Air Quality Assessment

Brocklesby Waste Processing Facility, North Cave

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Executive Summary

Redmore Environmental Ltd was commissioned by H&C Consultancy Ltd to undertake an Air Quality Assessment in support of the Brocklesby Ltd waste processing facility, Crosslands Lane, North Cave.

The facility has the potential to cause air quality impacts as a result of atmospheric emissions from proposed combustion processes. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and quantity potential effects.

Dispersion modelling was undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the plant. The results indicated that impacts on pollutant concentrations were not predicted to be significant at any human receptor location in the vicinity of the site.

Impacts were also predicted at relevant ecological sites. The results indicated that emissions from the plant would not significantly affect existing conditions at any designation.

Impacts were predicted based on a worst-case assessment scenario of the plant constantly emitting the maximum anticipated concentration of each pollutant throughout an entire year. As such, predicted pollutant concentrations are likely to overestimate actual impacts.

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1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by H&C Consultancy Ltd to undertake an Air Quality Assessment in support of the Brocklesby Ltd waste processing facility, Crosslands Lane, North Cave.

1.1.2 The facility has the potential to cause air quality impacts as a result of atmospheric emissions from proposed combustion processes. As such, an Air Quality Assessment was required in order to determine baseline conditions and quantity potential effects.

1.2 Site Location and Context

1.2.1 The Brocklesby Ltd facility is located on land off Crosslands Lane, North Cave, at National Grid Reference (NGR): 488150, 432180. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 The site operates as a waste processing facility under an Environmental Permit (No. JP3931SG/V002) issued by the Environment Agency (EA). An Environmental Permit Variation Application is currently being made in order to authorise a number of changes to operations. These include the construction of a new tank farm in order to facilitate an increase in waste storage and processing capacity, as well as the replacement of two existing boilers which are used to produce steam for heat processing of materials.

1.2.3 The proposed boilers will operate using natural gas delivered through the mains supply. A summary of the plant is provided as follows:

- Two 6,268kW Cochran ST37 boilers.

1.2.4 The operation of the proposed boilers will result in atmospheric emissions of combustion products. These have the potential to cause air quality impacts at sensitive locations in the vicinity of the site and have therefore been quantified within this report.

2.0 LEGISLATION AND POLICY

2.1 Legislation

2.1.1 The Air Quality Standards Regulations (2010) came into force on 11th June 2010 and include Air Quality Limit Values (AQLVs) for the following pollutants:

- Nitrogen dioxide (NO_2);
- Sulphur dioxide;
- Lead;
- Particulate matter with an aerodynamic diameter of less than 10µm;
- Particulate matter with an aerodynamic diameter of less than 2.5µm;
- Benzene; and,
- Carbon monoxide (CO).

2.1.2 Target Values were also provided for an additional 5 pollutants. These include:

- Ozone;
- Arsenic;
- Cadmium;
- Nickel; and,
- Benzo(a)pyrene.

2.1.3 Part IV of the Environment Act (1995) requires UK government to produce a national Air Quality Strategy (AQS) which contains standards, objectives and measures for improving ambient air quality. The most recent AQS was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and published in July 2007[1]. The AQS sets out Air Quality Objectives (AQOs) that are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedences over a specified timescale. These are generally in line with the AQLVs, although the requirements for the determination of compliance vary.

2.1.4 Table 1 presents the AQOs for pollutants considered within this assessment.

[1] The AQS for England, Scotland, Wales and Northern Ireland, DEFRA, 2007.

Table 1 Air Quality Objectives

Pollutant	Air Quality Objective	
	Concentration (µg/m^3)	Averaging Period
NO_2	40	Annual mean
	200	1-hour mean, not to be exceeded on more than 18 occasions per annum
CO	10,000	8-hour rolling mean

2.2 Local Air Quality Management

2.2.1 Under Section 82 of the Environment Act (1995) (Part IV) Local Authorities are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves comparing present and likely future pollutant concentrations against the AQOs. If it is predicted that levels at locations of relevant exposure are likely to be exceeded, the Local Authority is required to declare an Air Quality Management Area (AQMA). For each AQMA the Local Authority is required to produce an Air Quality Action Plan, the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

2.3 Industrial Pollution Control Legislation

2.3.1 Atmospheric emissions from industry are controlled in the UK through the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. As such, the site is required to operate in accordance with an Environmental Permit issued by the EA. Amongst conditions of operation are stated Emission Limit Values (ELVs) for various pollutants produced by the process. Compliance with these conditions must be demonstrated through periodic monitoring requirements, which have been set in order to limit potential impacts in the surrounding area.

2.4 Critical Loads and Levels

2.4.1 A critical load is defined by the UK Air Pollution Information System (APIS)[2] as:

[2] UK Air Pollution Information System, www.apis.ac.uk.

"A quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The exceedance of a critical load is defined as the atmospheric deposition of the pollutant above the critical load."

2.4.2 A critical level is defined as:

"Threshold for direct effects of pollutant concentrations according to current knowledge. Exceedance of a critical level is defined as the atmospheric concentration of the pollutant above the critical level."

2.4.3 A critical load refers to deposition of a pollutant, while a critical level refers to pollutant concentrations in the atmosphere (which usually have direct effects on vegetation or human health).

2.4.4 When pollutant loads (or concentrations) exceed the critical load or level it is considered that there is a risk of harmful effects. The excess over the critical load or level is termed the exceedence. A larger exceedence is often considered to represent a greater risk of damage.

2.4.5 Maps of critical loads and levels and their exceedences have been used to show the potential extent of pollution damage and aid in developing strategies for reducing pollution. Decreasing deposition below the critical load is seen as means for preventing the risk of damage. However, even a decrease in the exceedence may infer that less damage will occur.

2.4.6 Table 2 presents the critical levels for the protection of vegetation for pollutants considered within the assessment.

Table 2 Critical Levels for the Protection of Vegetation

Pollutant	Critical Level	
	Concentration (µg/m^3)	Averaging Period
Oxides of nitrogen (NO_x)	30	Annual mean
	75	24-hour mean

2.4.7 Critical loads have been designated within the UK based on the sensitivity of the receiving habitat and have been reviewed for the purpose of this assessment.

3.0 BASELINE

3.1 Introduction

3.1.1 Existing air quality conditions in the vicinity of the site were identified in order to provide a baseline for assessment. These are detailed in the following Sections.

3.2 Local Air Quality Management

3.2.1 As required by the Environment Act (1995), East Riding of Yorkshire Council (ERYC) has undertaken Review and Assessment of air quality within their area of jurisdiction. This process has indicated that concentrations of all pollutants considered within the AQS are currently below the relevant AQOs. As such, no AQMAs have been designated.

3.3 Air Quality Monitoring

3.3.1 Monitoring of pollutant concentrations is undertaken by ERYC using continuous and periodic methods throughout their area of jurisdiction. Recent NO_2 results recorded in the vicinity of the site are shown in Table 3.

Table 3 Monitoring Results

Monitoring Site		Site Classification	Monitored NO_2 Concentration ($\mu g/m^3$)		
			2017	2018	2019
65	Church Street (No 38), North Cave	Roadside	23	23	21

3.3.2 As shown in Table 3, annual mean NO_2 concentrations were below the relevant AQO at the Church Street monitor during recent years. It is noted that the survey position is approximately 1.2km east of the facility at a roadside location on the corner of a junction. As such, elevated pollution levels would be anticipated when compared with overall concentrations throughout North Cave.

3.4 Background Pollutant Concentrations

3.4.1 Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK to assist Local Authorities in their Review and Assessment of air quality. The site is located in grid square NGR: 488500, 432500. Data for this location was downloaded from the DEFRA website[3] for the purpose of the assessment and is summarised in Table 4.

Table 4 Background Pollutant Concentration Predictions

Pollutant	Predicted Background Pollutant Concentration (µg/m³)
NO_2	8.74
CO	247

3.4.2 It should be noted that concentrations of NO_2 are predicted for 2021 and CO for 2001. These were the most recent predictions available from DEFRA at the time of assessment and are therefore considered to provide a reasonable representation of background concentrations in the vicinity of the site.

3.5 Sensitive Receptors

3.5.1 A sensitive receptor is defined as any location which may be affected by changes in air quality. These have been defined for human and ecological receptors in the following Sections.

Human Receptors

3.5.2 A desk-top study was undertaken in order to identify any sensitive human receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in Table 5.

[3] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html.

Table 5 Sensitive Human Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Residential - Newport Road	488282.1	431986.0
R2	Residential - Newport Road	488301.3	431984.8
R3	Residential - Newport Road	488331.0	432001.7
R4	Residential - Newport Road	488446.2	432091.6
R5	Residential - Bungalow Farm	488581.9	432276.0
R6	Residential - Walnut Grove	488106.8	431839.8
R7	Residential - Breck Lane	487747.8	432038.1
R8	Residential - Dryham	487551.0	432769.1
R9	Residential - Townend Lane	488808.4	432460.7

3.5.3 Reference should be made to Figure 2 for a map of the human receptor locations.

Ecological Receptors

3.5.4 Atmospheric emissions from the facility also have the potential to impact on receptors of ecological sensitivity within the vicinity of the site. The Conservation of Habitats and Species Regulations (2010) and subsequent amendments require competent authorities to review applications and consents that have the potential to impact on ecological sites. A pre-application request was therefore submitted to the EA in order to identify any sites of ecological or nature conservation importance that required consideration within the assessment. The response indicated the following should be included:

- Humber Estuary Special Area of Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI) and Ramsar site;
- North Cave Wetlands Local Wildlife Site (LWS); and,
- North Cave Fish Pond LWS.

3.5.5 For the purpose of the modelling assessment discrete receptors were placed at the closest point of each designation to the facility to ensure the maximum potential impact was predicted. These are summarised in Table 6.

Table 6 Ecological Receptor Locations

Receptor		Designation	NGR (m)	
			X	Y
E1	Humber Estuary	SAC, SPA, SSSI and Ramsar Site	488246.2	426110.3
E2	Humber Estuary	SAC, SPA, SSSI and Ramsar Site	489269.7	426546.5
E3	Humber Estuary	SAC, SPA, SSSI and Ramsar Site	490387.1	427256.9
E4	Humber Estuary	SAC, SPA, SSSI and Ramsar Site	491633.4	427071.3
E5	North Cave Wetlands	LWS	487938.2	432805.6
E6	North Cave Wetlands	LWS	488223.7	432820.6
E7	North Cave Wetlands	LWS	488510.9	432832.3
E8	North Cave Fish Pond	LWS	488998.7	432463.3

3.5.6 Reference should be made to Figure 3 for a map of the ecological receptor locations.

3.5.7 Critical loads have been designated within the UK based on the sensitivity and relevant features of the receiving habitat. A review of the APIS[4] and MAGIC[5] websites, as well as the relevant site designations and publicly available information, was undertaken in order to identify the most suitable habitat description and associated critical load for the area of each designation considered within the assessment.

3.5.8 The relevant critical loads for nitrogen deposition are presented in Table 7.

Table 7 Critical Loads for Nitrogen Deposition

Ecological Designation	Feature	APIS Habitat	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
Humber Estuary SAC, SPA, SSSI and Ramsar Site	Fixed coastal dunes with herbaceous vegetation	Coastal stable dune grasslands - acid type	8	10

4 http://www.apis.ac.uk/.

5 Multi-Agency Geographic Information for the Countryside, www.magic.gov.uk.

Ecological Designation	Feature	APIS Habitat	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
North Cave Wetlands LWS	Hedgerows	Broadleaved deciduous woodland	10	20
North Cave Fish Pond LWS	Fen, marsh and swamp	Valley mires, poor fens and transition mires	10	15

3.5.9 The site features were also reviewed to identify the habitat types most sensitive to acid deposition. These are summarised in Table 8.

Table 8 Critical Loads for Acid Deposition

Ecological Designation	Feature	APIS Habitat	Acid Critical Load (keq/ha/yr)		
			CLMaxS	CLMinN	CLMaxN
Humber Estuary SAC, SPA, SSSI and Ramsar Site	Fixed coastal dunes with herbaceous vegetation	Acid grassland	0.42	0.223	0.643
North Cave Wetlands LWS	Hedgerows	Broadleafed/ Coniferous unmanaged woodland	10.771	0.142	10.913
North Cave Fish Pond LWS	Fen, marsh and swamp	Valley mires, poor fens and transition mires	-(a)	-(a)	-(a)

NOTE: (a) Habitat not sensitive to acid deposition.

3.5.10 Baseline pollutant concentrations and deposition rates at each ecological receptor were obtained from the APIS website and are summarised in Table 9.

Table 9 Baseline Pollution Levels

Receptor		Annual Mean NO_x Concentration ($\mu g/m^3$)	Annual Nitrogen Deposition (kgN/ha/yr)	Annual Acid Deposition (keq/ha/yr)	
				Nitrogen	Sulphur
E1	Humber Estuary SAC, SPA, SSSI and Ramsar Site	11.00	18.20	1.30	0.20
E2		11.08	16.00	1.30	0.20
E3		11.93	15.80	1.10	0.20

Receptor		Annual Mean NO_x Concentration ($\mu g/m^3$)	Annual Nitrogen Deposition (kgN/ha/yr)	Annual Acid Deposition (keq/ha/yr)	
				Nitrogen	Sulphur
E4		12.71	15.80	1.10	0.20
E5	North Cave Wetlands LWS	12.40	41.02	2.93	0.26
E6		14.43	41.02	2.93	0.26
E7		14.43	41.02	2.93	0.26
E8	North Cave Fish Pond LWS	14.43	23.80	1.70	0.22

4.0 METHODOLOGY

4.1 Introduction

4.1.1 Emissions associated with the proposed boilers have the potential to contribute to elevated pollutant concentrations in the vicinity of the site. These have been quantified through dispersion modelling in accordance with the methodology outlined in the following Sections.

4.2 Dispersion Model

4.2.1 Dispersion modelling was undertaken using ADMS-5.2 (v5.2.4.0), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-5 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

4.2.2 The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages.

4.3 Modelling Scenarios

4.3.1 The scenarios considered for human receptors in the modelling assessment are summarised in Table 10.

Table 10 Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO_2	99.8th percentile (%ile) 1-hour mean	Annual mean
CO	100th %ile 8-hour rolling mean	-

4.3.2 Some short-term air quality criteria are framed in terms of the number of occasions in a calendar year on which the concentration should not be exceeded. As such, the %iles shown in Table 10 were selected to represent the relationship between the permitted number of exceedences of short-period concentrations and the number of periods within a calendar year.

4.3.3 The scenarios considered for ecological receptors in the modelling assessment are summarised in Table 11.

Table 11 Ecological Receptor Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO_x	24-hour mean	Annual mean
Nitrogen deposition	-	Annual deposition
Acid deposition	-	Annual deposition

4.3.4 Predicted pollutant concentrations were summarised in the following formats:

- Process contribution (PC) - Predicted pollutant concentration as a result of emissions from the facility only; and
- Predicted environmental concentration (PEC) - Total predicted pollutant concentration as a result of emissions from the facility and existing baseline levels.

4.3.5 Predicted ground level pollutant concentrations and deposition rates were compared with the relevant AQOs, critical loads and critical levels. These criteria are collectively referred to as Environmental Quality Standards (EQSs).

4.4 Assessment Area

4.4.1 The assessment area was defined based on the facility location, anticipated pollutant dispersion patterns and the positioning of sensitive receptors. Ambient concentrations were predicted over NGR: 487445, 431475 to 488945, 432975. One Cartesian grid with a resolution of 10m was used within the model to produce data suitable for contour plotting using the Surfer software package.

4.4.2 Reference should be made to Figure 4 for a graphical representation of the assessment grid extents.

4.5 Process Conditions

4.5.1 A summary of the inputs used in the assessment is provided in Table 12. These were provided by Brocklesby Ltd.

Table 12 Process Conditions

Parameter	Unit	Boiler 1	Boiler 2
Stack position	NGR	488093.0, 432173.0	488098.6, 432175.5
Stack height	m	10.0	10.0
Stack diameter	m	0.66	0.66
Exhaust gas temperature	°C	126	126
Exhaust gas moisture content	%	10.75	10.75
Exhaust gas oxygen (O_2) content	%	2.39	2.39
Exhaust gas flow rate	m^3/hr	3,929	3,929
Exhaust gas flow rate (dry at 3% O_2)	Nm^3/hr	2,480	2,480
Exhaust gas efflux velocity	m/s	3.19	3.19

4.6 Emissions

4.6.1 Pollutant emission concentrations for the proposed boilers were provided by Brocklesby Ltd. These are shown in Table 13.

Table 13 Proposed Boilers - Pollutant Emission Concentrations

Pollutant	Pollutant Emission Concentration (mg/Nm^3)
NO_x	100
CO	34

4.6.2 Mass emission rates for the boilers were derived from the concentrations shown in Table 13 and the flow rates shown in Table 12. These are summarised in Table 14.

Table 14 Proposed Boilers - Pollutant Mass Emission Rates

Pollutant	Pollutant Mass Emission Rate (g/s)	
	Boiler 1	Boiler 2
NO_x	0.0689	0.0689
CO	0.0237	0.0237

4.6.3 Emissions from both boilers were assumed to be constant, with the plant in operation 24-hours per day, 365-days per year. This is considered to provide a worst-case assessment of potential impacts as the boilers will operate as duty and standby and both units will not run concurrently.

4.7 NO_x to NO_2 Conversion

4.7.1 Emissions of total NO_x from combustion processes are predominantly in the form of nitric oxide (NO). Excess oxygen in the combustion gases and further atmospheric reactions cause the oxidation of NO to NO_2. Comparisons of ambient NO and NO_2 concentrations in the vicinity of point sources in recent years has indicated that it is unlikely that more than 30% of the NO_x is present at ground level as NO_2.

4.7.2 Ambient NO_x concentrations were predicted through dispersion modelling. Concentrations of NO_2 shown in the results section assume 70% conversion from NO_x to NO_2 for annual means and 35% conversion for 1-hour concentrations, based upon EA guidance[6].

4.8 Building Effects

4.8.1 The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.

6 https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports.

4.8.2 Analysis of the site layout indicated that a number of structures should be included within the model in order to take account of effects on pollutant dispersion. Building input geometries are shown in Table 15.

Table 15 Building Geometries

Building	NGR (m)		Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
	X	Y				
B1	488113.8	432127.2	15.8	16.8	16.8	158.0
B2	488102.0	432159.5	7.6	46.0	14.1	158.0
B3	488126.3	432166.4	15.4	18.5	14.5	158.0
B4	488150.8	432199.3	18.4	42.6	44.3	158.0
B5	488120.2	432187.0	9.0	20.4	20.8	158.0
B6	488101.7	432220.2	10.0	12.1	6.2	158.0
B7	488147.1	432157.9	14.5	16.9	4.6	158.0
B8	488154.1	432160.9	14.5	16.8	8.8	158.0
B9	488161.1	432163.8	14.5	16.8	4.5	158.0
B10	488176.3	432170.2	10.0	20.1	19.0	158.0
B11	488106.9	432209.8	10.0	6.8	12.3	158.0
B12	488078.1	432219.7	15.0	19.1	6.0	158.0
B13	488083.6	432225.7	5.0	12.3	5.0	158.0
B14	488098.7	432232.9	10.0	7.8	8.0	158.0

4.9 Meteorological Data

4.9.1 Meteorological data used in the assessment was taken from Leconfield meteorological station over the period 1st January 2015 to 31st December 2019 (inclusive). Leconfield observation station is located at NGR: 503329, 442674, which is approximately 18.1km north-east of the facility. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

4.9.2 All meteorological files used in the assessment were provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 5 for wind roses of utilised meteorological records.

4.10 Roughness Length

4.10.1 Roughness length (z_0) is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 0.3m was used to describe the modelling extents and the meteorological site. This value is considered appropriate for the morphology of both areas and is suggested within ADMS-5 as being suitable for 'agricultural areas (max)'.

4.11 Monin-Obukhov Length

4.11.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 10m was used to describe the modelling extents and meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-5 as being suitable for 'small towns < 50,000'.

4.12 Terrain Data

4.12.1 Ordnance Survey OS Terrain 50 data was included in the model for the site and surrounding area in order to take account of the specific flow field produced by variations in ground height throughout the assessment extents. This was pre-processed using the method suggested by CERC.

4.13 Nitrogen Deposition

4.13.1 Nitrogen deposition rates were calculated using the conversion factors provided within EA document 'Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06'[7]. Predicted pollutant concentrations were multiplied by the relevant deposition velocity and conversion factor to calculate the speciated dry deposition flux. The conversion factors used for the determination of nitrogen deposition are presented within Table 16.

[7] Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06, EA, 2014.

Table 16 Conversion Factors to Determine Dry Deposition Flux for Nitrogen Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (µg/m²/s to kg/ha/yr of pollutant species)
	Grassland	Forest	
NO_2	0.0015	0.003	95.9

4.13.2 The relevant deposition velocity for each ecological receptor was selected from Table 16 based on the vegetation type present within the designation.

4.14 Acid Deposition

4.14.1 Predicted ground level NO_2 concentrations were converted to kilo-equivalent ion depositions (keq/ha/yr) for comparison with the critical load for acid deposition at each of the identified ecological receptors. The conversion to units of equivalents, a measure of the potential acidifying effect of a species, was undertaken using the standard conversion factors shown in Table 17.

Table 17 Conversion Factors to Determine Dry Deposition Flux for Acid Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (µg/m²/s to keq/ha/yr of pollutant species)
	Grassland	Forest	
NO_2	0.0015	0.003	6.84

4.14.2 The PC and PEC proportion of the EQS were calculated using the tool available on the APIS website[8]. It should be noted that the following formula was used to calculate predicted PCs as a proportion of the critical load function where PECs were identified to be greater than the CLminN value.

PC as %CL function = ((PC of N deposition)/CLmaxN)*100

4.14.3 The above formula was obtained from the APIS website[9].

[8] http://www.apis.ac.uk/.

[9] http://www.apis.ac.uk/.

4.15 Background Concentrations

4.15.1 Review of existing data in the vicinity of the site was undertaken in Section 3.0 in order to identify suitable background values for use in the assessment. This indicated the closest monitor is positioned at a roadside location outside of the modelling extents. As such, results are considered unlikely to be representative of the facility location. The background concentrations predicted by DEFRA were therefore utilised to represent baseline levels in the vicinity of the site.

4.15.2 It is not possible to add short-term peak baseline and process concentrations. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different to the conditions which give rise to peak concentrations due to emissions from other sources. This point is addressed in in EA guidance 'Air emissions risk assessment for your environmental permit'[10], which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum predicted short-term concentration due to emissions from the source to twice the annual mean baseline concentration. This approach was adopted throughout the assessment.

4.16 Assessment Criteria

Human Receptors

4.16.1 EA guidance 'Air emissions risk assessment for your environmental permit'[11] states that PCs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard; and,
- The long-term PC is less than 1% of the long-term environmental standard.

4.16.2 If these criteria are exceeded the following guidance is provided on when whether PECs can be screened as insignificant:

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

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

- The short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration; and,
- The long-term PEC is less than 70% of the long-term environmental standards.

Ecological Receptors

4.16.3 EA guidance 'Air emissions risk assessment for your environmental permit'[12] states that PCs at SPAs, SACs, Ramsar sites or SSSIs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard for protected conservation areas;
- The long-term PC is less than 1% of the long-term environmental standard for protected conservation areas; or,
- The long-term PC is greater than 1% and the long term PEC is less than 70% of the long term environmental standard.

4.16.4 The guidance states that PCs at local nature sites can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 100% of the short-term environmental standard; and,
- The long-term PC is less than 100% of the long-term environmental standard.

4.16.5 Predicted PCs have been compared to the relevant EQSs and the criteria stated above. Where the impact is within these parameters, the EA concludes that impacts associated with an installation are acceptable.

4.17 Modelling Uncertainty

4.17.1 Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;

[12] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

- Data uncertainty - due to errors in input data, including emission estimates, operational procedures, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

4.17.2 Potential uncertainties in the model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS-5 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using five annual meteorological data sets from the closest observation site to the facility to take account of local conditions. The assessment was based on the worst-case year for each averaging period to ensure maximum concentrations were considered;
- Surface characteristics - The z_0 and Monin-Obukhov length were determined for both the dispersion and meteorological sites based on the surrounding land uses and guidance provided by CERC;
- Plant operating conditions - Operational parameters were supplied by Brocklesby Ltd based on the specifications of the proposed plant. As such, these are considered to be representative of normal operating conditions;
- Emission rates - Emission rates were derived from the plant specifications. Emissions from both boilers were assumed to be constant throughout the modelling period, which does not allow for the proposed duty and standby operating schedule. This is assumption is likely to result in overestimation of actual emissions and therefore result in a worst-case assessment;
- Background concentrations - Background pollutant levels were obtained from the DEFRA mapping study and APIS website;
- Receptor locations - A Cartesian Grid was included in the model in order to provide suitable data for contour plotting. Receptor points were also included at sensitive locations to provide additional consideration of these areas; and,
- Variability - All model inputs were as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

4.17.3 Results were considered in the context of the relevant EQSs. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

5.0 ASSESSMENT RESULTS

5.1 Introduction

5.1.1 Dispersion modelling was undertaken with the inputs described in Section 4.0. The results are outlined in the following Sections.

5.2 Maximum Pollutant Concentrations

5.2.1 The maximum predicted pollutant concentrations at any point within the modelling extents for any meteorological data set are summarised in Table 18.

Table 18 Maximum Predicted Pollutant Concentrations

Pollutant	Averaging Period	EQS (µg/m³)	PC (µg/m³)	PC Proportion of EQS (%)	PEC (µg/m³)	PEC Proportion of EQS (%)
NO_2	Annual	40	15.83	39.6	24.57	61.4
	99.8th %ile 1-hour	200	42.87	21.4	60.35	30.2
CO	100th %ile 8-hour rolling	10,000	311.44	3.1	558.44	5.6

5.2.2 As shown in Table 18, there were no predicted exceedences of any EQS at any location for any pollutant or averaging period of interest.

5.2.3 Reference should be made to Figure 6 to Figure 8 for graphical representations of predicted pollutant concentrations, inclusive of background levels, throughout the assessment extents. It should be noted that the values shown in the Figures are predictions from the meteorological data set which resulted in the maximum pollutant concentration for that species. For example, the maximum annual mean NO_2 concentration was predicted using the 2018 meteorological data set. As such, the contours shown in Figure 6 were produced from the 2018 model outputs.

5.3 Sensitive Human Receptors

5.3.1 Predicted concentrations of each pollutant at the sensitive receptor locations identified in Table 5 are summarised in the following Sections.

Nitrogen Dioxide

5.3.2 Predicted annual mean NO_2 PECs, inclusive of background levels, are summarised in Table 19.

Table 19 Predicted Annual Mean NO_2 Concentrations

Receptor		Predicted Annual Mean NO_2 PEC (µg/m³)				
		2015	2016	2017	2018	2019
R1	Residential - Newport Road	8.92	8.95	8.94	8.91	8.95
R2	Residential - Newport Road	8.92	8.94	8.94	8.90	8.95
R3	Residential - Newport Road	8.93	8.94	8.96	8.91	8.95
R4	Residential - Newport Road	9.02	8.98	9.08	8.98	8.98
R5	Residential - Bungalow Farm	9.07	9.05	9.12	9.02	9.06
R6	Residential - Walnut Grove	8.84	8.91	8.82	8.87	8.84
R7	Residential - Breck Lane	8.84	8.86	8.82	8.87	8.84
R8	Residential - Dryham	8.78	8.78	8.79	8.80	8.80
R9	Residential - Townend Lane	8.87	8.87	8.89	8.86	8.88

5.3.3 As indicated in Table 19, predicted NO_2 concentrations were well below the annual mean EQS of 40µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.4 Maximum predicted annual mean NO_2 concentrations at the receptor locations are summarised in Table 20. Reference should be made to Figure 6 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 20 Maximum Predicted Annual Mean NO_2 Concentrations

Receptor		Predicted Annual Mean NO_2 Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Residential - Newport Road	0.21	8.95	0.5	22.4
R2	Residential - Newport Road	0.21	8.95	0.5	22.4

Receptor		Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R3	Residential - Newport Road	0.22	8.96	0.6	22.4
R4	Residential - Newport Road	0.34	9.08	0.9	22.7
R5	Residential - Bungalow Farm	0.38	9.12	1.0	22.8
R6	Residential - Walnut Grove	0.17	8.91	0.4	22.3
R7	Residential - Breck Lane	0.13	8.87	0.3	22.2
R8	Residential - Dryham	0.06	8.80	0.2	22.0
R9	Residential - Townend Lane	0.15	8.89	0.4	22.2

5.3.5 As indicated in Table 20, all PECs were below 70% of the EQS. As such, predicted effects on annual mean NO_2 concentrations are not considered to be significant, in accordance with the stated criteria.

5.3.6 Predicted 99.8th %ile 1-hour mean NO_2 PECs, inclusive of background levels, are summarised in Table 21.

Table 21 Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations

Receptor		Predicted 99.8th %ile 1-hour Mean NO_2 PEC ($\mu g/m^3$)				
		2015	2016	2017	2018	2019
R1	Residential - Newport Road	21.05	21.08	20.63	20.95	21.20
R2	Residential - Newport Road	20.84	20.85	20.62	20.83	21.11
R3	Residential - Newport Road	20.79	20.96	20.54	20.96	20.99
R4	Residential - Newport Road	20.04	20.31	20.57	20.61	20.09
R5	Residential - Bungalow Farm	20.69	20.51	20.03	20.60	20.69
R6	Residential - Walnut Grove	20.27	20.38	19.66	20.24	19.74
R7	Residential - Breck Lane	20.06	20.16	20.25	20.28	19.87
R8	Residential - Dryham	18.85	18.79	18.75	18.96	18.87
R9	Residential - Townend Lane	19.33	19.37	19.27	19.31	19.57

5.3.7 As indicated in Table 21, predicted 99.8th %ile 1-hour mean NO_2 concentrations were below the EQS of 200µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.8 Maximum predicted 99.8th %ile 1-hour mean NO_2 concentrations at the receptor locations are summarised in Table 22. Reference should be made to Figure 7 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 22 Maximum Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations

Receptor		Maximum Predicted 99.8th %ile 1-hour Mean NO_2 Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)[a]
		PC	PEC		
R1	Residential - Newport Road	3.72	21.20	1.9	2.0
R2	Residential - Newport Road	3.63	21.11	1.8	2.0
R3	Residential - Newport Road	3.51	20.99	1.8	1.9
R4	Residential - Newport Road	3.13	20.61	1.6	1.7
R5	Residential - Bungalow Farm	3.22	20.69	1.6	1.8
R6	Residential - Walnut Grove	2.90	20.38	1.5	1.6
R7	Residential - Breck Lane	2.80	20.28	1.4	1.5
R8	Residential - Dryham	1.48	18.96	0.7	0.8
R9	Residential - Townend Lane	2.09	19.57	1.0	1.1

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.3.9 As indicated in Table 22, the PC proportion of the EQS was below 10% at all receptors. As such, predicted effects on 1-hour mean NO_2 concentrations are not considered to be significant, in accordance with the stated criteria.

Carbon Monoxide

5.3.10 Predicted 8-hour rolling mean CO PECs, inclusive of background levels, are summarised in Table 23.

Table 23 Predicted 8-hour Rolling Mean CO Concentrations

Receptor		Predicted 8-hour Rolling Mean CO PEC (µg/m³)				
		2015	2016	2017	2018	2019
R1	Residential - Newport Road	496.22	496.45	495.76	496.01	496.51
R2	Residential - Newport Road	496.09	496.33	495.87	496.12	496.43
R3	Residential - Newport Road	496.24	495.88	496.34	496.37	496.11
R4	Residential - Newport Road	495.88	495.78	495.94	495.69	495.52
R5	Residential - Bungalow Farm	496.26	495.87	495.69	497.24	496.29
R6	Residential - Walnut Grove	496.12	495.89	496.13	496.09	495.58
R7	Residential - Breck Lane	495.55	495.63	496.27	496.30	495.36
R8	Residential - Dryham	494.86	495.63	494.92	495.31	495.09
R9	Residential - Townend Lane	495.16	494.96	494.97	495.42	495.06

5.3.11 As indicated in Table 23, predicted CO concentrations were below the 8-hour rolling mean EQS of 10,000µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.12 Maximum predicted 8-hour rolling mean CO concentrations at the receptor locations are summarised in Table 24. Reference should be made to Figure 8 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 24 Maximum Predicted 8-hour Rolling Mean CO Concentrations

Receptor		Maximum Predicted 8-hour Rolling Mean CO Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)[a]
		PC	PEC		
R1	Residential - Newport Road	2.51	496.51	0.03	0.03
R2	Residential - Newport Road	2.43	496.43	0.02	0.03
R3	Residential - Newport Road	2.37	496.37	0.02	0.02
R4	Residential - Newport Road	1.94	495.94	0.02	0.02
R5	Residential - Bungalow Farm	3.24	497.24	0.03	0.03

Receptor		Maximum Predicted 8-hour Rolling Mean CO Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)[a]
		PC	PEC		
R6	Residential - Walnut Grove	2.13	496.13	0.02	0.02
R7	Residential - Breck Lane	2.30	496.30	0.02	0.02
R8	Residential - Dryham	1.63	495.63	0.02	0.02
R9	Residential - Townend Lane	1.42	495.42	0.01	0.01

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.3.13 As indicated in Table 24, the PC proportion of the EQS was below 10% at all receptor locations. As such, predicted effects on 8-hour rolling mean CO concentrations are not considered to be significant, in accordance with the stated criteria.

5.4 Ecological Receptors

Nitrogen Oxides

5.4.1 Predicted annual mean NO_x PECs at the receptor locations, inclusive of background levels, are summarised in Table 25.

Table 25 Predicted Annual Mean NO_x Concentrations

Receptor	Predicted Annual Mean NO_x PEC (µg/m³)				
	2015	2016	2017	2018	2019
E1	11.00	11.01	11.00	11.00	11.00
E2	11.08	11.08	11.08	11.09	11.08
E3	11.94	11.94	11.93	11.94	11.94
E4	12.72	12.71	12.71	12.71	12.71
E5	12.49	12.51	12.51	12.50	12.50
E6	14.59	14.62	14.62	14.61	14.63
E7	14.58	14.58	14.60	14.58	14.59
E8	14.59	14.59	14.60	14.57	14.60

5.4.2 As indicated in Table 25, predicted NO_x concentrations were below the annual mean EQS of 30µg/m³ at ecological receptor locations.

5.4.3 Maximum predicted annual mean NO_x concentrations at the receptor locations are summarised in Table 26.

Table 26 Maximum Predicted Annual Mean NO_x Concentrations

Receptor		Maximum Predicted Annual Mean NO_x Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Humber Estuary SAC, SPA, SSSI and Ramsar Site	0.01	11.01	0.0	36.7
E2		0.01	11.09	0.0	37.0
E3		0.01	11.94	0.0	39.8
E4		0.01	12.72	0.0	42.4
E5	North Cave Wetlands LWS	0.11	12.51	0.4	41.7
E6		0.20	14.63	0.7	48.8
E7		0.17	14.60	0.6	48.7
E8	North Cave Fish Pond LWS	0.17	14.60	0.6	48.7

5.4.4 As shown in Table 26, PCs were below 1% of the EQS at the Humber Estuary SAC, SPA, SSSI and Ramsar Site and below 100% of the EQS at all local sites. As such, predicted effects on annual mean NO_x concentrations are not considered to be significant, in accordance with the stated criteria.

5.4.5 Predicted 24-hour mean NO_x PECs at the receptor locations, inclusive of background levels, are summarised in Table 27.

Table 27 Predicted 24-hour Mean NO_x Concentrations

Receptor	Predicted 24-hour Mean NO_x PEC (µg/m³)				
	2015	2016	2017	2018	2019
E1	22.09	22.07	22.05	22.06	22.06

Receptor	Predicted 24-hour Mean NO_x PEC (µg/m³)				
	2015	2016	2017	2018	2019
E2	22.24	22.23	22.24	22.25	22.24
E3	23.97	23.95	23.97	23.94	23.96
E4	25.52	25.52	25.47	25.51	25.49
E5	25.74	26.47	26.51	25.91	25.99
E6	30.43	30.42	31.12	30.83	30.59
E7	29.89	29.76	29.86	30.19	29.84
E8	29.81	29.98	29.85	30.27	29.85

5.4.6 Maximum predicted 24-hour mean NO_x concentrations at the receptor locations are summarised in Table 28.

Table 28 Maximum Predicted 24-hour Mean NO_x Concentrations

Receptor		Maximum Predicted 24-hour Mean NO_x Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Humber Estuary SAC, SPA, SSSI and Ramsar Site	0.09	22.09	0.1	29.5
E2		0.09	22.25	0.1	29.7
E3		0.11	23.97	0.2	32.0
E4		0.10	25.52	0.1	34.0
E7	North Cave Wetlands LWS	1.71	26.51	2.3	35.3
E8		2.26	31.12	3.0	41.5
E9		1.33	30.19	1.8	40.3
E10	North Cave Fish Pond LWS	1.41	30.27	1.9	40.4

5.4.7 As shown in Table 28, PCs were below 10% of the EQS at the Humber Estuary SAC, SPA, SSSI and Ramsar Site and below 100% of the EQS at all local sites. As such, predicted effects on 24-hour mean NO_x concentrations are not considered to be significant, in accordance with the stated criteria.

Nitrogen Deposition

5.4.8 Predicted annual nitrogen PC deposition rates at the receptor locations are summarised in Table 29.

Table 29 Predicted Annual Nitrogen Deposition Rates

Receptor	Predicted Annual PC Nitrogen Deposition Rate (kgN/ha/yr)				
	2015	2016	2017	2018	2019
E1	0.0004	0.0005	0.0003	0.0005	0.0004
E2	0.0005	0.0005	0.0003	0.0005	0.0004
E3	0.0006	0.0005	0.0004	0.0006	0.0006
E4	0.0005	0.0005	0.0003	0.0004	0.0005
E5	0.0179	0.0220	0.0228	0.0204	0.0209
E6	0.0331	0.0383	0.0392	0.0372	0.0397
E7	0.0311	0.0302	0.0338	0.0309	0.0332
E8	0.0156	0.0157	0.0176	0.0138	0.0167

5.4.9 Maximum predicted annual nitrogen deposition rates at the receptor locations are summarised in Table 30.

Table 30 Maximum Predicted Annual Nitrogen Deposition Rates

Receptor		Maximum Predicted Annual Nitrogen Deposition Rate (kgN/ha/yr)		Proportion of EQS (%)			
		PC	PEC	Low EQS		High EQS	
				PC	PEC	PC	PEC
E1	Humber Estuary SAC, SPA, SSSI and Ramsar Site	0.001	18.201	0.0	227.5	0.0	182.0
E2		0.001	16.001	0.0	200.0	0.0	160.0
E3		0.001	15.801	0.0	197.5	0.0	158.0
E4		0.001	15.801	0.0	197.5	0.0	158.0
E5	North Cave Wetlands LWS	0.023	41.043	0.3	410.4	0.1	205.2

Receptor		Maximum Predicted Annual Nitrogen Deposition Rate (kgN/ha/yr)		Proportion of EQS (%)			
		PC	PEC	Low EQS		High EQS	
				PC	PEC	PC	PEC
E6		0.040	41.060	0.4	410.6	0.2	205.3
E7		0.034	41.054	0.4	410.5	0.2	205.3
E8	North Cave Fish Pond LWS	0.018	23.818	0.2	238.2	0.1	158.8

5.4.10 As shown in Table 30, PCs were below 1% of the low EQSs at the Humber Estuary SAC, SPA, SSSI and Ramsar Site and below 100% of the EQS at all local sites. As such, predicted effects on annual nitrogen deposition are not considered to be significant, in accordance with the stated criteria.

5.4.11 It should be noted that PECs are predicted to exceed the relevant EQSs at the receptor locations as a base condition in the majority of cases.

Acid Deposition

5.4.12 Predicted annual acid PC deposition rates are summarised in Table 31.

Table 31 Predicted Annual PC Acid Deposition Rates

Receptor		Predicted Annual PC Acid Deposition Rate (keq/ha/yr)				
		2015	2016	2017	2018	2019
E1	Humber Estuary SAC, SPA, SSSI and Ramsar Site	0.0000	0.0000	0.0000	0.0000	0.0000
E2		0.0000	0.0000	0.0000	0.0000	0.0000
E3		0.0000	0.0000	0.0000	0.0000	0.0000
E4		0.0000	0.0000	0.0000	0.0000	0.0000
E5	North Cave Wetlands LWS	0.0013	0.0016	0.0016	0.0015	0.0015
E6		0.0024	0.0027	0.0028	0.0027	0.0028
E7		0.0022	0.0022	0.0024	0.0022	0.0024

Receptor		Predicted Annual PC Acid Deposition Rate (keq/ha/yr)				
		2015	2016	2017	2018	2019
E8	North Cave Fish Pond LWS	0.0011	0.0011	0.0013	0.0010	0.0012

5.4.13 Maximum predicted annual acid deposition rates at the receptor locations are summarised in Table 32.

Table 32 Maximum Predicted Annual Acid Deposition Rates

Receptor		Maximum Predicted Annual Acid PC Deposition Rate (keq/ha/yr)	Proportion of EQS (%)
E1	Humber Estuary SAC, SPA, SSSI and Ramsar Site	0.0000	0.01
E2		0.0000	0.01
E3		0.0000	0.01
E4		0.0000	0.00
E5	North Cave Wetlands LWS	0.0016	0.00
E6		0.0028	0.00
E7		0.0024	0.00
E8	North Cave Fish Pond LWS	0.0013	0.00

5.4.14 As shown in Table 32, PCs were below 1% at the Humber Estuary SAC, SPA, SSSI and Ramsar Site and below 100% at all local sites. As such, predicted effects on annual acid deposition are not considered to be significant, in accordance with the stated criteria.

6.0 CONCLUSION

6.1.1 Redmore Environmental Ltd was commissioned by H&C Consultancy Ltd to undertake an Air Quality Assessment in support of the Brocklesby Ltd waste processing facility, Crosslands Lane, North Cave.

6.1.2 The facility has the potential to cause air quality impacts as a result of atmospheric emissions from proposed combustion processes. As such, an Air Quality Assessment was required in order to determine baseline conditions and quantity potential effects.

6.1.3 Dispersion modelling was undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the plant. The results indicated that impacts on pollutant concentrations were not predicted to be significant at any human receptor location in the vicinity of the site.

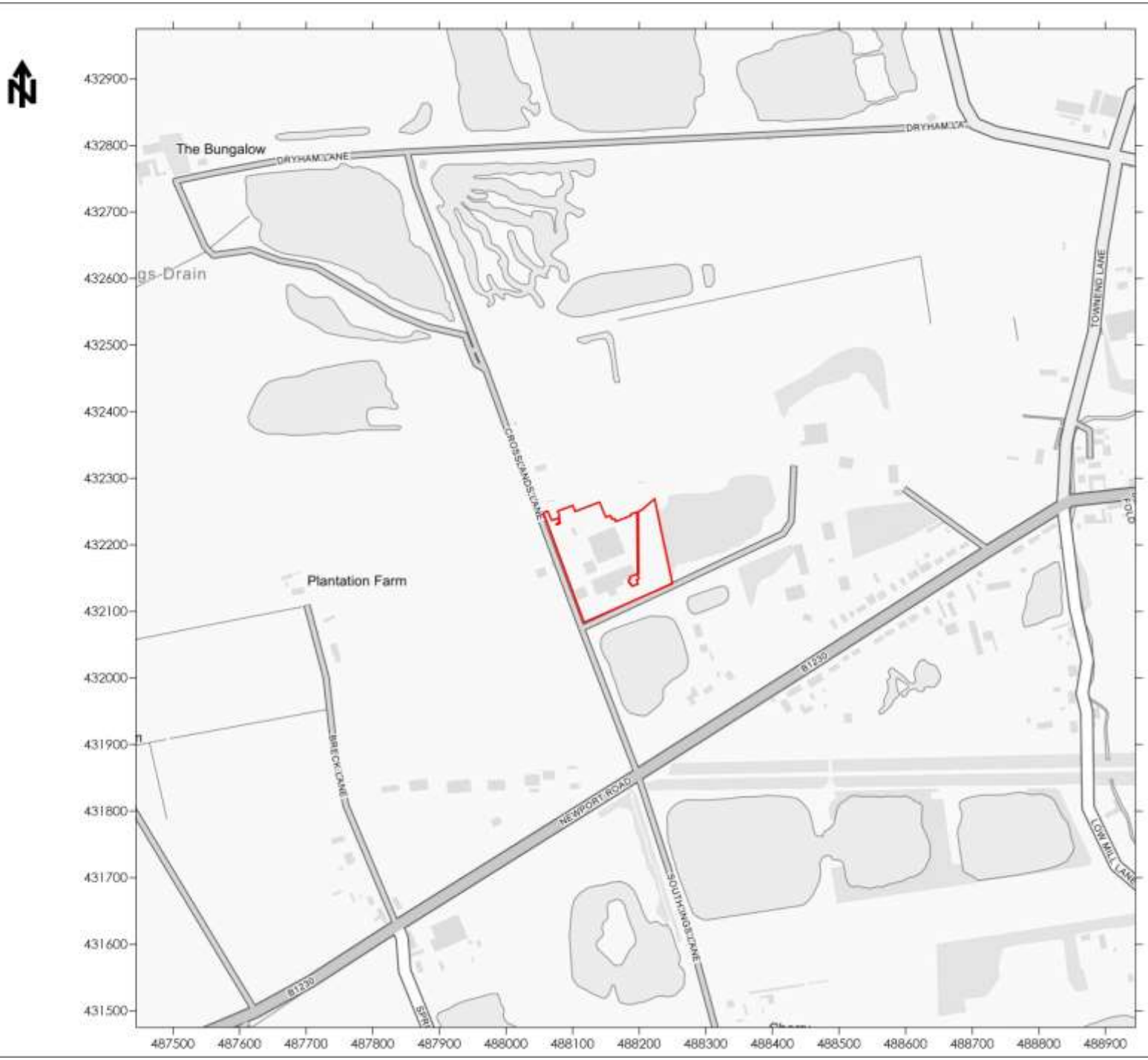
6.1.4 Impacts were also predicted at relevant ecological sites. The results indicated that emissions from the plant would not significantly affect existing conditions at any designation.

6.1.5 Impacts were predicted based on a worst-case assessment scenario of the plant constantly emitting the maximum anticipated concentration of each pollutant throughout an entire year. As such, predicted pollutant concentrations are likely to overestimate actual impacts.

7.0 ABBREVIATIONS

AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
CERC	Cambridge Environmental Research Consultants
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
ELV	Emission Limit Value
ERYC	East Riding of Yorkshire Council
EQS	Environmental Quality Standard
LAQM	Local Air Quality Management
LWS	Local Wildlife Site
MAGIC	Multi-Agency Geographic Information for the Countryside
NGR	National Grid Reference
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PC	Process Contribution
PEC	Predicted Environmental Concentration
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
z_0	Roughness length
%ile	Percentile

Figures



Legend

Site Boundary

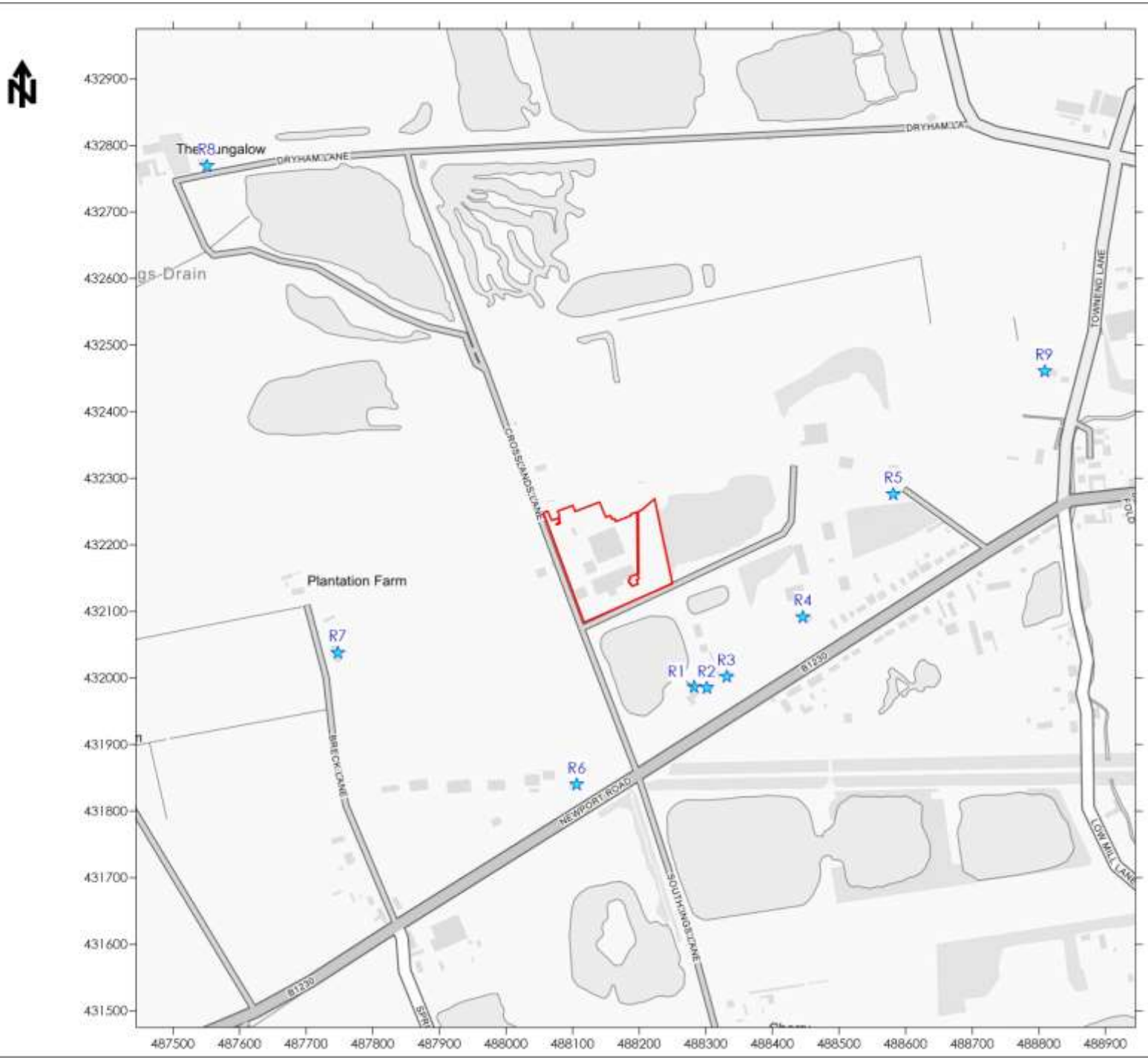
Title
Figure 1 - Site Location

Project
Air Quality Assessment
Brocklesby Waste Processing Facility,
North Cave

Project Reference
4089

Client
H&C Consultancy Ltd

Redmore environmental
www.red-env.co.uk | 0161 7060075



Legend

Site Boundary

Human Receptor

Title
Figure 2 - Sensitive Human Receptor Locations

Project
Air Quality Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference
4089

Client
H&C Consultancy Ltd

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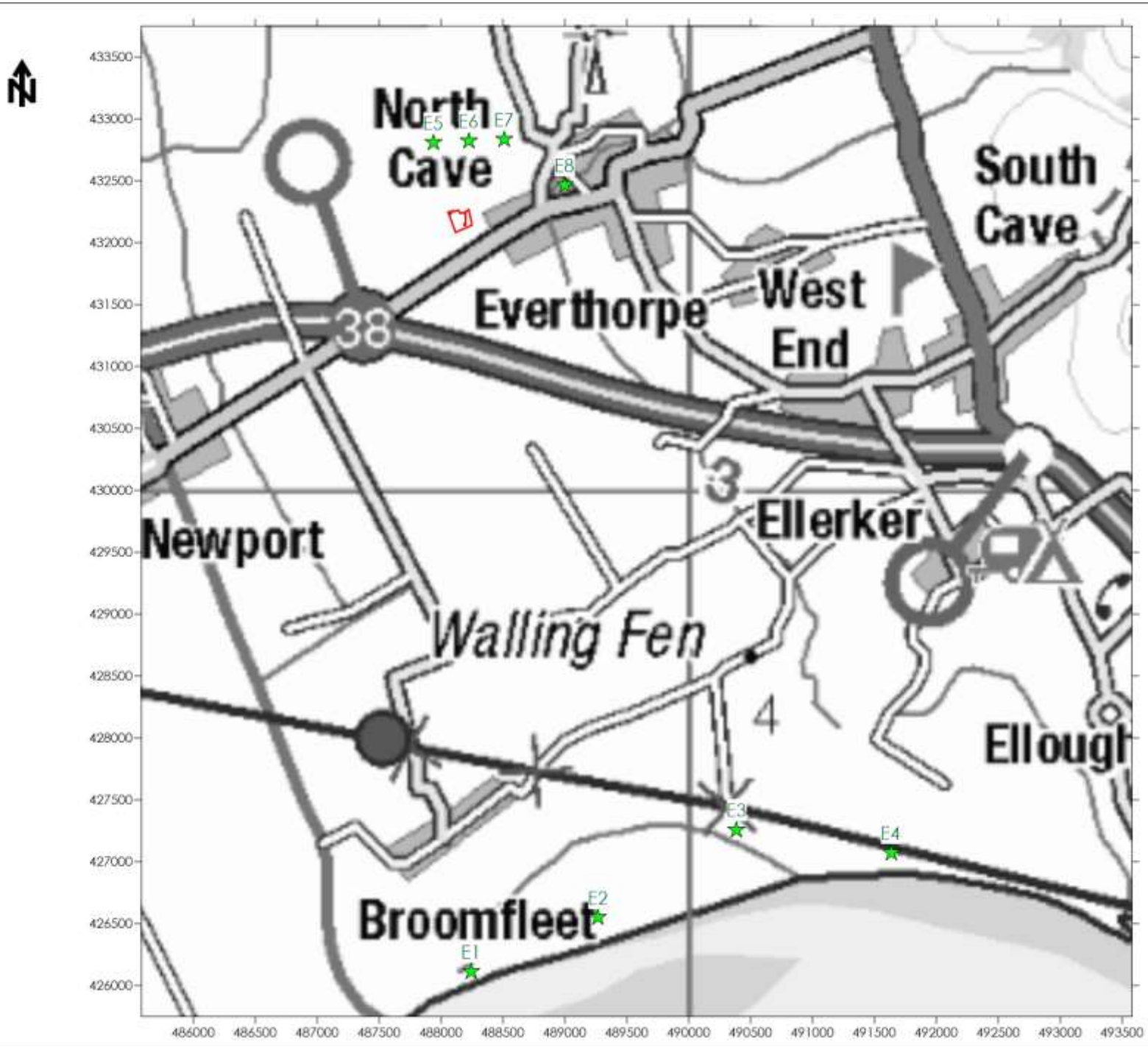

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Site Boundary

Ecological Receptor

Title
Figure 3 - Sensitive Ecological Receptor Locations

Project
Air Quality Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference
4089

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Legend

- Site Boundary
- Building
- ADMS-5 Output Grid
- Point Source

Title
Figure 4 - ADMS-5 Inputs

Project
Air Quality Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference
4089

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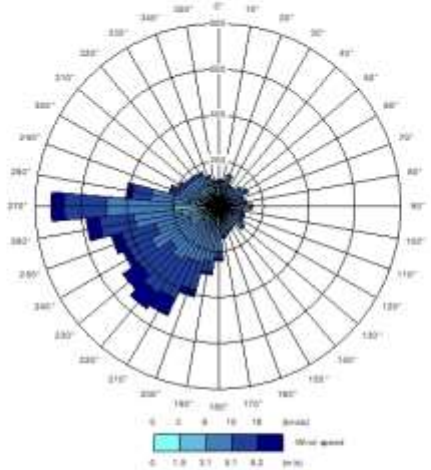
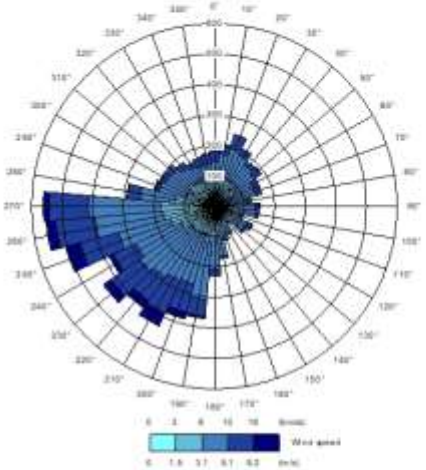
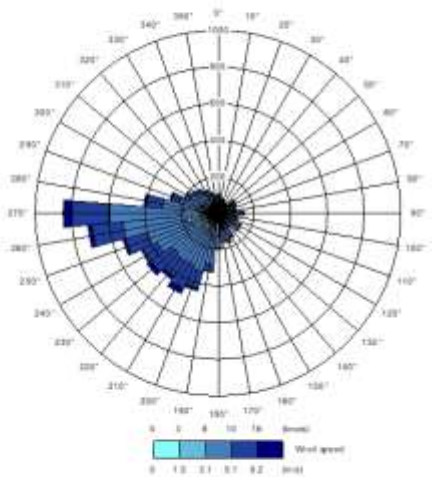


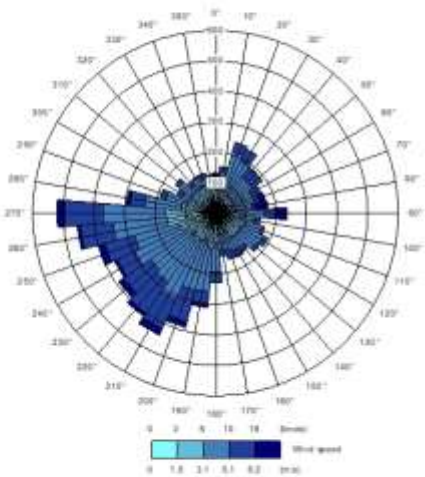
2015 Meteorological Data



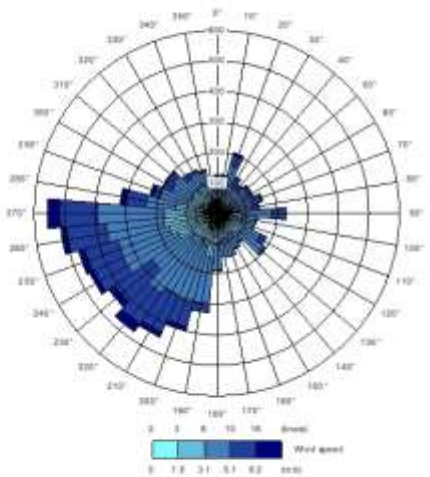
2016 Meteorological Data



2017 Meteorological Data



2018 Meteorological Data



2019 Meteorological Data

Legend

Title
Figure 5 - Wind Roses of 2015 to 2019 Leconfield Meteorological Data

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Legend

Site Boundary

Predicted Annual Mean NO_2 Concentration (µg/m³)

22
20
18
16
14
12
10

Title
Figure 6 - Predicted Annual Mean NO_2 Concentrations (µg/m³)
2018 Meteorological Data

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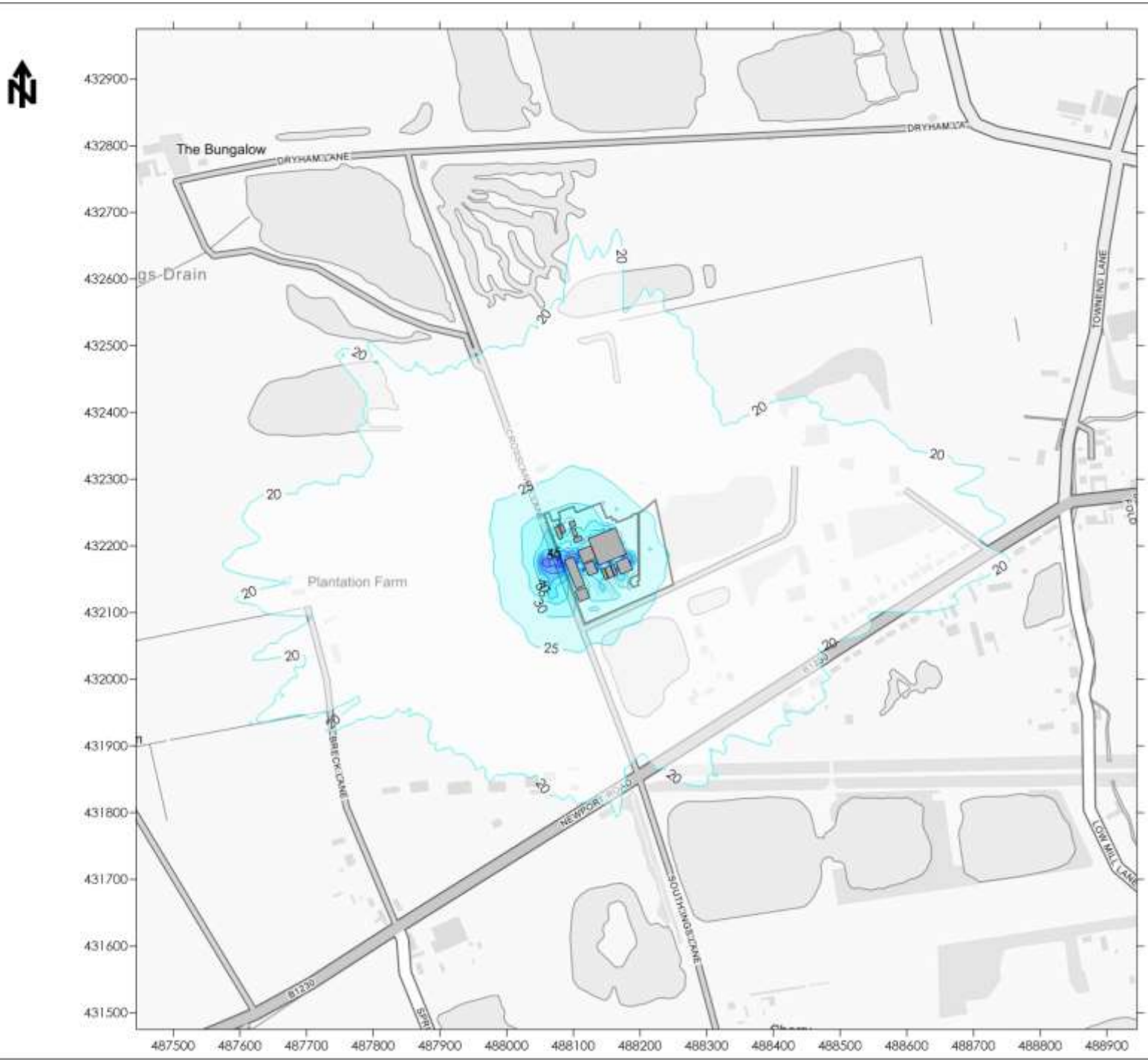

Legend

Site Boundary

Predicted 99.8th %ile 1-hour Mean NO_2 Concentration (µg/m³)

60
55
50
45
40
35
30
25
20

Title
Figure 7 - Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations (µg/m³) 2018 Meteorological Data

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Site Boundary

8-hour Rolling Mean CO Concentration (µg/m³)

550
545
540
535
530
525
520
515
510
505
500

Title
Figure 8 - Predicted 8-hour Rolling Mean CO Concentrations (µg/m³) 2017 Meteorological Data

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