7.9	0.1%
R21	0.06	0.04	0.04	0.06	0.05	**0.06**	7.9	0.2%
R22	0.05	0.03	0.04	0.05	0.04	**0.05**	7.9	0.1%
R23	0.04	0.03	0.03	0.04	0.04	**0.04**	7.8	0.1%
R24	0.04	0.02	0.03	0.04	0.03	**0.04**	7.8	0.1%
R25	0.06	0.05	0.05	0.08	0.06	**0.08**	7.9	0.2%
Receptor Maximum	**0.23**	**0.24**	**0.23**	**0.30**	**0.25**	**0.30**	**8.1**	**0.8%**
Off-Site Grid Maximum	**1.45**	**1.36**	**1.35**	**1.14**	**1.43**	**1.45**	**9.2**	**3.6%**
Air Quality Assessment Level (AQAL)						**40**		

(a) Assuming 100% oxidation of oxides of nitrogen (NO_x) to nitrogen dioxide (NO_2).
(b) Predicted Environmental Concentration (PEC) = PC + background of 7.8 $\mu g\ m^{-3}$.

Table 5.1 shows that the maximum predicted annual average ground-level Process Contribution (PC) at any of the specific receptors of nitrogen dioxide (NO_2) is 0.3 $\mu g\ m^{-3}$, which is 0.8% of the long-term Air Quality Assessment Level (AQAL) of 40 $\mu g\ m^{-3}$. Given that the maximum PC with relevant exposure is less than 1% of the Air Quality Assessment Level (AQAL), it is screened out as insignificant using the EA/NRW screening criteria.

The IAQM/EPUK significance criteria apply to locations with relevant exposure and only apply to annual average concentrations. Defra's TG22 guidance gives the following examples of where there is relevant exposure to annual average objectives:

- Building facades of residential properties
- Schools
- Hospitals
- Care homes

Examples of where there is no relevant exposure to annual average objectives include; gardens of residential properties, hotels, and kerbside sites.

The IAQM/EPUK impact description is '*negligible*' at all the receptor locations with relevant exposure to annual average concentration (eg residential properties).

Table 5.2 shows the predicted 99.8th percentile of hourly average Process Contribution (PC) at the specific receptors at the point of maximum off-site impact for each of the five years of meteorological data. The Predicted Environmental Concentrations (PEC) are also shown.

Table 5.2 ADMS 6.0 Predicted Process Contribution (PC) and Predicted Environmental Concentration (PEC) 99.8th Percentile of Hourly Average Ground Level Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$) (a)

Location	Process Contribution (PC)						Predicted Environmental Concentration (PEC) (b)	Maximum PC as Percentage of AQAL (%)
	2019	2020	2021	2022	2023	Max.		
R1	1.8	1.7	1.8	1.9	1.8	**1.8**	17.4	0.9%
R2	1.3	1.3	1.3	1.3	1.3	**1.3**	16.9	0.7%
R3	2.8	2.6	2.7	2.7	2.7	**2.8**	18.4	1.4%
R4	2.2	2.2	2.3	2.2	2.2	**2.3**	17.9	1.1%
R5	2.2	2.1	2.2	2.1	2.0	**2.2**	17.8	1.1%
R6	1.4	1.5	1.4	1.4	1.5	**1.5**	17.1	0.7%
R7	1.3	1.3	1.3	1.3	1.2	**1.3**	16.9	0.7%
R8	0.9	0.9	1.0	0.9	0.9	**1.0**	16.6	0.5%
R9	0.5	0.5	0.5	0.5	0.4	**0.5**	16.1	0.2%
R10	0.5	0.5	0.6	0.5	0.5	**0.6**	16.2	0.3%
R11	0.6	0.6	0.6	0.6	0.6	**0.6**	16.2	0.3%
R12	0.9	0.8	0.8	0.8	0.9	**0.9**	16.5	0.4%
R13	0.9	0.9	0.9	0.9	0.9	**0.9**	16.5	0.5%
R14	0.8	0.8	0.8	0.8	0.9	**0.8**	16.4	0.4%
R15	0.8	0.8	0.8	0.8	0.8	**0.8**	16.4	0.4%
R16	1.2	1.1	1.2	1.1	1.1	**1.2**	16.8	0.6%
R17	1.4	1.3	1.5	1.3	1.5	**1.5**	17.1	0.7%
R18	0.6	0.6	0.5	0.6	0.6	**0.6**	16.2	0.3%
R19	0.8	0.7	0.7	0.8	0.7	**0.8**	16.4	0.4%
R20	0.7	0.7	0.7	0.7	0.6	**0.7**	16.3	0.3%
R21	1.1	0.9	1.0	1.2	1.1	**1.1**	16.7	0.5%
R22	0.9	0.8	0.9	0.9	0.9	**0.9**	16.5	0.4%
R23	0.9	0.8	0.9	0.8	0.9	**0.9**	16.5	0.5%
R24	0.9	0.8	0.9	0.8	0.9	**0.9**	16.5	0.4%
R25	1.0	0.9	0.9	1.0	0.9	**1.0**	16.6	0.5%
Receptor Maximum	**2.8**	**2.6**	**2.7**	**2.7**	**2.7**	**2.8**	**18.4**	**1.4%**
Off-Site Grid Maximum	**8.1**	**14.9**	**8.2**	**7.9**	**8.7**	**14.9**	**30.5**	**7.4%**
Air Quality Assessment Level (AQAL)					**200**			

(a) Assuming 50% oxidation of the oxides of nitrogen (NO_x) to nitrogen dioxide (NO_2).
(b) Defra guidance TG4(00); NO_2 99.8th + 2 x annual average NO_2 background (7.9 $\mu g\ m^{-3}$).

Table 5.2 shows that the maximum predicted 99.8th percentile of hourly average nitrogen dioxide (NO_2, PC) is 14.9 $\mu g\ m^{-3}$, which is 7.4% of the Air Quality Assessment Level (AQAL) of 200 $\mu g\ m^{-3}$.

Given that the off-site grid maximum PC is less than 10% of the short-term Air Quality Assessment Level (AQAL), it is screened out as insignificant using the EA/NRW screening criteria.

The IAQM/EPUK impact description is '*negligible'* at all the receptor locations with relevant exposure to short-term concentrations.

Table 5.1 and Table 5.2 show that predicted Process Contribution (PC) concentrations of nitrogen dioxide (NO_2) occurring due to emissions from the proposed boilers operating at their emissions limit are insignificant and not of concern to human health.

The following figures illustrate the distribution of nitrogen dioxide (NO_2) concentration. The year of meteorological data used gives rise to the highest off-site impact. The predictions are for the Process Contributions (PC).

- **Figure 5.1;** Annual Average (2019 meteorological data)
- **Figure 5.2**; 99.8th percentile of hourly averages (2020)

The figures show that peak predicted increments to ground-level concentrations occur within about 100 m of the installation.

Figure 5.1 ADMS 6.0 Predicted Annual Average Ground Level Process Contribution (PC) of Nitrogen Dioxide (NO_2); 2019 Meteorological Data (μg m^{-3}); Assuming 100% Oxidation

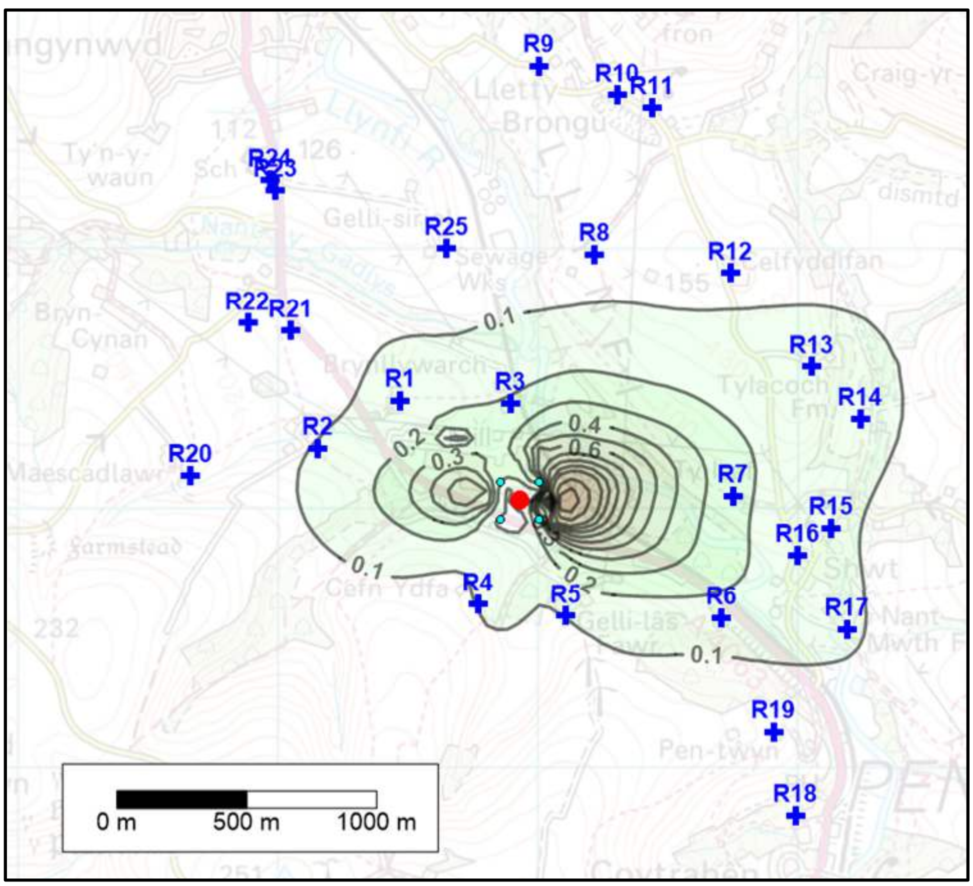
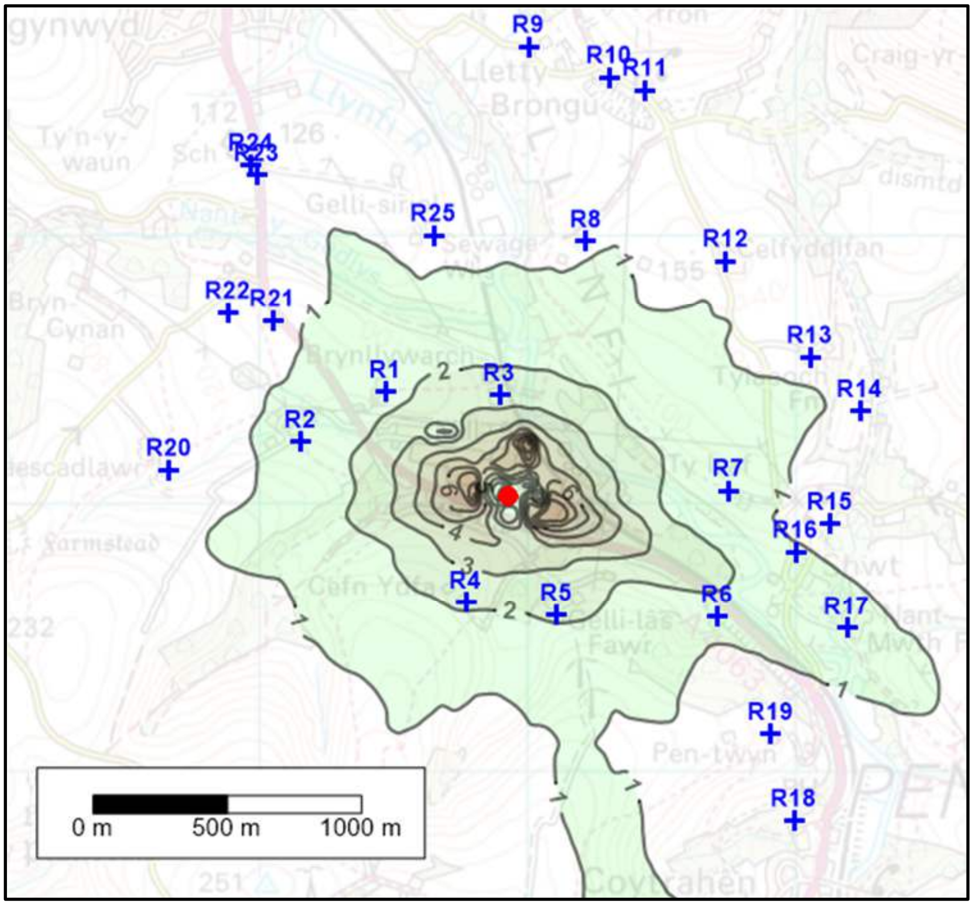


Figure 5.2 ADMS 6.0 Predicted 99.8th Percentile of Hourly Average Ground Level Process Contribution (PC) Concentrations of Nitrogen Dioxide (NO_2); 2020 Meteorological ($\mu g\ m^{-3}$); Assuming 50% Oxidation



5.2.2 VEGETATION AND ECOSYSTEMS

Table 5.3 shows the predicted annual average ground-level Process Concentration (PC) of nitrogen oxides (NO_x) at the ecological sites.

Table 5.3 ADMS 6.0 Predicted Process Contribution (PC) and Predicted Environmental Concentration (PEC) Annual Average Ground Level Concentrations of Oxides of Nitrogen (NO_x, μg m^{-3})

Location	Process Contribution (PC)						Predicted Environmental Concentration (PEC) [(a)]	Maximum PC as Percentage of AQAL (%)
	2019	2020	2021	2022	2023	Max.		
E1 (Woodland)	0.33	0.27	0.29	0.26	0.23	**0.33**	10.4	1.1%
E2 (Woodland)	0.33	0.28	0.36	0.31	0.28	**0.36**	10.5	1.2%
E3 (Woodland)	0.27	0.31	0.31	0.38	0.32	**0.38**	10.5	1.3%
E4 (Woodland)	0.95	1.06	0.75	0.82	1.01	**1.06**	11.2	3.5%
E5 (Woodland)	0.15	0.12	0.15	0.13	0.12	**0.15**	10.3	0.5%
E6 (Woodland)	0.14	0.15	0.11	0.12	0.15	**0.15**	10.3	0.5%
E7 (Woodland)	0.10	0.08	0.07	0.12	0.09	**0.12**	10.2	0.4%
E8 (SAC)	0.00	0.01	0.01	0.01	0.00	**0.01**	10.1	0.0%
E9 (SAC)	0.01	0.01	0.01	0.01	0.01	**0.01**	10.1	0.0%
E10 (SAC)	0.02	0.01	0.02	0.01	0.02	**0.02**	10.1	0.1%
Air Quality Assessment Level (AQAL)						**30**		

(a) Predicted Environmental Concentration (PEC) = PC + background of 10.1 μg m^{-3}.

Table 5.4 shows the predicted 24 hour average ground-level Process Concentration (PC) of nitrogen oxides (NO_x) at the ecological sites.

Table 5.4 ADMS 6.0 Predicted Process Contribution (PC) and Predicted Environmental Concentration (PEC) 24-Hour Average Ground Level Concentrations of Oxides of Nitrogen (NO_x, μg m^{-3})

Location	Process Contribution (PC)						Predicted Environmental Concentration (PEC) [(a)]	Maximum PC as Percentage of AQAL (%)
	2019	2020	2021	2022	2023	Max.		
E1 (Woodland)	4.24	3.29	4.41	3.40	3.84	**4.41**	24.6	5.9%
E2 (Woodland)	3.87	3.69	3.82	4.05	4.47	**4.47**	24.7	6.0%
E3 (Woodland)	3.23	3.51	4.11	3.62	3.81	**4.11**	24.3	5.5%
E4 (Woodland)	5.79	5.40	4.51	4.91	5.90	**5.90**	26.1	7.9%
E5 (Woodland)	1.58	1.64	1.81	1.41	1.47	**1.81**	22.0	2.4%
E6 (Woodland)	0.97	1.09	0.83	0.93	0.99	**1.09**	21.3	1.5%
E7 (Woodland)	1.43	1.05	1.08	1.50	1.07	**1.50**	21.7	2.0%
E8 (SAC)	0.07	0.09	0.13	0.09	0.08	**0.13**	20.3	0.2%
E9 (SAC)	0.18	0.17	0.16	0.37	0.25	**0.37**	20.6	0.5%
E10 (SAC)	0.26	0.21	0.22	0.17	0.20	**0.26**	20.5	0.3%
Air Quality Assessment Level (AQAL)						**75**		

(a) Defra guidance TG4(00); NO_x max 24 Hour + 2 x annual average NO_2 background (10.1 μg m^{-3}).

Consideration of Special Areas of Conservation (SAC)

The NWR/EA guidance states:

If your emissions that affect SPAs, SACs, Ramsar sites or SSSIs meet both of the following criteria, they're insignificant - you do not need to assess them any further:

- *the short term PC is less than 10% of the short term environmental standard for protected conservation areas*
- *the long term PC is less than 1% of the long term environmental standard for protected conservation areas*

Table 5.3 and **Table 5.4** show that the maximum predicted short-term PC at and three SACs is 0.5%, and the maximum predicted long-term PC is 0.1% of the environmental standards. Therefore, the predicted impacts at the SACs are insignificant and do not need further assessment.

Consideration of Ancient Woodlands

The NWR/EA guidance states:

When there are local nature sites within the specified distance (2 km)

If your emissions meet both of the following criteria they're insignificant – you do not need to assess them any further:

- *the short term PC is less than 100% of the short term environmental standard for protected conservation areas*
- *the long term PC is less than 100% of the long term environmental standard for protected conservation areas*

Table 5.3 and **Table 5.4** shows that the maximum predicted short-term PC at any local nature site is 7.9%, and the maximum predicted long-term PC is 3.5% of the environmental standards. Therefore, the predicted impacts at the local nature sites are insignificant and do not need further assessment.

6 SENSITIVITY ANALYSIS

6.1 INTRODUCTION

This section considers the sensitivity of model-predicted concentrations to the following:

- Meteorological data
- Roughness length
- Grid spacing
- Building downwash
- Terrain
- Stack height
- Single boiler operation

6.2 METEOROLOGICAL DATA

The assessment presented in this report is based on predictions made using five years (2019-2023) of NWP meteorological data.

To illustrate the year-to-year variation in meteorological data, **Table 6.1** shows the maximum predicted off-site ground-level concentration of nitrogen (NO_2) for five years of NWP meteorological data and predictions made with 2022 meteorological data from both St Athan and Cardiff Airport.

Table 6.1 ADMS 6.0 Maximum Predicted Off-Site Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$): Effect of Meteorological Data (a)

Year and Source	Annual Average	99.8th Percentile of Hourly Averages
NWP 2019	1.45	8.05
NWP 2020	1.36	8.37
NWP 2021	1.35	8.24
NWP 2022	1.14	7.94
NWP 2023	1.43	8.70
St Attan 2022	1.84	8.15
Cardiff 2022	1.83	8.15
Assessment Criteria	**40**	**200**

(a) Assuming 100% oxidation of the oxides of nitrogen (NO_x) to nitrogen dioxide (NO_2) for the annual average and 50% for 99.8th percentiles

Table 6.1 shows that there is some year-to-year variation in predicted concentrations, although it is not considered to be significant. The maximum predicted annual average concentration using meteorological data from St Athan and Cardiff is higher than that predicted using NWP data; the 99.8th percentiles are similar. The NWP data are considered more representative than either Cardiff or St Athan, given their coastal location.

6.3 ROUGHNESS LENGTH

The roughness length of 0.5 m used in this assessment was selected using professional judgment because roughness length cannot be directly measured. There is no one unique roughness that fits a given wind speed profile in practice. Roughness length will also vary depending on wind direction and other factors, such as the season of the year.

Therefore, it is of interest to see how sensitive the model predictions are to roughness length.

Table 6.2 shows the maximum predicted off-site ground-level concentration of nitrogen dioxide (NO_2) for roughness lengths in the 0.25 m to 0.75 m range using 2023 meteorological data.

Table 6.2 ADMS 6.0 Maximum Predicted Off-Site Annual Average and 99.8th Percentile of Houry Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$): Effect of Roughness Length (a)

Roughness Length (m)	Annual Average	99.8th Percentile of Hourly Averages
0.25	1.32	8.66
0.50	**1.43**	**8.70**
0.75	1.48	8.78
Assessment Criteria	**40**	**200**

(a) Assuming 100% oxidation of the oxides of nitrogen (NO_x) to nitrogen dioxide (NO_2) for the annual average and 50% for 99.8th percentiles

Table 6.2 shows that increasing roughness length does not significantly affect the maximum predicted off-site concentration.

6.4 BUILDING DOWNWASH AND TERRAIN

The modelling presented in this assessment includes both the effects of building downwash and terrain. **Table 6.3** shows the predicted maximum off-site ground level concentration of nitrogen dioxide (NO_2) both with and without the effects of building downwash and terrain using 2023 meteorological data.

Table 6.3 ADMS 6.0 Maximum Predicted Off-Site Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$) (a)

Building Downwash Effects	Terrain Effects	Annual Average	99.8th Percentile of Hourly Averages
Yes	**Yes**	**1.43**	**8.70**
No	Yes	1.13	4.92
Yes	No	1.24	8.47
No	No	0.74	4.03
Assessment Criteria		**40**	**200**

(a) Assuming 100% oxidation of the oxides of nitrogen (NO_x) to nitrogen dioxide (NO_2) for the annual average and 50% for 99.8th percentiles

Table 6.3 shows that building downwash effects are predicted to significantly affect dispersion. The effects of terrain on dispersion are not as significant.

6.5 GRID SPACING

If the grid spacing is too large, the reported maximum concentrations may be less than the actual maximum. This assessment uses a grid spacing of 25 m. One way to demonstrate this is to model with smaller and larger grid spacing. If the maximum concentration is not significantly different, one can be confident that the grid spacing is adequate.

Table 6.4 shows the maximum predicted ground-level concentration of nitrogen dioxide (NO_2) for the grid spacing of 12.5 m, 25 m (used in this assessment), and 50 m. Predictions are made using 2023 meteorological data. It should be noted that the presented concentrations are for all locations (i.e., this includes on-site locations).

Table 6.4 ADMS 6.0 Maximum Predicted Annual Average and 99.8th Percentile of Hour Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$): Effect of Grid Spacing (a)

Grid Spacing (m)	Annual Average	99.8th Percentile of Hourly Averages
12.5	2.06	12.9
25	2.06	12.9
50	1.91	12.2
Assessment Criteria	**40**	**200**

(a) Assuming 100% oxidation of the oxides of nitrogen (NO_x) to nitrogen dioxide (NO_2) for the annual average and 50% for 99.8th percentiles

Table 6.4 shows that halving the grid spacing does not affect the maximum predicted concentrations. It can be concluded from this that the selected receptor spacing of 25 m is adequate to capture the maximum impact.

6.6 STACK HEIGHT

Table 6.5 shows the ADMS 6.0 maximum predicted off-site annual average and 99.8th percentile of hourly average concentrations of nitrogen dioxide (NO_2) for stack heights between 20 m and 40 m. Predictions are made for 2023 meteorological data.

Table 6.5 ADMS 6.0 Maximum Predicted Off-Site Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$): Effect of Stack Height [(a)]

Stack Height (m)	Annual Average	99.8th Percentile
20	2.30	18.0
25	1.60	12.3
30	**1.43**	**8.7**
35	1.20	7.6
40	0.91	5.2
Assessment Criteria	**40**	**200**

(a) Assuming 100% oxidation of the oxides of nitrogen (NO_x) to nitrogen dioxide (NO_2) for the annual average and 50% for 99.8th percentiles

Table 6.5 shows the reduction in predicted concentrations with each additional 5 m increase in stack height reduces as the height increases. This assessment has demonstrated that the selected stack height of 30 m gives rise to impacts that are not of concern.

6.7 NUMBER OF OPERATING BOILERS

Table 6.5 shows the ADMS 6.0 maximum predicted off-site annual average and 99.8th percentile of hourly average concentrations of nitrogen dioxide (NO_2) for both two-boiler operation (as assumed in this assessment) and single-boiler operation. Predictions are made for 2023 meteorological data.

Table 6.6 ADMS 6.0 Maximum Predicted Off-Site Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$): Number of Operating Boilers [(a)]

Number of Boilers	Annual Average	99.8th Percentile
2	**1.43**	**8.7**
1	0.82	5.5
Assessment Criteria	**40**	**200**

(a) Assuming 100% oxidation of the oxides of nitrogen (NO_x) to nitrogen dioxide (NO_2) for the annual average and 50% for 99.8th percentiles

Table 6.6 shows that the maximum predicted off-site concentration for one boiler operation is about 60% of the concentration for two boiler operations (due to reduced plume rise).

7 SUMMARY AND CONCLUSIONS

Earth & Marine Environmental Consultants Ltd (EAME) has commissioned Atmospheric Dispersion Modelling Ltd (ADM Ltd) to undertake an air quality risk assessment of emissions to the atmosphere from the two proposed boilers located at WEPA Bridgend paper mill.

The two proposed boilers are required to replace the existing CHP.

The two proposed boilers require a permit variation to operate. This Air Quality Assessment (AQA) is required to support an application for a variation to the existing Environmental Permit (EPR/EP3738NG) under the Environmental Permitting (England and Wales) Regulations 2016.

The existing Combine Heath and Power (CHP) Plant has a net thermal input of less than 50 MW and supplies the entire steam demand of the papermaking operation and approximately 50% of the electrical power of the mill. The CHP plant is natural gas-fired with the capacity for supplementary gas oil firing. The CHP plant comprises two gas turbines with a single 37 m stack and a shell boiler with a 30 m stack.

The two proposed boilers will be fuelled by natural gas, and therefore, the only atmospheric pollutants of concern are the oxide of nitrogen (NO_x) with emissions to the atmosphere via a single twin flue 30 m high stack.

The ADMS 6.0 dispersion model has been used to predict ground-level concentrations of the oxide of nitrogen (NO_x) and nitrogen dioxide (NO_2) released into the atmosphere from the proposed new boilers.

The principal conclusion of this assessment is that emissions to the atmosphere at their emission limits from the proposed two new boilers give rise to predicted ground-level pollutant concentrations (process contributions, PC) that are not of concern to human health or ecosystems. The impacts are predicted to be insignificant.