

Air Quality Assessment
Whaley Road, Barnsley

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Executive Summary

ENVIRON UK Ltd was commissioned by Hargreaves Services Plc and Rocpower Ltd to carry out an air quality assessment of a proposed biofuel power generation plant to be located at a former sub station on Whaley Road, Barnsley. The site is located within the Metropolitan Borough of Barnsley. This assessment is provided in support of the planning application for the proposals, which are to be submitted to the local authority, Barnsley Metropolitan Borough Council (BMBC).

The proposed site will incorporate five 1.6 MWe second-hand engines, which will run on biofuel, to generate electricity, which will be fed into the national grid. A review of the Environmental Permitting (England and Wales) Regulations 2007 indicates that the trigger threshold for permitting (under part B of the regulations) is an aggregate rated thermal capacity in excess of 20MW. As the aggregated thermal capacity of the proposed site is 19 MW, an environmental permit application is not required. However, as a result of objections to the site by Biofuel Watch, BMBC has requested an air quality assessment of the proposed installation.

The proposed site is located on the outskirts of Barnsley, approximately 2.5 km northwest of the city centre. The site was previously an electricity sub station and forms part of an existing industrial estate.

Ground level concentrations of pollutants have been predicted assuming a stack height of 15 m and compared with the relevant air quality objectives. Emissions from the installation have been provided by Rocpower Ltd, from a number of different sources. The scope and methodology have been discussed and agreed with BMBC.

The predicted process contribution (PC) at both the point of maximum concentration and at each of the receptor locations have been compared with the relevant air quality objectives. To determine the significance of the releases, the results have been assessed using the criteria given in the Environment Agency's H1 Guidance.

The predicted annual mean nitrogen dioxide concentrations emitted by the proposed boiler are greater than 1% of the annual mean objective at all the selected receptor locations (Table 4.1). The short-term concentrations are over 10% of the short term objective at all locations with the exception of the Gawber background monitoring site. Emissions of nitrogen dioxide can not, therefore, be considered as insignificant.

Predicted PM_{10} concentrations are over 1% of the annual mean objective at all of the selected receptor locations, with the exception of the Gawber background site (Table 4.2), therefore the annual mean PM_{10} emissions can not be considered insignificant at any of the receptor locations with the exception of the Gawber background site. However, short-term concentrations do not exceed 10% of the short-term objective at any of the residential receptor locations, but are over 30% of the objective at the three receptors along the public track and at the point of maximum concentration. As a result short-term PM_{10} emissions can be considered as insignificant at each of the residential receptors presented in Table 4.2, but can not be considered as insignificant at the other three receptors.

Emissions of $PM_{2.5}$ are predicted to be over 1% of the annual mean objective at all receptor locations (Table 4.3), therefore emissions can not be considered as insignificant.

Where the process concentrations cannot be considered to be insignificant, the next stage in the assessment process is to consider the process contribution together with the existing background concentration, to calculate the Predicted Environmental Concentration (PEC) to determine the overall impact on air quality. Through discussions with BMBC it has been agreed that this stage of the assessment would be carried out for all predicted results, regardless of whether they could be deemed as insignificant at stage 1.

Calculation of the annual mean and short-term PEC for nitrogen dioxide is less than 70% of the objective limits at each of the residential receptors. It is therefore considered that there is no risk of the contribution from the facility causing a breach of the air quality objective. However, the PEC calculated at point B along the public track, to the east of the railway track, is over 70% of the annual mean objective, with exceedance of the objective predicted at points A and C and at the point of maximum concentrations.

However, based on the LAQM.TG(09) guidance, the annual mean objective only applies at locations where the public might be regularly exposed such as building facades of residential properties, schools and hospitals. The objective does not apply at locations where public exposure is expected to be short-term. Public exposure along the public track, to the east of the railway, is considered to be short-term, therefore the annual mean objective does not apply. The short-term PEC calculated along this track is over 70% of the objective limit (73.5% at point A, 90.2% at point B and 76.5% at point C) and meets the limit at the point of maximum concentration. The point of maximum concentration is located in close proximity to the public track (Figure B2) therefore there is some risk of the objective being exceeded along the public track, although the area of potential exceedance is relatively small.

The annual mean PM_{10} PEC calculated at each receptor, including the point of maximum concentration, is less than 65% of the objective limit, therefore, there is no risk of the facility resulting in an exceedance of the annual mean objective at any location.

The PEC calculated for short-term PM_{10} is greater than 70% of the objective at the point of maximum concentration, at the three points along the public track and at Snow Hill Farm, with the objective being exceeded at Point A and Point C along the public track and at the point of maximum concentration. However based on the LAQM.TG(09) guidance, the short-term PM_{10} objective does not apply along the public track.

Snow Hill Farm is a residential property. Although the 24-hour PM_{10} objective does not apply at the façade of residential properties, it is considered relevant within residential gardens. However, the PEC at Snow Hall Farm is only just over 70% of the objective, at 72.5%, therefore it is very unlikely that this objective will be exceeded as a result of the proposed installation.

The PEC calculated for annual mean $PM_{2.5}$ is comfortably less than 70% of the 25 μgm^{-3} objective at all receptor locations, with the exception of point A along the public track and at the point of maximum concentration. However, concentrations are only just over 70% of the objective limit, therefore there is little risk of the objective being exceeded at a result of the proposed installation.

BMBC has raised concerns regarding residential receptors located on Dovebush Way, southwest of the installation site. Properties 1 and 2 are located directly adjacent to A637 Claycliffe Road, which can experience congestion at peak periods. Annual mean nitrogen

dioxide concentrations predicted at Dovebush Way are below the annual mean objective, after traffic related emissions have been taken into consideration. The proposed installation is predicted to result in a 'very small' change in nitrogen dioxide concentrations (an increase of 46% compared to existing concentrations), which equates to a 'slightly adverse' impact on air quality. As the predicted concentrations at Dovebush Way are based on worst case data, the impact from the facility is not considered to be significant.

In summary, although emissions arising from the proposed energy generation plant can not be considered as insignificant based on the criteria given in the H1 guidance, subsequent analysis of the data in conjunction with local background concentrations indicates that the proposed facility is unlikely to result in a breach of the air quality objectives for nitrogen dioxide, PM_{10} and $PM_{2.5}$ at any of the surrounding residential receptors. However, there is a small risk of the short-term nitrogen dioxide objective being exceeded along the public track, although the area of potential exceedances is relatively small.

1 Introduction

1.1 Introduction

ENVIRON UK Ltd was commissioned by Hargreaves Services Plc and Rocpower Ltd to carry out an air quality assessment of a proposed biofuel power generation plant to be located at a former sub station on Whaley Road, Barnsley. The site is located within the Metropolitan Borough of Barnsley. This assessment is provided in support of the planning application for the proposals, which are to be submitted to the local authority, Barnsley Metropolitan Borough Council (BMBC).

The proposed site will incorporate five 1.6MWe second-hand engines, which will be run on biofuel, to generate electricity, which will be fed into the national grid. A review of the Environmental Permitting (England and Wales) Regulations 2007 indicates that the trigger threshold for permitting (under part B of the regulations) is an aggregate rated thermal capacity in excess of 20MW. As the aggregated thermal capacity of the proposed site is 19 MW, an environmental permit application is not required. However, as a result of objections to the site by Biofuel Watch, BMBC has requested an air quality assessment of the proposed installation.

The proposed site is located on the outskirts of Barnsley, approximately 2.5 km northwest of the city centre. The site was previously an electricity sub station and forms part of an existing industrial estate. The location of the site is shown in Figure 1.1.



Figure 1.1: Site Location

1.2 Scope and Methodology

The aim of the assessment is to determine the impact of pollutant emissions arising from the proposed site on ambient air quality with regard to human health.

The scope and methodology of the assessment has been discussed and agreed with BMBC.

1.2.1 Air dispersion modelling

The ADMS air dispersion model has been used to predict the likely ground level concentrations of pollutants arising from the proposed installation. The engines will be fired using biofuels (tall oil and vegetable oils) and therefore the main emissions of concern arising from the proposed engines are oxides of nitrogen (NO_x) and PM_{10}. The model has been used to predict ground level concentrations of both pollutants in the vicinity of the site. Predicted concentrations of oxides of nitrogen have been used to calculate ground level concentrations of nitrogen dioxide, to allow comparison with UK air quality objectives. Emissions of other pollutants normally associated with combustion activities i.e. sulphur dioxide, are expected to be negligible and have therefore not been assessed.

2 Installation Details

The proposed site, a former sub station, is located at Whaley Road, Barnsley, to the north of the South Yorkshire (Redbrook) Industrial Site (OS 431960, 408530).

It is proposed to install five 1.6MWe second-hand diesel engines at the site, all of which will run on biofuels. The site will make use of various types of fuel sources e.g. tall oil, a by-product of the wood pulp manufacturing process, vegetable oils etc. that are commercially available on the market. The choice of fuel will be largely dependent on the availability and prevailing financial conditions.

All five diesel engines will be housed within a single building, with emissions released via a 15 m stack located on the southern façade of the building. The location of the engines and the associated stack are shown in Figure 2.1.

The thermal efficiency of the site is envisaged to be approximately 41%. Excess heat generated by the engines will be released via five external radiators located to the south of the proposed building, two to the west of the emission stack and three to the east. Each radiator will include fans to help disperse the heat. The location of the radiators is shown in Figure 2.1.

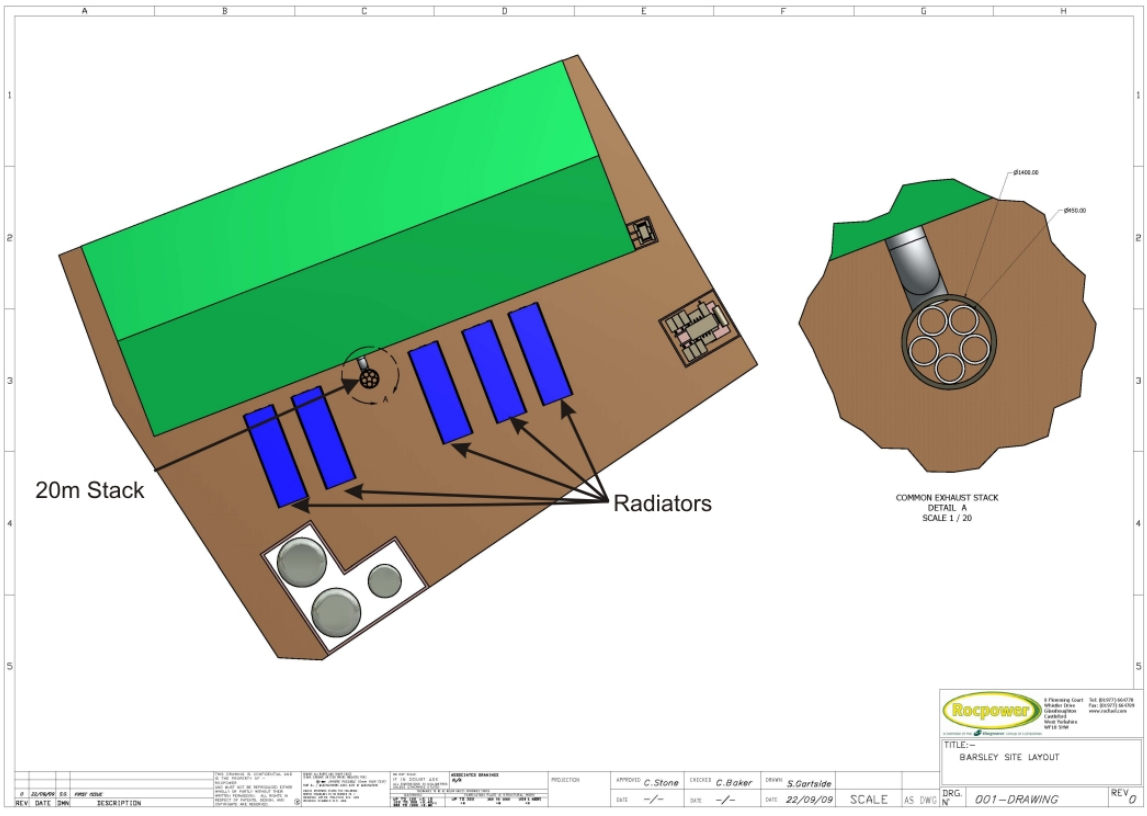


Figure 2.1: Layout of Proposed Energy Generation Plant

3 Methodology

3.1 Choice of Model

Air dispersion modelling is a method whereby computer models are used to estimate the ground level concentration of pollutants derived from emission sources, which in this case arise from an elevated stack.

There is a wide range of dispersion models available and the choice of model depends on the situation under assessment. The models range from simple spreadsheet sets of nomograms to highly complex multi-source programmes. The model used for this assessment is the ADMS 4 model.

ADMS 4 is a 'new generation' dispersion model, which uses Gaussian based equations to predict the dispersion of pollutants within the atmosphere. It is primarily designed for the assessment of industrial emissions from point, line, volume or area sources.

Meteorological data are used to characterise the boundary layer within which the dispersion takes place. Instead of using the old single parameter of the Pasquill Class, stability conditions within the boundary layer are determined by use of the Monin-Obukhov length and the depth of the boundary layer. A further modification from older models is the use of a skewed Gaussian concentration distribution under convective meteorological conditions.

The ADMS 4 model is extensively used within the UK to model industrial sources and is widely used by the Environment Agency, Scottish Environment Protection Agency (SEPA) and other regulatory authorities. The model has been validated against field data sets. The most recent version of the model, version 4.1, has been used in this assessment.

3.2 Meteorological Data

The modelling has utilised hourly sequential meteorological data for the last 5 complete years (2004 to 2008) obtained from the Emley Moor meteorological station. This is the closest site to the power generation plant, providing appropriate data for use within ADMS 4.

3.3 Scenarios Assessed

The model has been run to predict concentrations arising from the proposed five engines assuming continuous operation on a 24/7 basis. Model runs were carried out for all meteorological years.

3.4 Input Parameters

The data used in the modelling is provided below in Tables 3.1 to 3.2. The emissions data has been supplied by Rocpower Ltd. The emissions rate for oxides of nitrogen has been extracted from a report published by Wartsila Power Plants on 'Vegetable Oils as fuel in diesel generation sets'[1]. The report was published at the 10th International Cogeneration,

1 Wartsila Power Plants, Vegetable Oils as Fuel in Diesel Generating Sets, 10th International Cogeneration, Combined Cycle & Environment Conference and Exhibition, Istanbul May 20, 2004

Combined Cycle & Environment Conference and Exhibition, Instanbul May 2004 and has therefore been the subject of peer review.

Emission rates for PM_{10} and $PM_{2.5}$ have been taken from the State of Michigan report by the Michigan Department of Environmental Quality on the 'General Permit for Diesel Fuel-Fired Engine Generators with a Maximum Nameplate Capacity of 5 Megawatts'[2]. However, this data is based on 1.8MWe diesel engines operating on diesel fuel. A report by Reves J.F and Senulveda M.A[3], found that emissions of PM_{10} from diesel engines fuelled with refined biodiesel were reduced by nearly 50% compared to engines fuelled by diesel fuel. Engines run on blended fuels with a lower content of crude or refined biodiesel also resulted in lower PM_{10} emissions, although to a lesser extent. The emissions data extracted from the State of Michigan report have therefore been reduced by 75%, to account for this improvement. This is considered to be a robust, but conservative approach.

$PM_{2.5}$ emission rates are given as PM_{10}, therefore are worst case.

Buildings can have a significant effect on the dispersion of pollutants from sources and can increase the maximum predicted ground level concentrations. The main impact from buildings is to entrain pollutants emitted via stacks rapidly down to ground level in the immediate leeward side of the most prominent building. This results in higher concentrations adjacent to buildings, with pollution levels decreasing further away.

ADMS 4 is designed to account for building wash effects, taking into consideration both the building dimensions and heights of the main buildings in close proximity to the stacks being modelled. The proposed building which will house the six diesel engines and the adjacent large storage tanks have been included within the model assessment, details of which are provided in Table 3.3 and their locations shown in Figure 3.1.

Table 3.1: Stack Data

Parameter	Data used
Stack Location	Proposed Engine Building
Stack Height (m)	15
Stack Diameter (m)	1.01
Volume Flowrate (m^3s^{-1})	44.8
Efflux Velocity (ms^{-1})	56.3
Stack Temperature (°C)	440
Water content (%)	0%[1]
Oxygen content (%)	15%[1]

[1] These values are assumed in the absence of other data

2 Michigan Department of Environmental Quality, General Permit for Diesel Fuel-Fired Engine Generators with a Maximum Nameplate Capacity of 5 Megawatts, January 31, 2005, page 6

3 Reves J.F. and Senulveda M.A., PM_{10} emissions and power of a diesel engine fuelled with crude and refined Biodiesel from Salmon Oil, 2006

Table 3.2: Emissions Data	
Parameter	**Data Used in Modelling**
Surface Roughness (m)	0.5
Fuel	Biofuel
Measurement units	gs^{-1}
Oxides of Nitrogen	16.45
PM_{10}	2.74
$PM_{2.5}$	2.74 [1]
[1] $PM_{2.5}$ given as PM_{10}	

Table 3.3: Building Dimensions				
Building	**National Grid Reference**	**Height (m)**	**Length/diameter (m)**	**Width (m)**
Proposed Engine Building	431997,408549	8.6	38	15
Cylinders	431993,408524	8.5	10	N/A

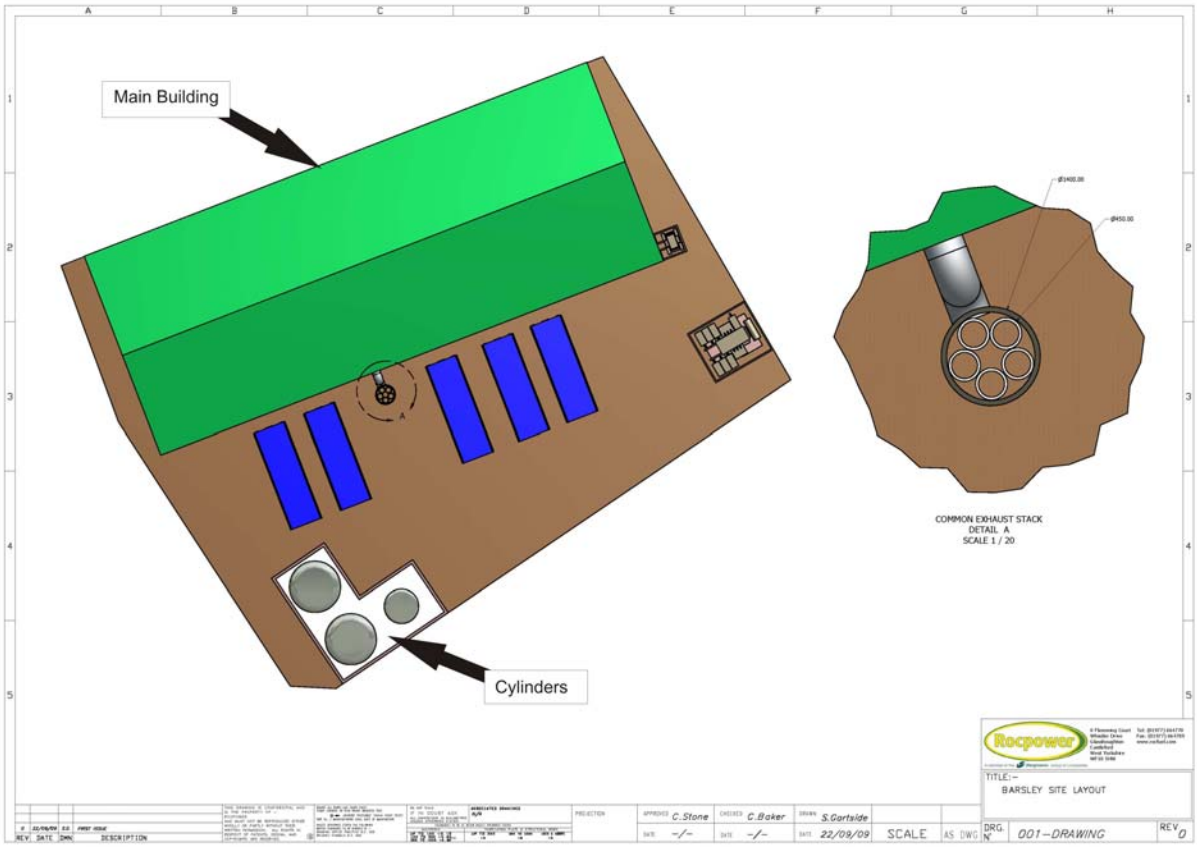


Figure 3.1: Location of Buildings included within ADMS 4

3.5 Output Parameters and Air Quality Objectives

The model has been run for a number of averaging periods to correspond with those used by the objectives set by the Air Quality England Regulations 2007, which implement the limit values prescribed by the relevant EU Directives and Daughter Directives within England. The objectives for nitrogen dioxide, PM_{10} and $PM_{2.5}$ are provided below in Table 3.4.

Table 3.4: Relevant Air Quality Objectives and Environmental Assessment Levels

Pollutant	Averaging Period	Objective	Not to be exceeded more than
Nitrogen Dioxide	Annual	40 μgm^{-3}	NA
	1 hour	200 μgm^{-3}	18 times per year
PM_{10}	Annual	40 μgm^{-3}	NA
	24 hour	50 μgm^{-3}	35 times per year
$PM_{2.5}$	Annual	25 μgm^{-3}	NA
	Annual	Target of 15% reduction in concentrations at background locations by 2020	NA

The UK AQOs and EU limits relate to external ambient air where members of the public are regularly present and may be exposed over the averaging period of the objective. Guidance is provided in LAQM.TG (09)[4] on the typical locations where the objectives should and should not apply. A summary of this current guidance is provided below in Table 3.5.

4 DEFRA, Local Air Quality Management, technical Guidance LAQM.TG(09), February 2009

Table 3.5: Typical Locations Where Air Quality Objectives Apply		
Averaging Period	**Objectives should apply at:**	**Objectives should generally not apply at:-**
Annual mean	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc.	Building facades of offices or other places of work where members of the public do not have regular access. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24 hour mean	All locations where the annual mean objective would apply. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1 hour mean	All locations where the annual mean and 24 hour mean objectives apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where the public might reasonably expected to spend 1-hour or more. Any outdoor locations to which the public might reasonably expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access.

The ADMS model has been used to predict concentrations of oxides of nitrogen, however the existing air quality objectives are for concentrations of nitrogen dioxide. Nitrogen dioxide is primarily a secondary pollutant, i.e. it is formed in the atmosphere rather than emitted directly. From all combustion sources the majority of oxides of nitrogen are emitted as nitrous oxide (between 90-95%), which is then converted to nitrogen dioxide in the atmosphere. The rate of conversion is governed by the availability of other pollutants, most importantly ozone.

Nitrogen dioxide concentrations have been calculated from the predicted concentrations of oxides of nitrogen using the conversion ratios advised by the Environment Agency. To calculate the annual average nitrogen dioxide contribution, 70% of the predicted oxides of nitrogen concentration have been used, with 35% of the short term predicted concentration used to calculate the 1 hour concentration.

3.6 Receptors

The model has been run to predict ground level concentrations both over a receptor grid and at a number of identified receptor locations.

3.6.1 Receptor Grids

Initially the model was run over a coarse grid covering an area of 10 km by 10 km with receptors placed every 100 m to identify the approximate location of the point of maximum concentration. The grid area was then refined to predict concentrations every 20 m over a 2 km by 2 km grid which included the area of maximum concentration. Contour plots indicating the ground level concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ over the small receptor grid area have been provided in Annex B.

3.6.2 Sensitive Receptors

The identified sensitive receptor locations are provided Table 3.6. and shown in Figure 3.2.

Table 3.6: Identified Sensitive Receptors

Receptor	Grid Coordinates	
2 Dovebush Way	431592	408448
1 Dovebush Way	431616	408427
24 Dearne Hall Fold	431650	408728
104 Dearne Hall Road Garden	431710	408845
Public Track A	432088	408591
Public Track B	432036	408654
Public Track C	432152	408539
2 Medway Close	431709	408271
Snow Hall Farm	432394	409130
Gawber Background Monitoring Site	432550	407550

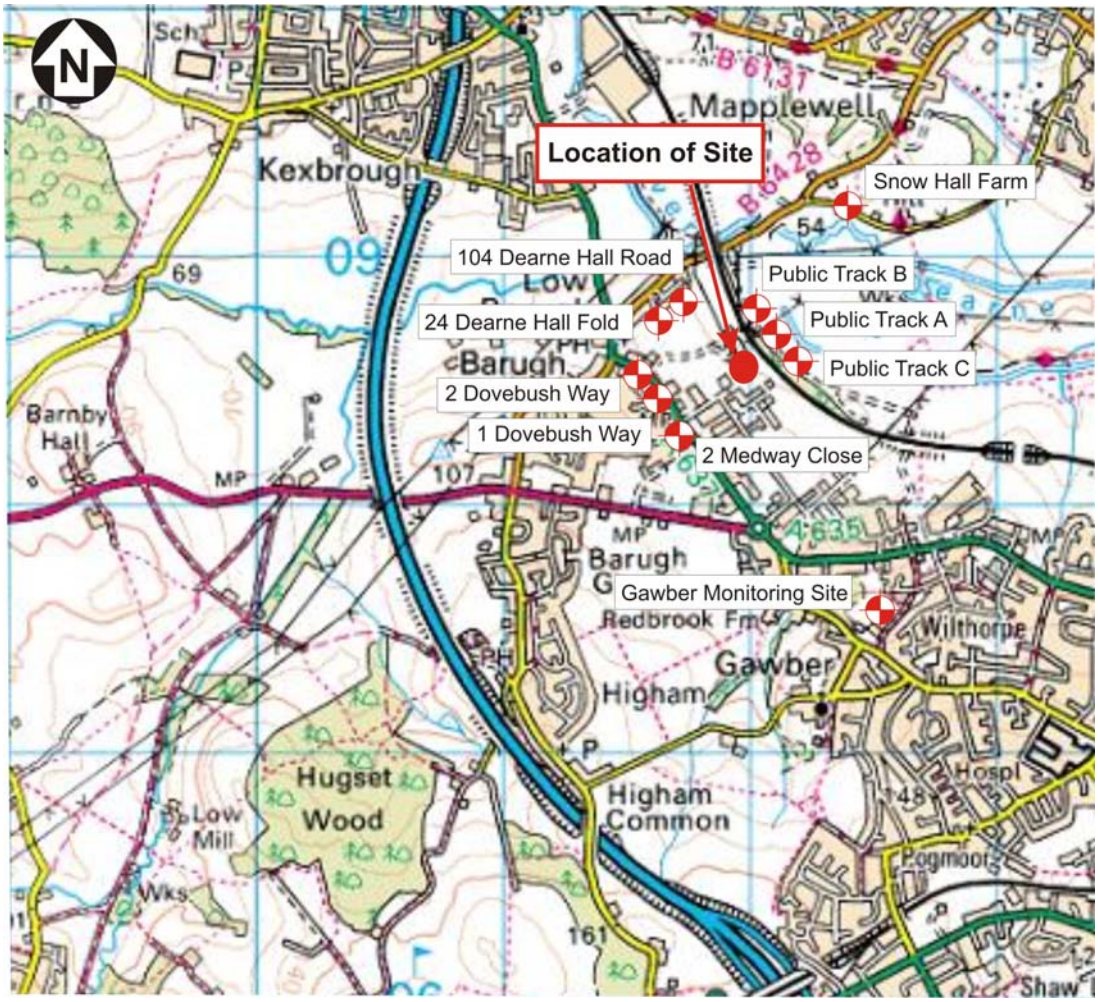


Figure 3.2: Receptor Locations

4 Air Dispersion Modelling Results

4.1 Predicted Concentrations

The results of the assessment for each receptor point are provided below in Tables 4.1, 4.2 and 4.3. The data provided is the maximum concentration from the 5 meteorological years assessed. The data for each meteorological year is provided in Annex A.

Contour plots depicting ground level concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ for the worst meteorological year are provided in Annex B. It has been found that the meteorological conditions during 2008 resulted in the highest concentrations of oxides of nitrogen and PM.

Table 4.1: Predicted nitrogen dioxide concentrations (µgm^{-3})

	Annual		99.8% 1-hour	
	Value	% AQO	Value	% AQO
Point of Maximum concentration	25.0	62.6	157.2	78.6
Receptors				
2 Dovebush Way	1.6	4.0	30.7	15.4
1 Dovebush Way	1.7	4.3	31.6	15.8
24 Deane Hall Fold	1.9	4.8	35.6	17.8
104 Deane Hall Road	2.3	5.8	31.7	15.9
Public Track A	23.7	59.1	103.8	51.9
Public Track B	11.4	28.4	137.1	68.6
Public Track C	21.6	53.9	109.9	54.9
2 Medway Close	1.4	3.6	30.8	15.4
Snow Hall Farm	2.8	7.1	16.5	8.2
Gawber BG Site	0.9	2.1	10.8	5.4
Objective below which concentrations can be considered insignificant	40	1	200	10

AQO – Air Quality Objective

Table 4.2: Predicted PM_{10} concentrations (μgm^{-3})				
	Annual		99.8% 1-hour	
	Value	% AQO	Value	% AQO
Point of Maximum concentration	8.0	20.0	26.9	53.8
Receptors				
2 Dovebush Way	0.5	1.2	1.2	2.4
1 Dovebush Way	0.5	1.2	1.7	3.4
24 Dearne Hall Fold	0.6	1.5	2.4	4.7
104 Dearne Hall Road	0.8	1.9	3.3	6.5
Public Track A	7.6	18.9	25.9	51.8
Public Track B	3.7	9.2	15.3	30.5
Public Track C	6.8	16.9	22.7	45.3
2 Medway Close	0.4	1.1	1.2	2.5
Snow Hall Farm	0.9	2.3	3.3	6.5
Gawber BG Site	0.3	0.7	1.1	2.2
Objective below which concentrations can be considered insignificant	40	1	200	10

AQO – Air Quality Objective

Table 4.3: Predicted $PM_{2.5}$ concentrations (μgm^{-3})		
	Annual	
	Value	% AQO
Point of Maximum concentration	8.0	32.0
Receptors		
2 Dovebush Way	0.5	1.9
1 Dovebush Way	0.5	2.1
24 Deane Hall Fold	0.6	2.4
104 Deane Hall Road	0.8	3.1
Public Track A	7.6	30.2
Public Track B	3.7	14.7
Public Track C	6.8	27.0
2 Medway Close	0.4	1.7
Snow Hall Farm	0.9	3.7
Gawber BG Site	0.3	1.0
Objective below which concentrations can be considered insignificant	25	1
AQO – Air Quality Objective		

4.2 Comparison of Process Contributions with Air Quality Objectives

The predicted concentrations at both the point of maximum concentration and at each of the receptor locations have been compared with the relevant air quality objectives.

To determine the significance of the releases, the results have been assessed using the criteria given in H1. Releases can be considered to be insignificant if:-

- Process Contribution long term <= 1 % of the long term environmental benchmark; and
- Process Contribution short term <= 10 % of the short term environmental benchmark.

The predicted annual mean nitrogen dioxide concentrations emitted by the proposed electricity generation plant are greater than 1% of the annual mean objective at all the selected receptor locations (Table 4.1). The short-term concentrations are over 10% of the short term objective at all locations with the exception of the Gawber background monitoring site and Snow Hall Farm. Emissions of nitrogen dioxide can not, therefore, be considered as insignificant.

Predicted PM_{10} concentrations are over 1% of the annual mean objective at all of the selected receptor locations, with the exception of the Gawber background site (Table 4.2). However, short-term concentrations do not exceed 10% of the short-term objective at any of

the residential receptor locations, but are over 30% of the objective at the three receptors along the public track and at the point of maximum concentration. As a result short-term PM_{10} emissions can be considered as insignificant at each of the residential receptors presented in Table 4.2, but can not be considered as insignificant at the other three receptors. The annual mean PM_{10} emissions can not be considered insignificant at any of the receptor locations with the exception of the Gawber background site.

Emissions of $PM_{2.5}$ are predicted to be over 1% of the annual mean objective at all receptor locations (Table 4.3), therefore emissions can not be considered as insignificant.

4.3 Predicted Environmental Concentrations

Where the process concentrations cannot be considered to be insignificant, the next stage in the assessment process is to consider the process contribution together with the existing background concentration, to calculate the Predicted Environmental Concentration (PEC) to determine the overall impact on air quality. Through discussions with BMBC it has been agreed that this stage of the assessment would be carried out for all predicted results, regardless of whether they could be deemed as insignificant at stage 1 (detailed in section 4.2).

This is relatively straight forward with regard to annual impacts as the background concentration and process contribution can be easily combined. For short-term emissions the H1 guidance recommends that the PEC is calculated by adding the short-term PC to twice the long-term ambient background concentrations.

Background nitrogen dioxide concentrations have been taken from the Barnsley Gawber background continuous monitoring site. Concentrations recorded during 2004, where found to be the highest during the previous five years, therefore data for this year has been used as a worst case.

PM_{10} and $PM_{2.5}$ concentrations are not monitored at the Gawber site, therefore background data for both these pollutants have been taken from the Defra 2008 background maps. Data has been extracted for the OS grid square, 431500,408500, which covers the proposed installation site.

Calculation of the PEC for nitrogen dioxide, PM_{10} and $PM_{2.5}$ at each of the receptor locations and the point of maximum concentration and comparison with the relevant environmental benchmarks is provided in Tables 4.4, 4.5 and 4.6 below.

Table 4.4: Calculation of the PEC for Annual Mean Nitrogen Dioxide					
	AQO μgm^{-3}	PC μgm^{-3}	Background μgm^{-3}	PEC μgm^{-3}	% EAL/AQO
Point of Maximum concentration	40	25.0	21.6[1]	46.6	116.6
Receptors					
2 Dovebush Way	40	1.6	21.6[1]	23.2	58.0
1 Dovebush Way		1.7		23.3	58.3
24 Dearne Hall Fold		1.9		23.5	58.8
104 Dearne Hall Road		2.3		23.9	59.8
Public Track A		23.7		45.3	113.1
Public Track B		11.4		33.0	82.4
Public Track C		21.6		43.2	107.9
2 Medway Close		1.4		23.0	57.6
Snow Hall Farm		2.8		24.4	61.1
Gawber BG Site		0.9		22.5	56.1

PC=Process Contribution

PEC=Process + Background Concentration

[1] Background concentration from the Barnsley Gawber background monitoring site for 2004 (as a worst case)

Table 4.5: Calculation of the PEC for Short-term Nitrogen Dioxide					
	AQO μgm^{-3}	PC μgm^{-3}	Background μgm^{-3}	PEC μgm^{-3}	% EAL/AQO
Point of Maximum concentration	200	157.2	21.6[1]	200.4	100.2
Receptors					
2 Dovebush Way	200	30.7	21.6[1]	73.9	37.0
1 Dovebush Way		31.6		74.8	37.4
24 Deane Hall Fold		35.6		78.8	39.4
104 Deane Hall Road (Garden)		31.7		74.9	37.5
Public Track A		103.8		147.0	73.5
Public Track B		137.1		180.3	90.2
Public Track C		109.9		153.1	76.5
2 Medway Close		30.8		74.0	37.0
Snow Hall Farm		16.5		59.7	29.8
Gawber BG Site		10.8		54.0	27.0

PC=Process Contribution

PEC=Process + Background Concentration

[1] Background concentration from the Barnsley Gawber background monitoring site for 2004 (as a worst case)

Table 4.6: Calculation of the PEC for Annual Mean PM_{10}					
	AQO μgm^{-3}	PC μgm^{-3}	Background μgm^{-3}	PEC μgm^{-3}	% EAL/AQO
Point of Maximum concentration	40	8.0	16.5[1]	24.5	61.2
Receptors					
2 Dovebush Way	40	0.5	16.5[1]	17.0	42.5
1 Dovebush Way		0.5		17.0	42.5
24 Deane Hall Fold		0.6		17.1	42.8
104 Deane Hall Road		0.8		17.3	43.2
Public Track A		7.6		24.1	60.1
Public Track B		3.7		20.2	50.4
Public Track C		6.8		23.3	58.1
2 Medway Close		0.4		16.9	42.3
Snow Hall Farm		0.9		17.4	43.5
Gawber BG Site		0.3		16.8	41.9

PC=Process Contribution
PEC=Process + Background Concentration
[1] Background concentration from 2008 Defra Background Maps

Table 4.7: Calculation of the PEC for Short-term PM_{10}					
	AQO μgm^{-3}	PC μgm^{-3}	Background μgm^{-3}	PEC μgm^{-3}	% EAL/AQO
Point of Maximum concentration	50	26.9	16.5[1]	59.9	119.8
Receptors					
2 Dovebush Way	50	1.2	16.5[1]	34.2	68.4
1 Dovebush Way		1.7		34.7	69.4
24 Deane Hall Fold		2.4		35.4	70.7
104 Deane Hall Road		3.3		36.3	72.5
Public Track A		25.9		58.9	117.8
Public Track B		15.3		48.3	96.5
Public Track C		22.7		55.7	111.3
2 Medway Close		1.2		34.2	68.5
Snow Hall Farm		3.3		36.3	72.5
Gawber BG Site		1.1		34.1	68.2

PC=Process Contribution
PEC=Process + Background Concentration

[1] Background concentration from 2008 Defra Background Maps

Table 4.8: Calculation of the PEC for Annual Mean $PM_{2.5}$					
	AQO μgm^{-3}	PC μgm^{-3}	Background μgm^{-3}	PEC μgm^{-3}	% EAL/AQO
Point of Maximum concentration	25	8.0	10.5 [1]	18.6	74.4
Receptors					
2 Dovebush Way	25	0.5	10.5[1]	11.0	43.9
1 Dovebush Way		0.5		11.0	44.1
24 Deane Hall Fold		0.6		11.1	44.4
104 Deane Hall Road		0.8		11.3	45.1
Public Track A		7.6		18.1	72.2
Public Track B		3.7		14.2	56.7
Public Track C		6.8		17.3	69.0
2 Medway Close		0.4		10.9	43.7
Snow Hall Farm		0.9		11.4	45.7
Gawber BG Site		0.3		10.8	43.0

PC=Process Contribution
PEC=Process + Background Concentration
[1] Background concentration from 2008 Defra Background Maps

Calculation of the annual mean PEC for nitrogen dioxide is less than 70% of the annual mean objective at each of the residential receptors (Table 4.4). It is therefore considered that there is no risk of the contribution from the facility causing a breach of the air quality objective, given the existing background concentrations in the vicinity of the facility. However, the PEC calculated at the point of maximum concentration and at point A, B and C along the public track, located to the east of the railway track, is over 70% of the annual mean objective, with exceedance of the objective at points A and C and at the point of maximum concentration.

However, as detailed in Table 3.5, the annual mean objective only applies at locations where the public might be regularly exposed such as building facades of residential properties, schools and hospitals. The objective does not apply at locations where public exposure is expected to be short-term. Public exposure along the public track, to the east of the railway, is considered to be short-term, therefore the annual mean objective does not apply.

The short-term PEC for nitrogen dioxide (Table 4.5) is below the objective limit of 200 μgm^{-3} at all receptor locations, but concentrations are at the limit at the point of maximum concentration. At all the residential receptors concentrations are less than 70% of the objective therefore there is no risk of the short term objective being exceeded in these locations. Along the public track, although below the objective limit, concentrations are over 70% of the objective limit (73.5% at point A, 90.2% at point B and 76.5% at point C),

therefore there is some risk of the objective being exceeded along the public track, although the risk is small.

The annual mean PM_{10} PEC calculated at each receptor, including the point of maximum concentration, is less than 65% of the objective limit. Therefore, there is no risk of the facility resulting in an exceedance of the annual mean objective at any location.

The PEC calculated for short-term PM_{10} is greater than 70% of the objective at the point of maximum concentration, at the three points along the public track and at Snow Hill Farm, with the objective being exceeded at Point A and Point C along the public track and at the point of maximum concentration. However, it should be noted that the LAQM.TG(09) guidance indicates that the short-term PM_{10} objective applies to locations where the public may be exposed on a regular basis, i.e residential properties and also in the gardens of residential properties, but does not apply to locations where public exposure is expected to be short-term (Table 3.5). Therefore, the short-term objective for PM_{10} is not considered to apply along the public track. The point of maximum concentrations falls within the agricultural field to the east of the railway track, as shown in Figure B4, where there is unlikely to be any relevant public exposure.

Snow Hill Farm is a residential property. Although the 24-hour PM_{10} objective does not apply at the façade of residential properties, it is considered relevant within residential gardens. However, the PEC at Snow Hall Farm is only just over 70% of the objective, at 72.5%, therefore it is very unlikely that this objective will be exceeded as a result of the proposed Energy Generation Plant.

The PEC calculated for annual mean $PM_{2.5}$ is less than 70% of the 25 μgm^{-3} objective at all receptor locations, with the exception of point a along the public track and at the point of maximum concentrations (Table 4.8) therefore there is no risk of the objective being exceeded at a result of the proposed installation at the majority of receptor locations. Concentrations are only just over 70% of the objective limit at Point A and at the point of maximum concentrations therefore there is very little risk of the objective being exceeded at any location. It should be noted that $PM_{2.5}$ emissions have been modelled as PM_{10} and therefore are a worst case scenario. Actual emissions from the facility are therefore likely to be less than predicted here and as a result the ground level PC will be lower.

BMBC has raised concerns regarding residential receptors located on Dovebush Way, southwest of the installation site. Properties 1 and 2 are located directly adjacent to A637 Claycliffe Road, which can experience congestion at peak period. The combined impact from traffic emissions and emissions from the proposed installation are therefore a concern with regard to nitrogen dioxide concentrations. It has been agreed with BMBC that to assess the combined impact from traffic emissions and emissions from the proposed diesel engines the PC from the site will be added to nitrogen dioxide concentrations recorded along the A637. BMBC operate a number of diffusion tubes within the borough to recorded nitrogen dioxide (DT) concentrations. The closest DT site to Dovebush Way is DT 46, which is located adjacent to the A637, close to the junction with the A635. The site is a roadside site and is considered a worst case representation of concentration at Dovebush Way, therefore the predicted PEC detailed in Table 4.9 below is likely to be an overestimate of actual concentrations.

Table 4.9: Calculation of the PEC for Annual Mean Nitrogen Dioxide					
Receptors	**AQO µgm^{-3}**	**PC µgm^{-3}**	**NO_2 Roadside Concentrations [1] µgm^{-3}**	**PEC µgm^{-3}**	**% EAL/AQO**
2 Dovebush Way	40	1.6	34.9	36.5	91.3
1 Dovebush Way		1.7		36.6	91.5
[1] recorded at Diffusion Tube site 46					

Annual mean nitrogen dioxide concentrations predicted at Dovebush Way are below the annual mean objective, after traffic related emissions have been taken into consideration. The proposed installation is predicted to increase annual mean nitrogen dioxide concentrations at both 1 and 2 Dovebush Way by approximately 1.6 µgm^{-3} (4.6%) compared to existing annual mean concentrations recorded at the Claycliffe Road diffusion tube site. Using guidance published by Environmental Protection UK (EPUK) (previously known as NSCA) for Development Control[5] an increase of 4.6% is considered a 'very small' change in air quality and equates to a 'slightly adverse' impact on air quality. As the predicted concentrations at Dovebush Way are based on worst case data, the impact from the facility is not considered to be significant.

The proposed installation will be 8MWe, which has the potential to generate 19MWth of thermal energy. However, the installation will operate at approximately 41% thermal efficiency, which will result in approximately 10 MWth being released as excess energy. This energy will be released as hot air through the radiators detailed in Figure 2.1. The radiators will be fitted with fans to disperse the hot air vertically. It is envisaged that the hot air released by the radiators will increase the buoyancy of the plumes emitted by the stack, improving the dispersal pattern of the emitted pollutants, resulting in a reduction in predicted ground level pollution concentrations detailed in Tables 4.4 to 4.9. ADMS 4.1 can not take account of the predicted increased buoyancy and therefore can not quantify the impact the radiators will have on plume dispersion. However, modelling of the buoyancy, resulting from the radiators, and the resulting impact on plume dispersal has been carried out by Rocpower, the results of which are provided in Annex C.

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5 Conclusions

The assessment has considered the emissions from the proposed new power generation site, which will operate five 1.6 MWe engines fuelled with biofuels, to generate electricity to feed into the national grid. Ground level concentrations of pollutants have been predicted assuming a stack height of 15 m and compared with the relevant air quality objectives.

Emissions from the installation have been provided by Rocpower Ltd, from a number of different sources.

The predicted process contribution (PC) at both the point of maximum concentration and at each of the receptor locations have been compared with the relevant air quality objectives. To determine the significance of the releases, the results have been assessed using the criteria given in the Environment Agency's H1 Guidance.

The predicted annual mean nitrogen dioxide concentrations emitted by the proposed boiler are greater than 1% of the annual mean objective at all the selected receptor locations (Table 4.1). The short-term concentrations are over 10% of the short term objective at all locations with the exception of the Gawber background monitoring site. Emissions of nitrogen dioxide can not, therefore, be considered as insignificant.

Predicted PM_{10} concentrations are over 1% of the annual mean objective at all of the selected receptor locations, with the exception of the Gawber background site (Table 4.2), therefore the annual mean PM_{10} emissions can not be considered insignificant at any of the receptor locations with the exception of the Gawber background site. However, short-term concentrations do not exceed 10% of the short-term objective at any of the residential receptor locations, but are over 30% of the objective at the three receptors along the public track and at the point of maximum concentration. As a result short-term PM_{10} emissions can be considered as insignificant at each of the residential receptors presented in Table 4.2, but can not be considered as insignificant at the other three receptors.

Emissions of $PM_{2.5}$ are predicted to be over 1% of the annual mean objective at all receptor locations (Table 4.3), therefore emissions can not be considered as insignificant.

Where the process concentrations cannot be considered to be insignificant, the next stage in the assessment process is to consider the process contribution together with the existing background concentration, to calculate the Predicted Environmental Concentration (PEC) to determine the overall impact on air quality. Through discussions with BMBC it has been agreed that this stage of the assessment would be carried out for all predicted results, regardless of whether they could be deemed as insignificant at stage 1.

Calculation of the annual mean and short-term PEC for nitrogen dioxide is less than 70% of the objective limits at each of the residential receptors. It is therefore considered that there is no risk of the contribution from the facility causing a breach of the air quality objective. However, the PEC calculated at point B along the public track, to the east of the railway track, is over 70% of the annual mean objective, with exceedance of the objective predicted at points A and C and at the point of maximum concentrations.

However, based on the LAQM.TG(09) guidance, the annual mean objective only applies at locations where the public might be regularly exposed such as building facades of residential

properties, schools and hospitals. The objective does not apply at locations where public exposure is expected to be short-term. Public exposure along the public track, to the east of the railway, is considered to be short-term, therefore the annual mean objective does not apply. The short-term PEC calculated along this track is over 70% of the objective limit (73.5% at point A, 90.2% at point B and 76.5% at point C) and meets the limit at the point of maximum concentration. The point of maximum concentration is located in close proximity to the public track (Figure B2) therefore there is some risk of the objective being exceeded along the public track, although the area of potential exceedance is relatively small.

The annual mean PM_{10} PEC calculated at each receptor, including the point of maximum concentration, is less than 65% of the objective limit, therefore, there is no risk of the facility resulting in an exceedance of the annual mean objective at any location.

The PEC calculated for short-term PM_{10} is greater than 70% of the objective at the point of maximum concentration, at the three points along the public track and at Snow Hill Farm, with the objective being exceeded at Point A and Point C along the public track and at the point of maximum concentration. However based on the LAQM.TG(09) guidance, the short-term PM_{10} objective does not apply along the public track.

Snow Hill Farm is a residential property. Although the 24-hour PM_{10} objective does not apply at the façade of residential properties, it is considered relevant within residential gardens. However, the PEC at Snow Hall Farm is only just over 70% of the objective, at 72.5%, therefore it is very unlikely that this objective will be exceeded as a result of the proposed installation.

The PEC calculated for annual mean $PM_{2.5}$ is comfortably less than 70% of the 25 μgm^{-3} objective at all receptor locations, with the exception of point A along the public track and at the point of maximum concentration. However, concentrations are only just over 70% of the objective limit, therefore there is little risk of the objective being exceeded at a result of the proposed installation.

BMBC has raised concerns regarding residential receptors located on Dovebush Way, southwest of the installation site. Properties 1 and 2 are located directly adjacent to A637 Claycliffe Road, which can experience congestion at peak periods. Annual mean nitrogen dioxide concentrations predicted at Dovebush Way are below the annual mean objective, after traffic related emissions have been taken into consideration. The proposed installation is predicted to result in a ‘very small’ change in nitrogen dioxide concentrations (an increase of 46% compared to existing concentrations), which equates to a ‘slightly adverse’ impact on air quality. As the predicted concentrations at Dovebush Way are based on worst case data, the impact from the facility is not considered to be significant.

In summary, although emissions arising from the proposed energy generation plant can not be considered as insignificant based on the criteria given in the H1 guidance, subsequent analysis of the data in conjunction with local background concentrations indicates that the proposed facility is unlikely to result in a breach of the air quality objectives for nitrogen dioxide, PM_{10} and $PM_{2.5}$ at any of the surrounding residential receptors. However, there is a small risk of the short-term nitrogen dioxide objective being exceeded along the public track, although the area of potential exceedances is relatively small.