



Air Quality Assessment: The Chocolate Factory, Neath Port Talbot

October 2017



Experts in air quality
management & assessment

Document Control

Client	Michton Ltd	Principal Contact	Tony Wadley
---------------	-------------	--------------------------	-------------

Job Number	J2924A
-------------------	--------

Report Prepared By:	Robert Kennedy and Kieran Laxen
----------------------------	---------------------------------

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J2924A/1/F4	9 October 2017	Final	Prof. Duncan Laxen (Managing Director)

This report has been prepared by Air Quality Consultants Ltd on behalf of the Client, taking into account the agreed scope of works. Unless otherwise agreed, this document and all other Intellectual Property Rights remain the property of Air Quality Consultants Ltd.

In preparing this report, Air Quality Consultants Ltd has exercised all reasonable skill and care, taking into account the objectives and the agreed scope of works. Air Quality Consultants Ltd does not accept any liability in negligence for any matters arising outside of the agreed scope of works. The Company operates a formal Quality Management System, which is certified to ISO 9001:2008, and a formal Environmental Management System, certified to ISO 14001:2015. QMF 08.

When issued in electronic format, Air Quality Consultants Ltd does not accept any responsibility for any unauthorised changes made by others.

When printed by Air Quality Consultants Ltd, this report will be on Evolve Office, 100% Recycled paper.

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
1 Burwood Place, London W2 2UT Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 12 St Oswalds Road, Bristol, BS6 7HT
Companies House Registration No: 2814570

Executive Summary

The air quality impacts associated with the operation of the biomass boilers at the Chocolate Factory in Neath Port Talbot have been assessed.

Existing conditions within the study area show good air quality, with concentrations of all pollutants below the relevant air quality objectives, with the exception of the nitrogen nutrient deposition rates which, due to high background levels, exceed the critical load for the most sensitive ecological habitat in the region.

Based on the results of the modelling, there are not expected to be any exceedances of the human health air quality objectives at any nearby receptors.

Nitrogen oxides concentrations have been modelled for the ecological receptors, and no exceedances of the nitrogen oxides critical level have been predicted. The nitrogen nutrient and acid deposition rates have been calculated from the nitrogen oxides emissions; the nitrogen deposition rates are in exceedance of the critical load, however, this is a direct result of the background deposition rates being in exceedance of the criteria; the additional contribution from the Chocolate Factory is at most 1.1% of the critical load, and less than 1% of the background deposition rates at the nearest ecological receptors, under the highly conservative assumptions modelled. The acid deposition rate is well below the critical load throughout the study area.

The biomass boilers at the Chocolate Factory generate a negligible contribution to surrounding existing pollutant concentrations or deposition rates. As such, no change in the stack heights is deemed necessary.

Contents

1	Introduction	4
2	Assessment Criteria	5
3	Assessment Approach	8
4	Site Description and Baseline Conditions	10
5	Assessment Results	14
6	Conclusions	23
7	References	24
8	Glossary	26
9	Appendices	28
A1	Policy Context	29
A2	Professional Experience	32
A3	Modelling Methodology	34

Tables

Table 1:	Air Quality Criteria for Nitrogen Dioxide, PM ₁₀ and PM _{2.5}	6
Table 2:	Vegetation and Ecosystem Critical Levels ^a	6
Table 3:	Vegetation and Ecosystem Critical Loads	7
Table 4:	Summary of Nitrogen Dioxide (NO ₂) Monitoring (2011-2015)	12
Table 5:	Summary of PM ₁₀ Automatic Monitoring (2011-2015) ^{a,b}	12
Table 6:	Estimated Annual Mean Background Pollutant Concentrations in 2016 (µg/m ³) 13	
Table 7:	Estimated Annual Mean Background Nitrogen Deposition	13
Table 8:	Worst-Case Annual Nitrogen Oxides Emissions at Nearest Ecological Receptor 20	
Table 9:	Worst-Case Annual Nitrogen Nutrient Deposition at Nearest Ecological Receptor	21
Table 10:	Worst-Case Acid Deposition at Nearest Ecological Receptor	22
Table A3.1:	Biomass Boiler Parameters	35
Table A3.2:	Model Input Parameters used in ADMS-5	35
Table A3.3:	Deposition Velocity Used in This Assessment	38

Figures

Figure 1:	Study Area and Surrounds	10
-----------	--------------------------------	----

Figure 2: Annual Mean NO ₂ Concentrations (µg/m ³)	14
Figure 3: 99.79 th Percentile Hourly NO ₂ Concentrations (µg/m ³)	15
Figure 4: Annual Mean PM ₁₀ Concentrations (µg/m ³)	16
Figure 5: 90.41 st Percentile Daily PM ₁₀ Concentrations (µg/m ³).....	17
Figure 6: Annual Mean PM _{2.5} Concentrations (µg/m ³)	18
Figure 7: Annual Mean Nitrogen Oxides Concentrations (µg/m ³)	19
Figure 8: Contour showing the 1% Exceedance of Process Nitrogen Nutrient Deposition over the Critical Load	21
 Figure A3.1: Flue Locations & Modelled Buildings	 36

1 Introduction

- 1.1 This report describes the potential air quality impacts associated with the operation of the biomass boilers at The Chocolate Factory in the Kenfig Industrial Estate, Port Talbot. The assessment has been carried out by Air Quality Consultants Ltd on behalf of Michton Ltd.
- 1.2 The facility has 43 biomass boilers, which operate at various loads and operating hours throughout the year, including:
- 20 x 199 kW wood chip boilers, operating for 5,000 hours per year;
 - 12 x 99.5 kW wood pellet boilers, operating for 6,500 hours per year;
 - 5 x 99.5 kW wood chip boilers, operating for 4,000 hours per year;
 - 5 x 99.5 kW wood pellet boilers, operating for 1,000 hours per year; and
 - 1 x 199 kW wood pellet boiler, operating at 5,000 hours per year.
- 1.3 Not all of the boilers will be running concurrently; in particular, the five 99.5 kW wood chip boilers will not run at the same time as the five 99.5 kW wood pellet boilers, and as such a maximum of 38 boilers will run at any time. In addition, the boilers generally operate at part-load, for an average output of 55 kW per boiler.
- 1.4 The Local Authority has questioned whether the flues serving the boilers are high enough to ensure that there are no adverse air quality impacts. An air quality assessment has been carried out to determine whether the current flue heights are appropriate and whether any unacceptable impacts arise in relation to the relevant air quality objectives, critical levels and critical loads with the current operation.
- 1.5 The main emissions of concern related to the biomass boilers are nitrogen oxides and nitrogen dioxide and fine particulate matter (PM₁₀ and PM_{2.5}).
- 1.6 This report describes the existing local air quality conditions, with the operation of the biomass boilers, for the years 2014, 2015 and 2016; noting 2016 has been focused on for presentation of results, as it represents the worst-case year.

2 Assessment Criteria

- 2.1 The assessment criteria used for this assessment are described in the following sections for both the health criteria and the ecological criteria. The background policy details are included in Appendix A1 for context.

Health Criteria

- 2.2 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations 2000 (2000) and the Air Quality (England) (Amendment) Regulations 2002 (2002).
- 2.3 The objectives for nitrogen dioxide and PM₁₀ were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The PM_{2.5} objective is to be achieved by 2020.
- 2.4 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2016b). The annual mean objectives for nitrogen dioxide and PM₁₀ are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour objective for PM₁₀ is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.
- 2.5 The European Union has also set limit values for nitrogen dioxide, PM₁₀ and PM_{2.5}. The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded.
- 2.6 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM₁₀ and PM_{2.5}

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 µg/m ³ not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m ³
Fine Particles (PM₁₀)	24-hour Mean	50 µg/m ³ not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m ³
Fine Particles (PM_{2.5})^a	Annual Mean	25 µg/m ³

^a The PM_{2.5} objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Vegetation and Ecosystem Criteria

- 2.7 Objectives for the protection of vegetation and ecosystems have been set by the UK Government. They are the same as the EU limit values. The limit values and objectives only apply a) more than 20 km from an agglomeration (about 250,000 people), and b) more than 5 km from Part A industrial sources, motorways and built up areas of more than 5,000 people. Critical levels and critical loads are the ambient concentrations and deposition fluxes below which significant harmful effects to sensitive ecosystems are unlikely to occur. Some of the critical levels are set at the same concentrations as the objectives, but do not have the same legal standing. Typically, the potential for exceedances of the critical levels and critical loads is considered in the context of the level of protection afforded to the ecological site as a whole. For example, the level of protection afforded to an internationally-designated site (such as an SAC) is significantly greater than that afforded to a local nature reserve; reflecting the relative sensitivity of the sites as well as their perceived ecological value. The critical levels relevant to this assessment are set out in Table 2, while the critical loads are provided in Table 3.

Table 2: Vegetation and Ecosystem Critical Levels^a

Pollutant	Time Period	Objective
Nitrogen Oxides (expressed as NO₂)	Annual Mean ^{a,b}	30 µg/m ³
	24-Hour Mean ^a	75 µg/m ³

^a The critical levels are defined by the World Health Organisation (WHO, 2000).

^b Away from major sources (see Paragraph 2.7), this critical level is set as an objective (Defra, 2007) and a limit value (Directive 2008/50/EC of the European Parliament and of the Council, 2008).

Table 3: Vegetation and Ecosystem Critical Loads

Habitat Type (and EUNIS code) ^a	Nutrient Nitrogen (kgN/ha/yr) ^b	Acid Deposition 'N _{max} ' (keq/ha/yr) ^c
Coastal stable dune grasslands - acid type (B1.4) Moist to wet dune slacks - acid type, supralittoral sediment, fen, marsh and swamp (B1.8) Atlantic salt meadows – mid-upper saltmarshes (A2.53)	8	1.530

^a The European Nature Information System. (European Environment Agency, 2017).

^b Critical loads for nutrient nitrogen taken from (APIS, 2013).

^c Critical loads for acid deposition have been taken from (APIS, 2017). N_{max} is the value above which additional nitrogen deposition will lead to an exceedance. The value of N_{max} used is the most stringent across the entire SAC and is not specific to the receptors assessed.

3 Assessment Approach

Existing Conditions

- 3.1 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra's Pollutant Release and Transfer Register (Defra, 2017b) and the Environment Agency's website 'what's in your backyard' (Environment Agency, 2017). Local sources have also been identified through examination of Port Talbot Council's Air Quality Review and Assessment reports.
- 3.2 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. This covers both the study area and nearby sites, the latter being used to provide context for the assessment. Background concentrations have been defined using the national pollution maps published by Defra (2017a). These cover the whole country on a 1x1 km grid.
- 3.3 The nearby M4 motorway is a potentially significant contributor to pollutant levels in the vicinity of the site; however, this as this source is over 250 m from the Chocolate Factory, and pollution impacts from both the M4 and the factory itself are generally nearfield impacts; the M4 has not been explicitly included in this assessment, it does, nevertheless, contribute to the background concentrations in the national maps.

Modelling Methodology

- 3.4 The impacts of emissions from the biomass boilers have been modelled using the ADMS-5.2 dispersion model. ADMS-5.2 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. Entrainment of the plumes into the wake of the buildings has been simulated within the model. The model input parameters are set out in Appendix A3.
- 3.5 Predictions of nitrogen oxides, nitrogen dioxide and particulate matter (PM₁₀ and PM_{2.5}) concentrations have been carried out.
- 3.6 Deposition fluxes have been calculated from the predicted concentrations of nitrogen dioxide. Details on the method for calculating the deposition rates are provided in Appendix A3.

Operating Hours

- 3.7 Operation of the biomass boilers is limited, based on demand, to, on average, 5,000 hours per year. However, in order to capture the worst-case meteorological conditions, the boilers have been assumed to be running continuously throughout the year. This allows the worst-case hourly

pollution concentrations to be determined; the annual average concentrations will therefore be significantly higher than in actual operation, hence providing a high level of conservatism in the results.

Receptor Grid

- 3.8 Concentrations have been predicted across nested Cartesian grids. These grids have a spacing of 5 m x 5 m within 200 m of the facility, 25 m x 25 m within 400 m of the facility, and 50 m x 50 m within 1,000 m of the facility. The receptor grid has been modelled at a height of 1.5 m above ground level.

Meteorological Data

- 3.9 In order to allow for uncertainties in local and future-year meteorological conditions, the dispersion model has been run 3 times, with each run using a different full year of hour-by-hour meteorological data from the nearest appropriate meteorological site. The years 2014, 2015 and 2016 have been modelled for the Mumbles meteorological station. Further details of the meteorological datasets used are provided in Appendix A3.

Uncertainty

- 3.10 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which in reality are variable as the plant will operate at different loads at different times. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms. These uncertainties cannot be easily quantified and it is not possible to verify the point-source model outputs. Where parameters have been estimated the approach has been to use reasonable worst-case assumptions.
- 3.11 On balance, when taking into account the assumed number of operating hours, the approach taken to meteorological conditions, and the assumed nitrogen oxides to nitrogen dioxide relationship, the assessment will over-predict the impacts of the facility. The approach used thus provides a robust assessment.

4 Site Description and Baseline Conditions

- 4.1 The Chocolate Factory is located in the Kenfig Industrial Estate, approximately 7.5 km to the south of the centre of Port Talbot. There are no large-scale residential developments in the vicinity of the site, with the nearest residential road located approximately 1.5 km to the southeast. There is a bed and breakfast located approximately 0.5 km to the northeast, and numerous commercial offices within the industrial estate¹.
- 4.2 The study area includes designated ecological sites, including the Cynffig / Kenfig Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) as well as the Kenfig Pool and Dunes, which is both a Local Nature Reserve (LNR) and a National Nature Reserve (NNR).

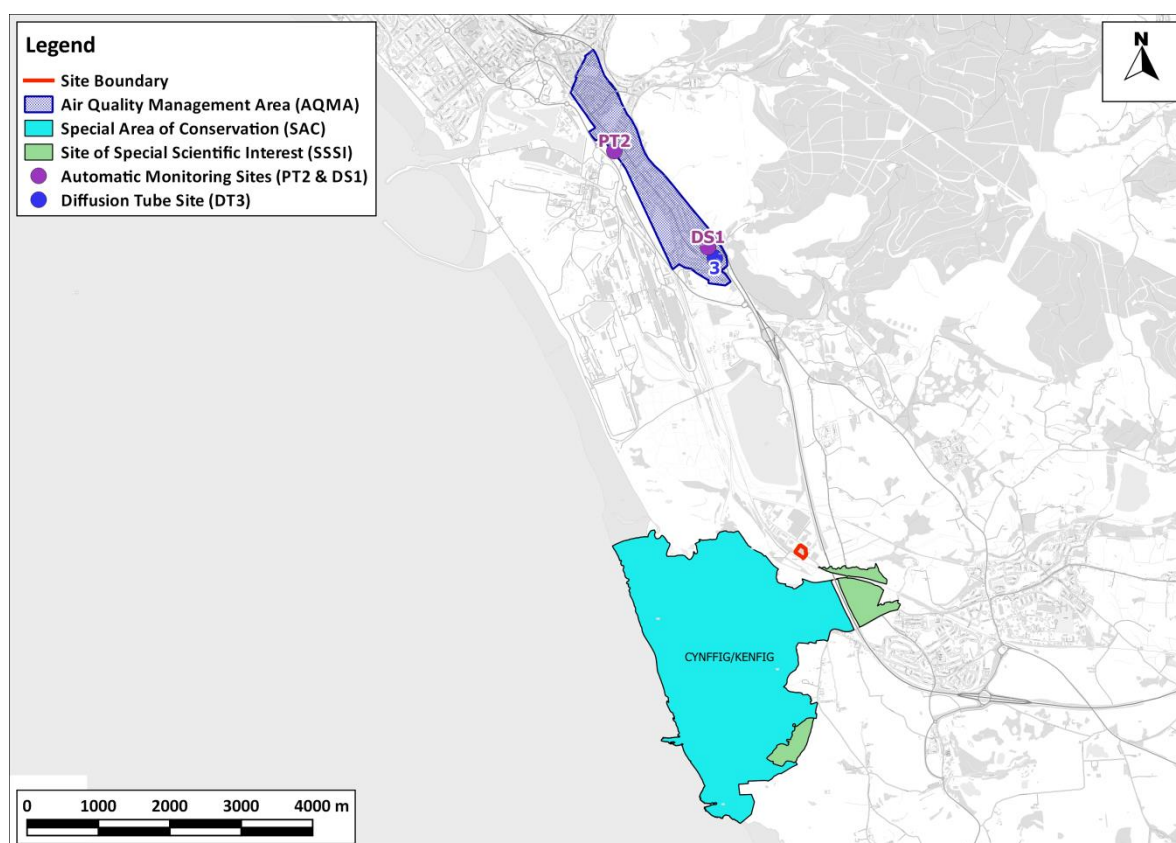


Figure 1: Study Area and Surrounds

Contains Ordnance Survey data © Crown copyright and database right 2017. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

¹ The air quality objectives do not apply to occupational exposure.

Industrial sources

- 4.3 A search of the UK Pollutant Release and Transfer Register (Defra, 2017b) and Environment Agency's 'what's in your backyard' (Environment Agency, 2017) websites identified the following sources which have the potential to contribute to air quality in the area:
- Western Wood Energy Plant, a 14 MWe biomass plant, located approximately 3 km north of The Chocolate Factory; and
 - Port Talbot Steel Works, located approximately 5 km to the west-northwest.
- 4.4 Given the significant distance between these sites and the study area, there is unlikely to be any significant cumulative impact within the study area and at nearby receptors. Emissions from these sources will be included in the background levels used in the modelling.
- 4.5 In general, there are numerous smaller industrial sources within the Kenfig Industrial Estate, where The Chocolate Factory is located, none of which are seen to provide significant emissions of the pollutants of interest within the study area assessed.

EU Limit Values

- 4.6 No exceedances of the annual mean EU limit value for nitrogen dioxide in the study area have been identified using the maps of roadside concentrations published by Defra for 2015 (Defra, 2017c) or for 2020 (Defra, 2016a). These are the maps used by the UK Government, together with the results from national AURN monitoring sites that operate to EU data quality standards, to report exceedances of the limit value to the EU. The maps are currently available for the past years 2001 to 2015 and the future years 2020, 2025 and 2030. The national maps of roadside PM₁₀ and PM_{2.5} concentrations, which are available for the years 2009 to 2015, show no exceedances of the limit values anywhere in the UK in 2015.

Air Quality Review and Assessment

- 4.7 Neath Port Talbot Council has investigated air quality within its area as part of its responsibilities under the LAQM regime. The Council has declared an Air Quality Management Area (AQMA) for exceedances of the 24-hour mean PM₁₀ objective to an area approximately 4 km north of the site, which is in close proximity to the steel works.

Local Air Quality Monitoring

- 4.8 There are no local monitoring sites, for either nitrogen oxides, nitrogen dioxide, PM₁₀ or PM_{2.5}, in the vicinity of The Chocolate Factory.
- 4.9 Neath Port Talbot County Borough Council operates a number of both automatic (NO₂ and PM₁₀) and diffusion tube (NO₂) monitoring stations within its area. None of these are in close proximity to

the proposed development site. However, for illustration of overall background levels in the area, the data for the closest sites have been described below, although it should be noted that these sites are, at minimum, 4 km from the site, and are likely to experience higher pollutant levels than the factory site, due to the closer proximity to the steel works and the fact they are located within an AQMA.

4.10 Results for the years 2011 to 2015 are summarised in Table 4 for NO₂ and Table 5 for PM₁₀.

Table 4: Summary of Nitrogen Dioxide (NO₂) Monitoring (2011-2015)

Site No.	Site Type	Location	2011	2012	2013	2014	2015
Automatic Monitor - Annual Mean (µg/m ³) ^a							
PT2	Industrial	Port Talbot Fire Station	18	18	17	17	17
Objective			40				
Automatic Monitor - No. of Hours > 200 µg/m ³							
PT2	Industrial	Port Talbot Fire Station	0	0	0	0	0
Objective			18				
Diffusion Tube - Annual Mean (µg/m ³) ^a							
3	Urban background	11 College Green, Port Talbot	17.0	16.9	15.7	14.9	14.5
Objective			40				

^a Data taken from the Neath Port Talbot County Borough Council Local Air Quality Management Progress Report 2016 (Neath Port Talbot, 2016).

Table 5: Summary of PM₁₀ Automatic Monitoring (2011-2015)^{a,b}

Site No.	Site Type	Location	2011	2012	2013	2014	2015
PM ₁₀ Annual Mean (µg/m ³)							
DS1	Industrial	Dyffryn School, Port Talbot	17	16	18	21	20
Objective			40				
PM ₁₀ No. Days >50 µg/m ³							
DS1	Industrial	Dyffryn School, Port Talbot	2	3	2	5	5
Objective			35				

^a Data taken from the Neath Port Talbot County Borough Council Local Air Quality Management Progress Report 2016 (Neath Port Talbot, 2016).

^b There is no specific data available for PM_{2.5}, although the council notes that PM_{2.5} levels are "well below both the target and limit values to be achieved by 2015" (Neath Port Talbot, 2016).

4.11 The local monitoring data show that NO₂ and PM₁₀ concentrations are well below the air quality objective. It is expected that concentrations within the study area will be lower, as the site is located further away from the steel works, and in similar proximity to the M4.

Background Concentrations and Fluxes

National Background Pollution Maps

- 4.12 Estimated background concentrations in the study area have been determined for the year 2016 using Defra's background maps (Defra, 2017a). The background concentrations are set out in Table 6 and have been derived as described in Appendix A3. The background concentrations are all well below the objectives.

Table 6: Estimated Annual Mean Background Pollutant Concentrations in 2016 ($\mu\text{g}/\text{m}^3$)

Year	NO _x	NO ₂	PM ₁₀	PM _{2.5}
2016	22.60	14.87	13.64	9.34
Objectives	30	40	40	25 ^a

^a The PM_{2.5} objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Background Deposition and Acidity

- 4.13 Background nitrogen deposition fluxes to the SAC and SSSI have been taken from the APIS website (APIS, 2017).

Table 7: Estimated Annual Mean Background Nitrogen Deposition

Site	Nutrient Nitrogen Deposition (kgN/ha/y)	Acid Nitrogen Deposition (keq/ha/y)
Background	11	0.790
Critical Load	8	1.530

- 4.14 Background nutrient nitrogen deposition exceeded the critical load in this period, which is common particular when selecting the lowest (and hence most conservative) critical load for use in the assessment.
- 4.15 Acid nitrogen deposition background rates are well below the critical load.

5 Assessment Results

Health

- 5.1 The results of the dispersion modelling are shown in the following sections for the pollutants of concern, namely nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5}). All results presented are inclusive of the background concentrations described in the previous chapter.
- 5.2 Whilst the years 2014, 2015 and 2016 were modelled, for clarity only the results from the year 2016 have been shown; these represented the worst-case results out of the years modelled.

Nitrogen Dioxide

- 5.3 Contours of the predicted annual mean nitrogen dioxide concentrations are shown in Figure 2, with any exceedances of the air quality objective (40 µg/m³) highlighted in red.



Figure 2: Annual Mean NO₂ Concentrations (µg/m³)

Contains Ordnance Survey data © Crown copyright and database right 2017. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

- 5.4 The results of the dispersion modelling show that elevated annual mean nitrogen dioxide concentrations, due to emissions from the biomass boilers, are expected to remain localised to the factory site. There are no relevant receptors at the location where there is the potential for concentrations to be greater than $40 \mu\text{g}/\text{m}^3$. Furthermore, no exceedances of the air quality objective are predicted at the nearest receptors with relevant exposure (not shown).
- 5.5 Contours of the predicted 99.79th percentile hourly mean nitrogen dioxide concentrations are shown in Figure 3, with any exceedances of the air quality objective ($200 \mu\text{g}/\text{m}^3$) highlighted in red.



Figure 3: 99.79th Percentile Hourly NO_2 Concentrations ($\mu\text{g}/\text{m}^3$)

Contains Ordnance Survey data © Crown copyright and database right 2017. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

- 5.6 The results of the dispersion modelling show that elevated hourly nitrogen dioxide concentrations due to emissions from the biomass boilers are also expected to remain localised to the factory site. No exceedances of the air quality objective are predicted at the locations consider to be relevant receptors for the hourly objective.

Particulate Matter – PM_{10}

- 5.7 Contours of the predicted annual mean PM_{10} concentrations are shown in Figure 4..



Figure 4: Annual Mean PM₁₀ Concentrations (µg/m³)

Contains Ordnance Survey data © Crown copyright and database right 2017. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

- 5.8 The results of the dispersion modelling show that elevated annual PM₁₀ concentrations due to emissions from the biomass boilers are expected to remain localised to the factory site; no exceedances of the annual mean air quality objective are predicted anywhere within the study area.
- 5.9 Contours of the predicted 90.41st percentile daily mean PM₁₀ concentrations are shown in Figure 5, with any exceedances of the air quality objective (50 µg/m³) highlighted in red.

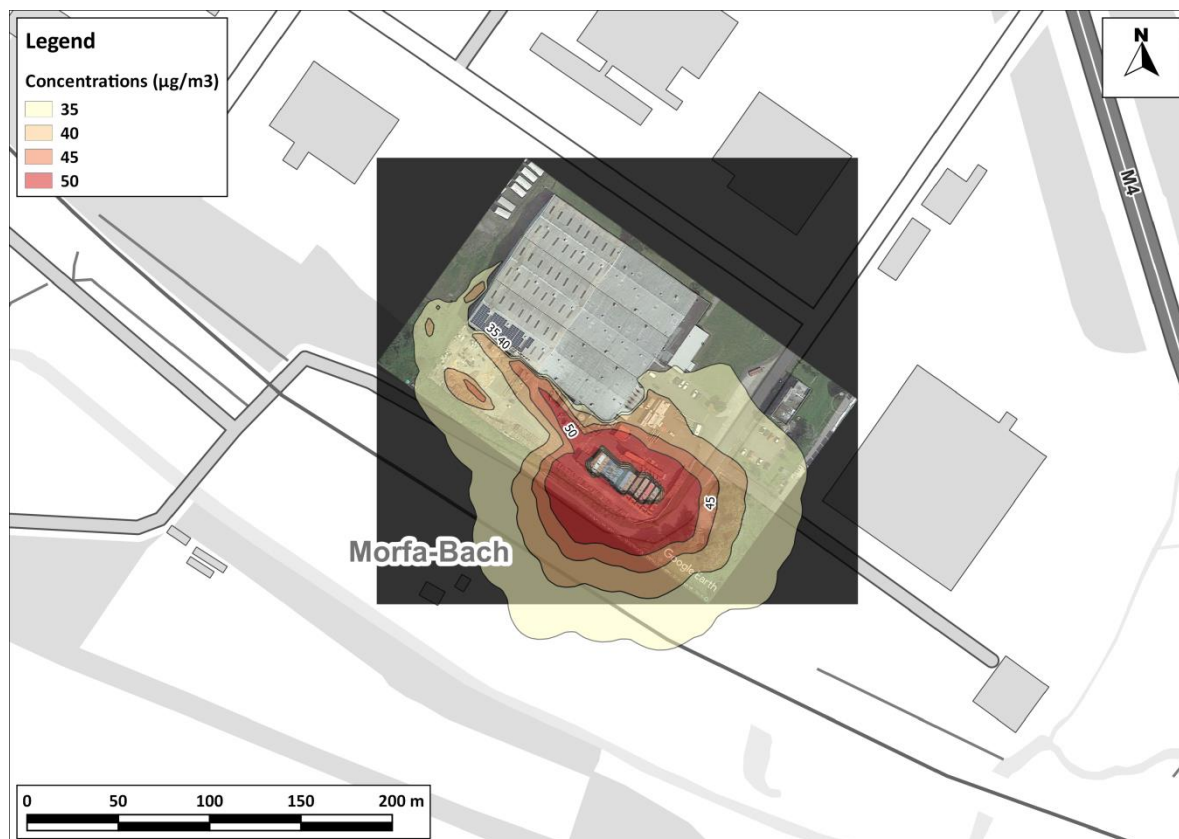


Figure 5: 90.41st Percentile Daily PM₁₀ Concentrations (µg/m³)

Contains Ordnance Survey data © Crown copyright and database right 2017. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

- 5.10 The results of the dispersion modelling show that elevated daily mean PM₁₀ concentrations due to emissions from the biomass boilers are also expected to remain localised to the factory site. There are no relevant receptors at the location where there is the potential for concentrations to be greater than 50 µg/m³. Furthermore, no exceedances of the air quality objective are predicted at the nearest receptors with relevant exposure (not shown).

Particulate Matter – PM_{2.5}

- 5.11 Contours of the predicted annual mean PM_{2.5} concentrations are shown in Figure 6, with any exceedances of the air quality objective (25 µg/m³) highlighted in red.



Figure 6: Annual Mean PM_{2.5} Concentrations (µg/m³)

Contains Ordnance Survey data © Crown copyright and database right 2017. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

- 5.12 The results of the dispersion modelling show that annual PM₁₀ concentrations from the biomass boilers are expected to remain localised to the factory site. No exceedances of the air quality objective are predicted anywhere within the study area.

Ecosystem

- 5.13 The results of the dispersion modelling are shown in the following sections for the pollutants of concern, namely nitrogen oxides, as well as the resulting nitrogen deposition and acid deposition. All results presented are inclusive of the background concentrations described in the previous chapter.
- 5.14 Whilst the years 2014, 2015 and 2016 were modelled, for clarity only the results from the year 2014 have been shown; these represented the worst-case results out of the years modelled.

Nitrogen Oxides

- 5.15 The ecosystem objectives only strictly apply at locations more than 5 km from Part A industrial sources, motorways and built up areas of more than 5,000 people. The SAC / SSSI is located within 5 km of the M4 and therefore the objectives do not apply. Natural Resources Wales, however, has adopted a more precautionary approach and applies the objectives as the critical levels. These are levels above which the concentrations are identified as of concern but they are not required to be met by regulations.
- 5.16 Contours of the area where the total nitrogen oxide concentrations are above the critical level ($30 \mu\text{g}/\text{m}^3$) are shown in Figure 7.

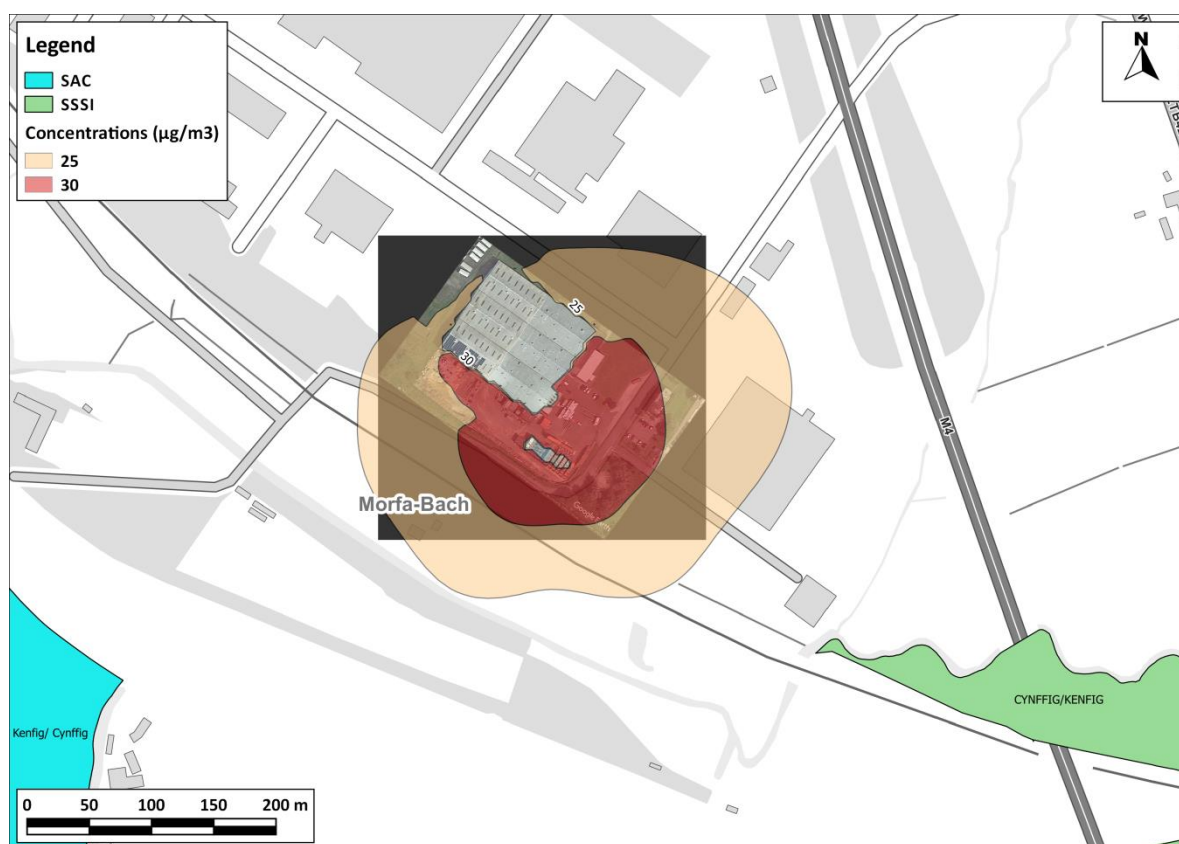


Figure 7: Annual Mean Nitrogen Oxides Concentrations ($\mu\text{g}/\text{m}^3$)

Contains Ordnance Survey data © Crown copyright and database right 2017. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

- 5.17 The results of the dispersion modelling show that elevated annual nitrogen oxides concentrations due to emissions from the biomass boilers are expected to remain localised to the factory site. There are no relevant receptors within the area presented in Figure 7, furthermore, no exceedances of the nitrogen oxides critical level are predicted at the nearest ecological receptors.

Table 8: Worst-Case Annual Nitrogen Oxides Emissions at Nearest Ecological Receptor

Site	Nitrogen Oxides Process Contribution ($\mu\text{g}/\text{m}^3$)	Nitrogen Oxides Background Contribution ($\mu\text{g}/\text{m}^3$)	Nitrogen Oxides Predicted Environmental Concentration ($\mu\text{g}/\text{m}^3$)
Worst-Case Concentrations at Cynffig/Kenfig SSSI	0.8	22.6	23.4
Annual Mean Critical Level	30		
% of Critical Level	2.8%	75.3%	78.1%

- 5.18 Table 8 shows the worst-case annual mean nitrogen oxides process contribution concentrations, plus predicted environmental concentration, for the worst-case location at the Cynffig/Kenfig SSSI (which can be seen from Figure 7 as the boundary of the SSSI closest to the site, located 240 m east-southeast of the factory).

Nitrogen Deposition

- 5.19 The background nitrogen deposition rate already exceeds the critical load for the most sensitive habitat in the nearby SAC and SSSI. As such, the nitrogen deposition results, including the background concentrations, also exceed the nitrogen deposition critical load.
- 5.20 In order to ascertain the significance of the contribution of the factory to the pollutant levels in the area, a screening criterion has been established, whereby, if the process contributes less than 1% of the critical load to the nitrogen nutrient deposition rates at the ecological receptors, the process contribution is considered to be negligible.
- 5.21 A contour of the area where the nitrogen nutrient deposition contributes more than 1% of the critical load is shown in Figure 8.

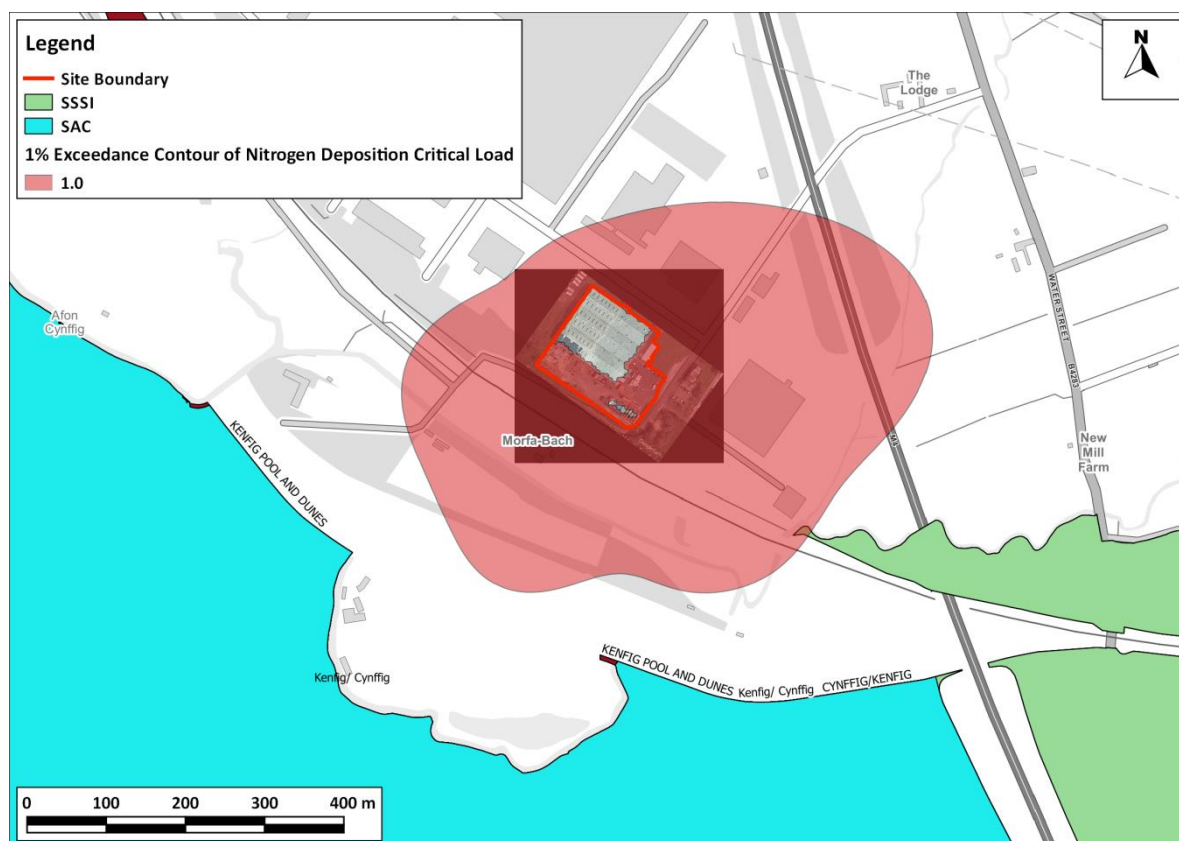


Figure 8: Contour showing the 1% Exceedance of Process Nitrogen Nutrient Deposition over the Critical Load

Contains Ordnance Survey data © Crown copyright and database right 2017. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0. Imagery © Google 2017.

Table 9: Worst-Case Annual Nitrogen Nutrient Deposition at Nearest Ecological Receptor

Site	Nitrogen Nutrient Deposition Process Contribution ($\mu\text{g}/\text{m}^3$)	Nitrogen Nutrient Deposition Background Contribution ($\mu\text{g}/\text{m}^3$)	Nitrogen Nutrient Predicted Environmental Deposition ($\mu\text{g}/\text{m}^3$)
Worst-Case Deposition at Cynffig/Kenfig SSSI	0.08	11.0	11.08
Annual Mean Critical Load	8		
% of Critical Load	1.1%	137.5%	138.6%

- 5.22 The process contribution is at most 1.1% of the critical load, and less than 1% of the background levels at the ecological receptor sites. The process contribution slightly exceeds the 1% screening criteria at the edge of the Cynffig/Kenfig SSSI, under the highly conservative modelling assumptions utilised, as such impacts cannot be discounted within this small area.

Acid Deposition

- 5.23 The acid deposition from the plant is calculated from the nitrogen oxides concentrations, which are relatively low from the biomass boilers. The maximum predicted acid deposition rate at the nearest ecological receptor is 0.787 keq/ha/y (including background levels), which is below the acid deposition critical load of 1.53 keq/ha/y. As such, no exceedances of the acid deposition critical load are predicted.

Table 10: Worst-Case Acid Deposition at Nearest Ecological Receptor

Site	Acid Deposition Process Contribution ($\mu\text{g}/\text{m}^3$)	Acid Deposition Background Concentration ($\mu\text{g}/\text{m}^3$)	Acid Deposition Predicted Environmental Deposition ($\mu\text{g}/\text{m}^3$)
Worst-Case Deposition at Cynffig/Kenfig SSSI	0.006	0.781	0.787
Annual Mean Critical Load	1.530		
% of Critical Load	0.4%	51.0%	51.4%

6 Conclusions

- 6.1 An air quality assessment has been carried out for the biomass boilers at the Chocolate Factory in Port Talbot. The factory has been conservatively assumed to be continuously running, when in actual operations the boilers will each be run for approximately 5,000 hours per year. As such, the worst-case hourly and daily concentrations have been determined, while the annual means will be higher than would arise from actual emissions and therefore can be considered to be highly conservative.
- 6.2 Based on the results of the modelling, there are not expected to be any exceedances of the human health air quality objectives at any nearby receptors.
- 6.3 Nitrogen oxides concentrations have been modelled to show the plant impacts at the ecological receptors, and no exceedances of the nitrogen oxides critical level are predicted. The nutrient nitrogen and acid deposition rates have been calculated from the predicted nitrogen dioxide concentrations; the nutrient nitrogen deposition rates exceed the critical load, however, this is a direct result of the background deposition rate being in exceedance of the criterion; the additional contribution from the Chocolate Factory is at most 1.1% of the critical load, and less than 1% of the background level at the nearest ecological receptors. The acid deposition rate is well below the critical load throughout the study area.
- 6.4 In conclusion, the biomass boilers at the Chocolate Factory generate negligible contributions to existing pollutant concentrations or deposition rates at relevant receptors in the area around the plant. As such, no change in the stack height is deemed necessary.

7 References

- APIS (2013) *Recommended values within nutrient nitrogen critical load ranges for use in air pollution impact assessments*.
http://www.apis.ac.uk/sites/default/files/downloads/APIS%20critical_load_range_document_0.pdf.
- APIS (2017) *APIS*, [Online], Available: www.apis.ac.uk.
- Countryside and Rights of Way Act 2000* (2000), HMSO.
- Defra (2007) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Defra.
- Defra (2016a) *2015 NO₂ projections data (2013 reference year)*, [Online], Available: <http://uk-air.defra.gov.uk/library/no2ten/2015-no2-projections-from-2013-data>.
- Defra (2016b) *Review & Assessment: Technical Guidance LAQM.TG16*, Defra.
- Defra (2017a) *Defra Air Quality Website*, [Online], Available: <http://laqm.defra.gov.uk/>.
- Defra (2017b) *UK Pollutant Release and Transfer Register*, [Online], Available: prtr.defra.gov.uk.
- Defra (2017c) *UK Ambient Air Quality Interactive Map*, [Online], Available: <http://uk-air.defra.gov.uk/data/gis-mapping>.
- Department of Energy and Climate Change (2016) *Consultation on further reforms to the Capacity Market*.
- Directive 2008/50/EC of the European Parliament and of the Council* (2008).
- Directive 2009/147/EC of the European Parliament and of the Council* (2009).
- Directive 2015/2193/EU of the European Parliament and of the Council* (2015).
- Environment (Wales) Act* (2016).
- Environment (Wales) Act* (2016).
- Environment Act* (1995), HMSO.
- Environment Agency (2005) *Conversion ratios for NO_x and NO₂*, [Online], Available: http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for_NOx_and_NO2.pdf.
- Environment Agency (2011) *AQTAG06 - Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air*.
- Environment Agency (2017) *'what's in your backyard'*, [Online], Available: <http://www.environment-agency.gov.uk/homeandleisure/37793.aspx>.
- European Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora* (1992).

European Environment Agency (2017) *The European Nature Information System*, [Online], Available: <http://eunis.eea.europa.eu/habitats-code.jsp>.

HMSO (1990) *Environmental Protection Act 1990*.

HMSO (1993a) *Clean Air Act 1993*.

HMSO (1993b) *Technical Guidance Note D1 (Dispersion)*.

National Parks and Access to the Countryside Act (1949), HMSO.

National Planning Policy Framework (2012), DCLG.

Natural Environment and Rural Communities Act (2006), HMSO.

Neath Port Talbot (2016) *Neath Port Talbot County Borough Council Local Air Quality Management Progress Report 2016*.

The Air Quality (England) (Amendment) Regulations, 2002, Statutory Instrument 3043 (2002), HMSO.

The Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000), HMSO.

The Conservation of Habitats and Species Regulations 2010 Statutory Instrument 490 (2010), Stationery Office.

Wadley, T. (2017) *Pers.Comm. The Chocolate Factory - AQ Assessment*.

WHO (2000) *Air Quality Guidelines for Europe; 2nd Edition*.
http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf.

Wildlife and Countryside Act (1981), HMSO.

8 Glossary

ADMS-5.2	Atmospheric Dispersion Modelling System model for point sources
APIS	Air Pollution Information System
AQC	Air Quality Consultants
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
CHP	Combined Heat and Power
CROW	Countryside and Rights of Way Act
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
Exceedance	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
EUNIS	European Nature Information System
HMSO	Her Majesty's Stationery Office
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LNR	Local Nature Reserve
µg/m³	Microgrammes per cubic metre
NNR	National Nature Reserve
NO	Nitric oxide
NO₂	Nitrogen dioxide
NO_x	Nitrogen oxides (taken to be NO ₂ + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PEC	Predicted Environmental Concentration

PM₁₀	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
PM_{2.5}	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide
WHO	World Health Organisation

9 Appendices

A1	Policy Context	29
A2	Professional Experience.....	32
A3	Modelling Methodology	34

A1 Policy Context

Air Quality Strategy

- A1.1 The Air Quality Strategy (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an AQMA, and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

Medium Combustion Plant (MCP) Directive

- A1.2 The European Union regulates pollutant emissions from combustion plant with a rated input between 1 and 50 megawatts (MW_{th}) in its Medium Combustion Plant (MCP) Directive (Directive 2015/2193/EU of the European Parliament and of the Council, 2015). The MCP Directive must be transposed into UK law by December 2017.
- A1.3 The MCP Directive sets emission limits to be applied from December 2018 for new plant and by 2025 or 2030 for existing plant (depending on plant size). Member States may choose to exempt existing plant that operate for fewer than 500 hours per year, but current indications are that the UK Government will not apply this exemption (Department of Energy and Climate Change, 2016).

Clean Air Act 1993 & Environmental Protection Act

- A1.4 Small combustion plant of less than 20 MW net rated thermal input are controlled under the Clean Air Act 1993 (HMSO, 1993a). This requires the local authority to approve the chimney height. Plant which are smaller than 366 kW have no such requirement.
- A1.5 Measures to ensure adequate dispersion of emissions from discharging stacks and vents are included in Technical Guidance Note D1 (Dispersion) (HMSO, 1993b), issued in support of the Environmental Protection Act (HMSO, 1990).

Policy for the Protection of Sensitive Ecosystems

European Policies

- A1.6 The “Habitats Directive” (European Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, 1992) requires member states to introduce a range of measures for the protection of habitats and species. The Regulations (The Conservation of Habitats and Species Regulations 2010 Statutory Instrument 490, 2010), transpose the Directive into law in England and Wales. They require the Secretary of State to provide the European Commission with a list of sites which are important for the habitats or species listed in the Directive. The Commission then designates worthy sites as Special Areas of Conservation (SACs). The Regulations also require the compilation and maintenance of a register of European sites, to include SACs and Special Protection Areas (SPAs), with these classified under the “Birds Directive” (Directive 2009/147/EC of the European Parliament and of the Council, 2009). These sites form a network termed “Natura 2000”.
- A1.7 The Regulations primarily provide measures for the protection of European Sites and European Protected Species, but also require local planning authorities to encourage the management of other features that are of major importance for wild flora and fauna.
- A1.8 In addition to SACs and SPAs, some internationally important UK sites are designated under the Ramsar Convention. Originally intended to protect waterfowl habitat, the Convention has broadened its scope to cover all aspects of wetland conservation.
- A1.9 The Habitats Directive (as implemented by the Regulations) requires the competent authority to firstly evaluate whether the development is likely to give rise to a significant effect on the European site. Where this is the case, it has to carry out an ‘appropriate assessment’ in order to determine whether the development will adversely affect the integrity of the site.

National Policies

- A1.10 Sites of national importance may be designated as Sites of Special Scientific Interest (SSSIs). Originally notified under the National Parks and Access to the Countryside Act (1949), SSSIs have been re-notified under the Wildlife and Countryside Act (1981). Improved provisions for the protection and management of SSSIs (in England and Wales) were introduced by the Countryside and Rights of Way Act (2000) (the “CROW” act). If a development is “likely to damage” a SSSI, the CROW act requires that a relevant conservation body (i.e. Natural Resources Wales) is consulted. The CROW act also provides protection to local nature conservation sites, which can be particularly important in providing ‘stepping stones’ or ‘buffers’ to SSSIs and European sites. In addition, the Environment Act (1995) and the Natural Environment and Rural Communities Act (2006) both require the conservation of biodiversity.

- A1.11 The Environment (Wales) Act (2016) replaces the biodiversity duty in the Natural Environment and Rural Communities Act (2006). This duty requires that public authorities seek to maintain and enhance biodiversity in the proper exercise of their functions. The duty also helps to deliver the sustainable management of natural resources as it will require public authorities, in delivering the new biodiversity duty, to promote the resilience of ecosystems.

A2 Professional Experience

Prof. Duncan Laxen, BSc (Hons) MSc PhD MEnvSc FIAQM

Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM₁₀, PM_{2.5} and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

Robert Kennedy, BSc (Phys. Chem.) MEIANZ

Mr Kennedy is a Principal Consultant with AQC, with 15 years' experience in the fields of air quality, greenhouse gasses and the environment. Robert has experience across all facets of air quality, including atmospheric dispersion modelling, ambient and stack pollution monitoring, pollution mitigation and control engineering design, air quality and greenhouse gas emissions inventories and assessments, environmental approvals, odour assessments, indoor air quality assessments and air quality and climate change management plans. Robert has worked for numerous clients covering commercial and residential developments, manufacturing, government, industrial, mining and energy (oil and gas) sectors. Robert has international experience, with exposure to both local and global environmental standards and practices on projects in the Middle East, Europe, United States, South-East Asia and Australia.

Kieran Laxen, MEng (Hons) AMIEnvSc MIAQM

Mr Laxen is a Principal Consultant with AQC with over seven years' experience in the field of air quality management and assessment, previously having two years' experience in scientific research on internal combustion engines. He is involved in a wide range of development projects, most of which have involved use of ADMS modelling methodologies for biomass boilers, CHP plant, generators and roads, and is also experienced in the assessment of construction dust. He

has pioneered the use of OpenAir software within the Company, which is used to analyse air quality monitoring data, and is responsible for routine calibration of air quality monitoring stations, together with data ratification. He is a Member of the Institute of Air Quality Management.

Full CVs are available at www.aqconsultants.co.uk.

A3 Modelling Methodology

Model Inputs

- A3.1 The impacts of emissions from the proposed biomass boilers have been predicted using the ADMS-5.2 dispersion model. ADMS-5.2 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. The model has been run to predict the annual mean concentrations of nitrogen oxides and particulate matter (both $PM_{2.5}$ and PM_{10}), the 99.79th percentile of 1-hour mean nitrogen oxides concentrations, and the 90.41st percentile of 24-hour mean PM_{10} concentrations. Post-processing has been carried out to determine the nitrogen dioxide concentrations and the nitrogen and acid deposition.
- A3.2 Hourly sequential meteorological data from the nearby Mumbles meteorological station have been used in the model for the years 2014, 2015 and 2016. The Mumbles meteorological monitoring station is located approximately 18 km to the northwest of the site. It is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the proposed development site; both the site and the Mumbles meteorological monitoring station are located at near-coastal locations on the west coast of Wales where they will be influenced by the effects of coastal meteorology.
- A3.3 The biomass boiler specifications have been obtained from client supplied data (Wadley, 2017). There are 43 boilers in total; however, there are two sets of 5 boilers (A2 and A3) which will not run in parallel. Of these boilers, 5 run on wood pellets (A2), and 5 on wood chips (A3); an assessment has been carried out to determine their emissions; the wood chip boilers (A2) have higher emissions, and as such have been treated as the operating boiler for all periods modelled. As such, 38 individual point sources have been modelled.
- A3.4 The biomass boiler specifications are shown in Table A3.1, and the model input parameters and calculated emission rates are shown in Table A3.2.

Table A3.1: Biomass Boiler Parameters

Source	Fuel Source	Moisture Rate (%)	Boiler Capacity (kW)	Operating Load (kW)	Stack Height (m)	Operating Hours
A1-1 to 10	Wood Chips	50%	199	55	4.2	5,000
A2-1 to 5	Wood Chips	30%	99.5	55	4.2	4,000
A3-1 to 5	Wood Pellets	10%	99.5	55	4.2	1,000
B1-1 to 12	Wood Pellets	10%	99.5	40	7.2	6,500
C1-1	Wood Pellets	10%	199	55	8.2	5,000
C2-1 to 10	Wood Chips	50%	199	55	8.2	5,000

Note: The A2 boilers do not run concurrently to the A3 boilers. As such, only one group of boilers will be operating at one time. To be conservative in the modelling, the A2 boilers, which have a higher emission rate to the A3 boilers, have been modelled for a total of 5,000 operating hours (the 4,000 hours of the A2 group and the 1,000 hours of the A3 group), and the A3 boilers have not been modelled.

Table A3.2: Model Input Parameters used in ADMS-5

Source	Flue internal diameter (m)	Flue exit temp. (°C)	Exhaust velocity (m/s)	Molecular mass (g/mol)	NO _x emission rate (g/s)	PM ₁₀ emission rate (g/s)	PM _{2.5} emission rate (g/s)
A1-1 to 10	0.25	180	0.832	27.43	0.00400	0.00147	0.00128
A2-1 to 5	0.25	180	0.686	28.55	0.00697	0.00077	0.00067
B1-1 to 12	0.20	180	0.667	29.25	0.00367	0.00040	0.00034
C1-1	0.25	180	0.587	29.25	0.00490	0.00130	0.00112
C2-1 to 10	0.25	180	0.832	27.43	0.00400	0.00147	0.00128

A3.5 Entrainment of the plume into the wake of the buildings (the so-called building downwash effect) has been taken into account in the model. The building dimensions and flue locations have been obtained from client supplied data (Wadley, 2017). The locations of the exhaust stacks are shown in Figure A3.1 along with the modelled buildings.

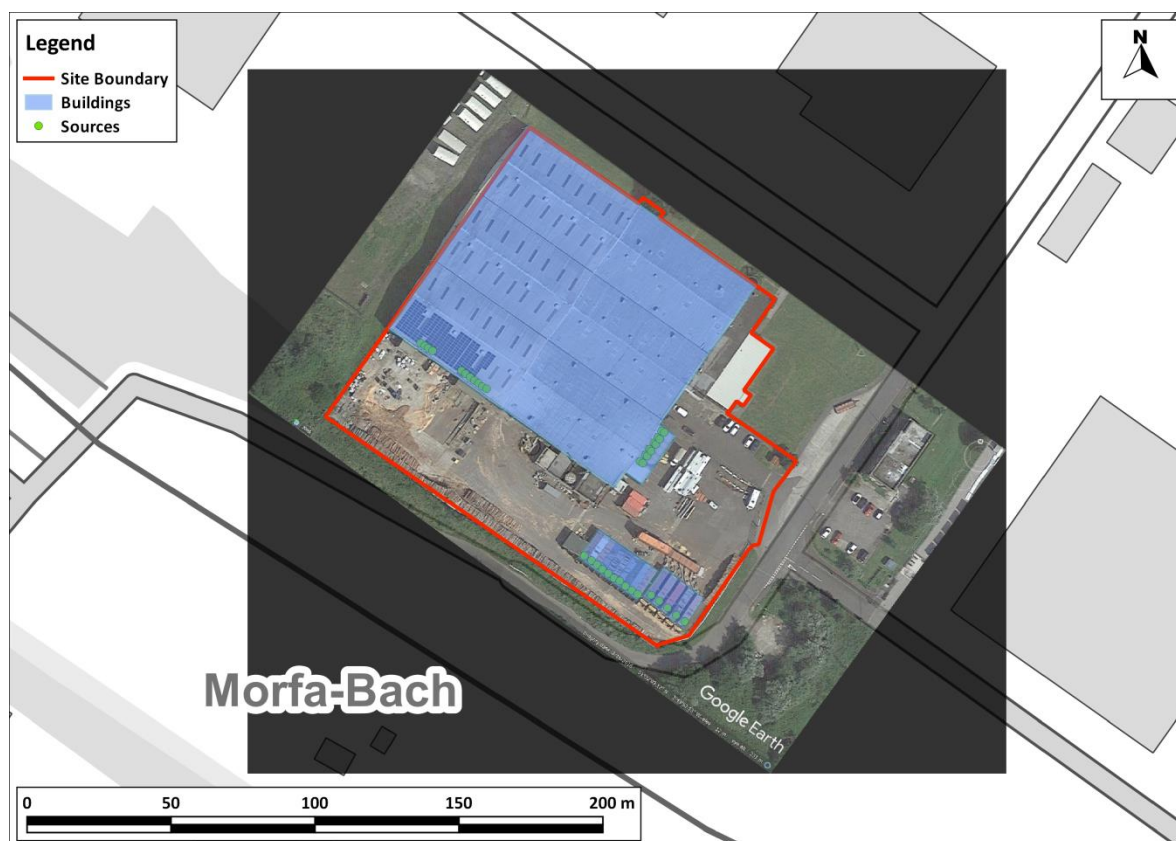


Figure A3.1: Flue Locations & Modelled Buildings

Contains Ordnance Survey data © Crown copyright and database right 2017. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

Modelling Assumptions

- A3.6 For consideration of concentrations in relation to the short-term objective, the worst-case assumption has been made that the biomass boiler units will run continuously, rather than for a reduced number of hours, as in practice, which is an average of 5,000 hours per year. This will capture the worst-case short-term concentrations, however, will have led to an over-prediction of annual mean concentrations, and as such can be considered as highly conservative.

Background Concentrations

- A3.7 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2017a). These cover the whole country on a 1x1 km grid and are published for each year from 2013 until 2030.

Model Verification

- A3.8 It is not practical, nor usual, to verify the ADMS-5.2 model. Predictions made using ADMS-5.2 have thus not been verified.

Model Post-processing

- A3.9 Emissions from the plant will be predominantly in the form of nitrogen oxides and particulate matter (PM₁₀ and PM_{2.5}). ADMS-5.2 has been run to predict the contribution of the biomass boiler emissions to annual mean concentrations of nitrogen oxides and PM, and to the 99.79th percentile of 1-hour mean nitrogen oxides concentrations and the 90.4th percentile of 24-hour mean PM₁₀ concentrations. For the initial screening of the process contributions, the approach recommended by the Environment Agency (Environment Agency, 2005) has been used to predict nitrogen dioxide concentrations, assuming that:

- annual mean NO₂ concentration = annual mean NO_x concentration multiplied by 0.7; and
- 99.79th percentile of 1-hour mean NO₂ concentrations = 99.79th percentile of 1-hour mean NO_x concentrations multiplied by 0.35.

- A3.10 For the assessment of short-term objectives, the following post-processing has been carried out:

- the 99.79th percentile of total hourly NO₂ concentrations = 99.79th percentile process contribution NO_x + 2 x 'background' annual mean NO₂ concentration; and
- the 90.41st percentile of total daily PM₁₀ concentrations = 90.41st percentile process contribution PM₁₀ + 2 x 'background' annual mean PM₁₀ concentration.

Deposition Rates

- A3.11 Deposition has not been derived from the dispersion model because the principal depositing component of concern is nitrogen dioxide and this is calculated from nitrogen oxides outside of the model. Instead, deposition has been calculated from the predicted ambient concentrations of nitrogen dioxide using the deposition velocities set out in Table A3.3. Deposition velocities refer to a height above ground, typically 1 or 2 m, although in practice the precise height makes little difference; here they have been applied to concentrations predicted at a height of 1.5 m above ground. The velocities are applied simply by multiplying a concentration (µg/m³) by the velocity (m/s) to predict a deposition flux (µg/m²/s). Subsequent calculations required to present the data as kg/ha/y of nitrogen or sulphur and as keq/ha/y for acidity follow basic chemical and mathematical rules².

² For example, 1 kg N/ha/y = 0.071 keq/ha/y

Table A3.3: Deposition Velocity Used in This Assessment

Pollutant	Deposition Velocity (m/s)	Reference
Nitrogen Dioxide	0.0015 m/s (Grassland)	AQTAG06 (Environment Agency, 2011)

A3.12 Wet deposition has been discounted. Wet deposition of the emitted pollutants this close to the emission source will be restricted to wash-out, or below cloud scavenging. For this to occur, rain droplets must come into contact with the gas molecules before they hit the ground. Falling raindrops displace the air around them, effectively pushing gasses away. The low solubility of nitrogen dioxide means that any scavenging of this gas will be a negligible factor.