Air Quality Assessment

Marsh Lane, Boston

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Executive Summary

Redmore Environmental Ltd was commissioned by EHS Projects Ltd to undertake an Air Quality Assessment of atmospheric emissions from Greencore, Marsh Lane, Riverside Industrial Estate, Boston.

Atmospheric emissions from boilers at the site have the potential to cause air quality impacts at sensitive locations. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and quantify potential effects.

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

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1.0 INTRODUCTION

1.1.1 Redmore Environmental Ltd was commissioned by EHS Projects Ltd to undertake an Air Quality Assessment of atmospheric emissions from Greencore, Marsh Lane, Riverside Industrial Estate, Boston.

1.1.2 The site is located on land off Marsh Lane, Riverside Industrial Estate, Boston, PE21 7PJ, at National Grid Reference (NGR): 533165, 342470. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.1.3 The following boilers are installed at the site:

- A1: Hot Water Boiler 1 - Lochinvar 550kW;
- A2: Hot Water Boiler 1 - Lochinvar 550kW;
- A3: Hot Water Boiler 3 - Lochinvar 550kW;
- A8: Steam Boiler 1 - 400kW; and,
- A9: Steam Boiler 2 - 400kW.

1.1.4 It should be noted that only Hot Water Boiler 1 and 2 operate under normal conditions, with Hot Water Boiler 3 reserved as an emergency back-up.

1.1.5 Emissions from the facility have the potential to affect pollution levels at sensitive locations. An Air Quality Assessment was therefore undertaken to define baseline conditions, assess potential impacts and consider the significance of any predicted effects. The results are summarised in the following report.

2.0 LEGISLATION AND POLICY

2.1 Legislation

2.1.1 The Air Quality Standards Regulations (2010) and subsequent amendments 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 ($PM_{2.5}$);
- Benzene; and,
- Carbon monoxide (CO).

2.1.2 Air quality target values were also provided for several additional pollutants. It should be noted that the AQLV for $PM_{2.5}$ stated in the Air Quality Standards Regulations (2010) was amended in the Environment (Miscellaneous Amendments) (EU Exit) Regulations (2020).

2.1.3 The Air Quality Strategy (AQS) was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and published in July 2007[1]. The document contains standards, objectives and measures for improving ambient air quality, including a number of Air Quality Objectives (AQOs). These 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/m³)	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 running mean

2.2 Local Air Quality Management

2.2.1 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 LA 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 England through the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. The operations undertaken at the plant are included within the Regulations and as such the facility is required to comply with an Environmental Permit issued by the Environment Agency (EA). This 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 this 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 identified for the relevant designations considered within the assessment in Section 3.5.

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), Boston Borough Council (BBC) has undertaken Review and Assessment of air quality within their area of jurisdiction. This process has indicated that annual mean concentrations of NO_2 are above the AQO within the borough. Two AQMAs have therefore been declared. The closest of these to the development is described as follows:

> "Haven Bridge AQMA: The AQMA follows the A16 trunk road through the centre of town encompassing properties on either side. It extends from Queen Street roundabout through to the intersection of John Adams Way and Main Ridge East."

3.2.2 The site is located approximately 1.1km south-west of the AQMA. It is considered unlikely that the facility would cause significant air quality impacts over a distance of this magnitude. As such, the designation was not considered further in the context of the assessment.

3.2.3 BBC has concluded that concentrations of all other pollutants considered within the AQS are currently below the relevant AQOs. As such, no further AQMAs have been designated.

3.3 Air Quality Monitoring

3.3.1 Monitoring of pollutant concentrations is undertaken by BBC 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		Classification	Monitored NO_2 Concentration (μg/m³)		
			2018	2019	2020
18	ATS Roundabout, London Road, Boston	Roadside	-	33.8	28.3
19	Opposite 55 London Road, Boston	Roadside	-	27.5	22.9

3.3.2 As shown in Table 3, annual mean NO_2 concentrations were below the AQO at both monitors during recent years. Reference should be made to Figure 2 for a map of the survey locations.

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: 533500, 342500. 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	11.00
CO	262

3.4.2 It should be noted that concentrations of NO_2 are predicted for 2022 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 http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html.

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.

Sensitive 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.

Table 5 Sensitive Human Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Residential - Marsh Avenue	533036.1	342451.3
R2	Residential - Marsh Avenue	533031.6	342482.0
R3	Residential - Marsh Avenue	533023.9	342520.4
R4	Residential - Marsh Avenue	533016.9	342560.7
R5	Residential - Marsh Avenue	533011.1	342608.1
R6	Residential - The Old Dairy	533035.4	342405.2
R7	Residential - The Old Dairy	533044.4	342378.4
R8	Residential - The Old Dairy	533052.7	342344.5
R9	Residential - The Old Dairy	533091.7	342283.7
R10	Residential - Wyberton Low Road	533170.5	342128.8
R11	Residential - Heron Way	533446.2	341999.6
R12	Residential - Heron Way	533496.1	341998.5
R13	Residential - Marsh Lane	533521.5	342104.7
R14	Residential - Marsh Lane	533658.0	342467.4
R15	Residential - Rectory Road	533585.3	343090.0

3.5.3 Reference should be made to Figure 3 for a map of the sensitive human receptor locations.

Ecological Receptors

3.5.4 Atmospheric emissions from the facility 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 designations. A Nature and Heritage Conservation Screening Report provided by the EA indicated the following sites should be considered within the assessment:

- The Wash & North Norfolk Coast Special Area of Conservation (SAC);
- The Wash Special Protection Area (SPA);
- The Wash Ramsar;
- Havenside Local Nature Reserve (LNR);
- Havenside Local Wildlife Site (LWS);
- Botolphs Park Pond LWS;
- Tytton Lane West Pits, West LWS;
- Tytton Lane West Pits, East LWS; and,
- Slippery Gowt Sea Bank South Forty Foot Drain LWS.

3.5.5 For the purpose of the modelling assessment discrete receptors were placed at the closest points 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		NGR (m)	
		X	Y
E1	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	534289.0	334982.2
E2	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	535301.0	337372.7
E3	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	535931.6	339954.0

Receptor		NGR (m)	
		X	Y
E4	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	539906.1	341376.6
E5	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	541138.1	343429.9
E6	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	541944.7	344647.1
E7	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	542560.7	345747.1
E8	Havenside LNR and LWS	534007.2	342707.2
E9	Havenside LNR and LWS	534219.2	342444.7
E10	Havenside LNR and LWS	534444.6	342148.5
E11	Havenside LNR and LWS	534582.6	341987.0
E12	Havenside LNR and LWS	534771.1	341704.3
E13	Botolphs Park Pond LWS	531646.0	342013.7
E14	Tytton Lane West Pits, West LWS	531640.3	341883.8
E15	Tytton Lane West Pits, East LWS	531792.9	341889.4
E16	Slippery Gowt Sea Bank South Forty Foot Drain LWS	534364.2	341929.0

3.5.6 Predicted pollutant concentrations were compared with the critical levels shown in Table 2.

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 information provided by the APIS[4] website, publicly available ecological appraisals and the MAGIC web-based interactive mapping service[5] was undertaken in order to identify the most relevant habitat and associated critical load for each designation considered within the assessment.

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

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

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

Table 7 Critical Loads for Nitrogen Deposition

Ecological Designation	Feature	Relevant Nitrogen Critical Load Class	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	Coastal lagoons (H1150)	Pioneer, low-mid, mid-upper saltmarshes	20	30
Havenside LNR and LWS	Coastal and Floodplain Grazing Marsh	Low and medium altitude hay meadows	20	30
Botolphs Park Pond LWS	Freshwater	Ponds	-	-
Tytton Lane West Pits, West LWS	Freshwater	Ponds	-	-
Tytton Lane West Pits, East LWS	Freshwater	Ponds	-	-
Slippery Gowt Sea Bank South Forty Foot Drain LWS	Coastal and Floodplain Grazing Marsh	Low and medium altitude hay meadows	20	30

3.5.9 The relevant acid deposition critical loads are presented in Table 8.

Table 8 Critical Loads for Acid Deposition

Ecological Designation	Feature	Acidity Class	Acid Critical Load (keq/ha/yr)		
			CLMinN	CLMaxS	CLMaxN
The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	Coastal lagoons (H1150)	Not Sensitive	-	-	-
Havenside LNR and LWS	Coastal and Floodplain Grazing Marsh	Not Sensitive	-	-	-
Botolphs Park Pond LWS	Freshwater	Ponds	-	-	-
Tytton Lane West Pits, West LWS	Freshwater	Ponds	-	-	-
Tytton Lane West Pits, East LWS	Freshwater	Ponds	-	-	-

Ecological Designation	Feature	Acidity Class	Acid Critical Load (keq/ha/yr)		
			CLMinN	CLMaxS	CLMaxN
Slippery Gowt Sea Bank South Forty Foot Drain LWS	Coastal and Floodplain Grazing Marsh	Not Sensitive	-	-	-

4.0 METHODOLOGY

4.1 Introduction

4.1.1 Combustion emissions 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 parameters considered in the modelling assessment for human receptors are summarised in Table 9.

Table 9 Human Receptor Assessment Parameters

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 9 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 parameters considered for ecological receptors in the modelling assessment are summarised in Table 10.

Table 10 Ecological Receptor Assessment Parameters

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 levels were summarised in the following formats:

- Process contribution (PC) - Predicted pollutant level as a result of emissions from the facility; and,
- Predicted environmental concentration (PEC) - Total predicted pollutant level as a result of emissions from the facility and existing background conditions.

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: 532410, 341715 to 533910, 343215. One Cartesian grid with a resolution of 10m was used within the model.

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 source parameters used in the assessment is provided in Table 11. These were obtained from Stack Emissions Monitoring reports produced by Atesta in 2022 and supplemented by information provided by the Applicant.

Table 11 Source Parameters

Parameter	Unit	A1	A2	A8	A9
Stack position	NGR	533130.1, 342446.1	533129.8, 342448.4	533130.1, 342470.9	533129.7, 342475.1
Stack height	m	7.1	7.1	8.3	6.9
Stack diameter	m	0.2	0.2	0.3	0.3
Exhaust gas temperature	°C	54.1	57.9	191.0	239.0
Exhaust gas oxygen (O_2) content	%	6.3	17.5	9.8	15.3
Exhaust gas flow rate	m^3/hr	299	565	958	1,371
Exhaust gas flow rate (dry, 3% O_2)	Nm^3/hr	191	84.5	328	217
Exhaust gas efflux velocity	m/s	3.5	6.5	3.8	5.4

4.5.2 Reference should be made to Figure 4 for a map of the source locations.

4.6 Emissions

4.6.1 Emission concentrations for NO_2 were obtained from the Medium Combustion Plant Directive and values for CO from the Stack Emissions Monitoring reports. These are shown in Table 12.

Table 12 Pollutant Emission Concentrations

Emission Point	Emission Concentration (mg/Nm^3)	
	NO_x	CO
A1	250	37.6
A2	250	156.0
A8	250	6.8
A9	250	156

4.6.2 The pollutant mass emission rates for use in the assessment were derived from the concentrations shown in Table 12 and the flow rates shown in Table 11. These are summarised in Table 13.

Table 13 Pollutant Mass Emission Rates

Emission Point	Emission Rate (g/s)	
	NO_x	CO
A1	0.0133	0.0020
A2	0.0059	0.0038
A8	0.0228	0.0006
A9	0.0151	0.0094

4.6.3 Emissions were assumed to be constant, with the boilers in operation 24-hours per day, 365-days per year. This is considered to be a worst-case assessment scenario as plant shutdown or periods of reduced work load are not reflected in the modelled emissions.

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.

4.8.2 Analysis of the site layout indicated that one structure should be included within the model in order to take account of effects on pollutant dispersion. Building input geometries are shown in Table 14.

Table 14 Building Geometries

Building	NGR (m)		Height (m)	Length (m)	Width (m)	Angle (°)
	X	Y				
Building 1	533154.8	342488.0	8.2	147.5	48.7	173.2

4.9 Meteorological Data

4.9.1 Meteorological data used in the assessment was taken from Coningsby meteorological station over the period 1st January 2017 to 31st December 2021 (inclusive). This observation station is located at NGR: 522784, 356757, which is approximately 17.6km north-west 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 the utilised meteorological records.

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

4.10 Roughness Length

4.10.1 A roughness length (z_0) of 0.5m was used to describe the modelling extents. This value of z_0 is considered appropriate for the morphology of the area and is suggested within ADMS-5 as being suitable for 'parkland, open suburbia'.

4.10.2 A z_0 of 0.2m was used to describe the meteorological site. This z_0 is considered appropriate for the morphology of the area and is suggested within ADMS-5 as being suitable for 'agricultural areas (min)'.

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. This value is considered appropriate for the nature of the area and is suggested within ADMS-5 as being suitable for 'small towns <50,000'.

4.11.2 A minimum Monin-Obukhov length of 1m was used to describe the meteorological site. This value is considered appropriate for the nature of the area and is suggested within ADMS-5 as being suitable for 'rural areas'.

4.12 Terrain Data

4.12.1 Inclusion of terrain data is recommended within the ADMS-5 user guide[7] if the gradient within a modelling extent varies by more than 10% (1 in 10). Assessment of changes in elevation throughout the modelling extents using Google Earth indicated the surrounding area is generally flat with a maximum gradient of 3.3%. As such, terrain data was not included within the model.

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

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7 ADMS-5 User Guide, CERC, 2016.

Assessment for Emissions to Air AQTAG 06'[8]. 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 15.

Table 15 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 15 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 16.

Table 16 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 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 S+N deposition)/CLmaxN) x 100

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

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

4.15 Background Concentrations

4.15.1 Review of existing data was undertaken in Section 3.0 in order to identify suitable background values for use in the assessment. This indicated the closest monitors are positioned at roadside locations and results are unlikely to be representative of conditions at the identified receptors. As such, the background concentrations predicted by DEFRA, as shown in Table 4, were utilised to represent existing concentrations 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.

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

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.

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

- 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 SACs, SPAs and Ramsar sites 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 PCs at LNRs and LWSs 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 for protected conservation areas; and,
- The long-term PC is less than 100% of the long-term environmental standard for protected conservation areas.

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.

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

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;
- 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 an observation station local to the site to account for inter-year variability. The assessment was based on the worst-case year 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 provided by the Applicant or based on recent monitoring reports. As such, input parameters are considered to be representative of normal operating conditions;
- Emission rates - Emission concentrations for NO_2 were obtained from the Medium Combustion Plant Directive and those for CO were obtained from recent monitoring reports. As such, these are considered to be representative of anticipated emissions from the installation;
- Background concentrations - Baseline pollutant levels were obtained from the APIS and DEFRA websites;
- 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 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 17.

Table 17 Maximum Predicted Pollutant Concentrations

Pollutant	Averaging Period	EQS (μg/m^3)	PC (μg/m^3)	PC Proportion of EQS (%)	PEC (μg/m^3)	PEC Proportion of EQS (%)
NO_2	Annual	40	13.51	33.8	24.51	61.3
	99.8th %ile 1-hour	200	31.68	15.8	53.68	26.8
CO	Rolling 8-hour	10,000	38.79	0.4	562.79	5.6

5.2.2 The results shown in Table 17 can be summarised as follows:

- There were no predicted exceedences of any EQS at any location for any pollutant or averaging period of interest;
- Impacts on annual mean NO_2 concentrations are considered to be potentially significant as the maximum PCs are above 1% of the EQS;
- Impacts on 1-hour mean NO_2 concentrations are considered to be potentially significant as the maximum PC is above 10% of the EQS; and,
- Impacts on 8-hour mean CO concentrations are not considered to be significant as the maximum PC is below 10% of the EQS.

5.2.3 As maximum impacts on 8-hour mean CO concentrations were not classified as significant, results at individual sensitive human receptor locations were not considered further.

5.3 Sensitive Human Receptors

5.3.1 Predicted annual mean NO_2 PECs, inclusive of background levels, at the sensitive human receptor locations identified in Table 5 are summarised in Table 18.

Table 18 Predicted Annual Mean NO_2 Concentrations

Receptor		Predicted Annual Mean NO_2 PEC (μg/m³)				
		2017	2018	2019	2020	2021
R1	Residential - Marsh Avenue	11.66	12.05	11.96	11.89	11.98
R2	Residential - Marsh Avenue	11.62	12.00	11.91	11.72	11.86
R3	Residential - Marsh Avenue	11.44	11.64	11.60	11.43	11.53
R4	Residential - Marsh Avenue	11.31	11.39	11.39	11.28	11.31
R5	Residential - Marsh Avenue	11.23	11.26	11.27	11.20	11.20
R6	Residential - The Old Dairy	11.38	11.66	11.55	11.63	11.68
R7	Residential - The Old Dairy	11.26	11.55	11.39	11.51	11.58
R8	Residential - The Old Dairy	11.17	11.44	11.27	11.37	11.45
R9	Residential - The Old Dairy	11.10	11.29	11.18	11.20	11.28
R10	Residential - Wyberton Low Road	11.05	11.09	11.07	11.07	11.11
R11	Residential - Heron Way	11.06	11.06	11.07	11.05	11.07
R12	Residential - Heron Way	11.06	11.06	11.06	11.05	11.07
R13	Residential - Marsh Lane	11.08	11.06	11.08	11.06	11.08
R14	Residential - Marsh Lane	11.11	11.07	11.08	11.08	11.08
R15	Residential - Rectory Road	11.06	11.05	11.06	11.05	11.05

5.3.2 As indicated in Table 18, predicted NO_2 concentrations were below the annual mean EQS of 40μg/m³ at all sensitive receptor locations for all meteorological data sets. Reference should be made to Figure 6 for a graphical representation of predicted concentrations throughout the assessment extents.

5.3.3 Maximum predicted annual mean NO_2 concentrations at the receptor locations are summarised in Table 19.

Table 19 Maximum Predicted Annual Mean NO_2 Concentrations

Receptor		Maximum Predicted Annual Mean NO_2 Concentration (µg/m^3)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Residential - Marsh Avenue	1.05	12.05	2.6	30.1
R2	Residential - Marsh Avenue	1.00	12.00	2.5	30.0
R3	Residential - Marsh Avenue	0.64	11.64	1.6	29.1
R4	Residential - Marsh Avenue	0.39	11.39	1.0	28.5
R5	Residential - Marsh Avenue	0.27	11.27	0.7	28.2
R6	Residential - The Old Dairy	0.68	11.68	1.7	29.2
R7	Residential - The Old Dairy	0.58	11.58	1.4	28.9
R8	Residential - The Old Dairy	0.45	11.45	1.1	28.6
R9	Residential - The Old Dairy	0.29	11.29	0.7	28.2
R10	Residential - Wyberton Low Road	0.11	11.11	0.3	27.8
R11	Residential - Heron Way	0.07	11.07	0.2	27.7
R12	Residential - Heron Way	0.07	11.07	0.2	27.7
R13	Residential - Marsh Lane	0.08	11.08	0.2	27.7
R14	Residential - Marsh Lane	0.11	11.11	0.3	27.8
R15	Residential - Rectory Road	0.06	11.06	0.2	27.7

5.3.4 As indicated in Table 19, predicted PECs were below 70% of the EQS at all receptors. As such, effects on annual mean NO_2 concentrations are not considered to be significant.

5.3.5 Predicted 99.8th %ile 1-hour mean NO_2 PECs, inclusive of background levels, are summarised in Table 20.

Table 20 Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations

Receptor		Predicted 99.8th %ile 1-hour Mean NO_2 PEC (µg/m^3)				
		2017	2018	2019	2020	2021
R1	Residential - Marsh Avenue	56.38	56.81	56.57	56.80	56.64

Receptor		Predicted 99.8th %ile 1-hour Mean NO_2 PEC (μg/m³)				
		2017	2018	2019	2020	2021
R2	Residential - Marsh Avenue	28.14	28.27	28.44	28.30	28.30
R3	Residential - Marsh Avenue	28.20	28.40	28.46	28.29	28.40
R4	Residential - Marsh Avenue	27.49	27.45	27.73	27.59	27.61
R5	Residential - Marsh Avenue	26.40	26.22	26.47	26.82	26.48
R6	Residential - The Old Dairy	25.37	25.38	25.62	25.47	25.37
R7	Residential - The Old Dairy	26.80	27.50	27.55	27.25	27.65
R8	Residential - The Old Dairy	26.31	26.99	26.85	26.37	27.43
R9	Residential - The Old Dairy	26.00	26.39	26.27	26.15	26.60
R10	Residential - Wyberton Low Road	24.80	25.64	25.42	25.63	25.40
R11	Residential - Heron Way	23.44	23.82	23.82	23.80	23.76
R12	Residential - Heron Way	23.24	23.34	23.29	23.13	23.30
R13	Residential - Marsh Lane	23.28	23.28	23.28	23.15	23.26
R14	Residential - Marsh Lane	23.46	23.51	23.53	23.67	23.67
R15	Residential - Rectory Road	23.53	23.39	23.56	23.61	23.47

5.3.6 As indicated in Table 20, 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.

5.3.7 Maximum predicted 99.8th %ile 1-hour mean NO_2 concentrations at the receptor locations are summarised in Table 21. Reference should be made to Figure 7 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 21 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 - Marsh Avenue	6.44	28.44	3.2	3.6

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		
R2	Residential - Marsh Avenue	6.46	28.46	3.2	3.6
R3	Residential - Marsh Avenue	5.73	27.73	2.9	3.2
R4	Residential - Marsh Avenue	4.82	26.82	2.4	2.7
R5	Residential - Marsh Avenue	3.62	25.62	1.8	2.0
R6	Residential - The Old Dairy	5.65	27.65	2.8	3.2
R7	Residential - The Old Dairy	5.43	27.43	2.7	3.0
R8	Residential - The Old Dairy	4.60	26.60	2.3	2.6
R9	Residential - The Old Dairy	3.64	25.64	1.8	2.0
R10	Residential - Wyberton Low Road	1.82	23.82	0.9	1.0
R11	Residential - Heron Way	1.34	23.34	0.7	0.8
R12	Residential - Heron Way	1.28	23.28	0.6	0.7
R13	Residential - Marsh Lane	1.67	23.67	0.8	0.9
R14	Residential - Marsh Lane	1.61	23.61	0.8	0.9
R15	Residential - Rectory Road	1.25	23.25	0.6	0.7

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

5.3.8 As indicated in Table 21, the PC proportion of the EQS was below 10% at all sensitive locations. As such, predicted effects on 1-hour mean NO_2 concentrations are not considered to be significant in accordance with the stated criteria.

5.4 Ecological Receptors

5.4.1 Predicted concentrations and deposition rates of each pollutant at the sensitive ecological receptor locations identified in Table 6 are summarised in the following Sections.

Nitrogen Oxides

5.4.2 Predicted annual mean NO_x PECs at the receptor locations are summarised in Table 22.

Table 22 Predicted Annual Mean NO_x PECs

Receptor		Predicted Annual Mean NO_x PEC (µg/m³)				
		2017	2018	2019	2020	2021
E1	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	10.64	10.64	10.64	10.64	10.64
E2	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	10.81	10.81	10.81	10.81	10.81
E3	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	11.09	11.08	11.09	11.08	11.09
E4	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	10.99	10.99	10.99	10.99	10.99
E5	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	10.99	10.99	10.99	10.99	10.99
E6	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	10.89	10.89	10.89	10.89	10.89
E7	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	11.05	11.05	11.05	11.05	11.05
E8	Havenside LNR and LWS	15.23	15.21	15.22	15.23	15.22
E9	Havenside LNR and LWS	15.21	15.19	15.19	15.19	15.19
E10	Havenside LNR and LWS	15.19	15.18	15.18	15.18	15.18
E11	Havenside LNR and LWS	13.00	12.99	13.00	13.00	13.00
E12	Havenside LNR and LWS	13.00	12.99	12.99	12.99	12.99
E13	Botolphs Park Pond LWS	12.22	12.23	12.23	12.23	12.23
E14	Tytton Lane West Pits, West LWS	11.90	11.90	11.91	11.90	11.91
E15	Tytton Lane West Pits, East LWS	11.90	11.91	11.91	11.91	11.91
E16	Slippery Gowt Sea Bank South Forty Foot Drain LWS	13.01	13.00	13.00	13.00	13.00

5.4.3 Maximum predicted annual mean NO_x concentrations at the receptors are summarised in Table 23.

Table 23 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	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00	10.64	0.0	35.5
E2	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00	10.81	0.0	36.0
E3	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.01	11.09	0.0	37.0
E4	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00	10.99	0.0	36.6
E5	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00	10.99	0.0	36.6
E6	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00	10.89	0.0	36.3
E7	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00	11.05	0.0	36.8
E8	Havenside LNR and LWS	0.07	15.23	0.2	50.8
E9	Havenside LNR and LWS	0.05	15.21	0.2	50.7
E10	Havenside LNR and LWS	0.03	15.19	0.1	50.6
E11	Havenside LNR and LWS	0.02	13.00	0.1	43.3
E12	Havenside LNR and LWS	0.02	13.00	0.1	43.3
E13	Botolphs Park Pond LWS	0.02	12.23	0.1	40.8
E14	Tytton Lane West Pits, West LWS	0.02	11.91	0.1	39.7
E15	Tytton Lane West Pits, East LWS	0.02	11.91	0.1	39.7
E16	Slippery Gowt Sea Bank South Forty Foot Drain LWS	0.03	13.01	0.1	43.4

5.4.4 As shown in Table 23, PCs were below 1% of the EQS at all SAC, SPA and Ramsar receptors and below 100% of the EQS at all LNR and LWS receptors. As such, predicted impacts 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 24.

Table 24 Predicted 24-hour Mean NO_x Concentrations

Receptor		Predicted 24-hour Mean NO_x PEC (µg/m³)				
		2017	2018	2019	2020	2021
E1	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	21.30	21.32	21.31	21.33	21.31
E2	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	21.65	21.67	21.68	21.67	21.67
E3	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	22.24	22.25	22.22	22.29	22.25
E4	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	22.01	22.01	22.01	22.03	22.01
E5	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	22.01	22.01	22.00	22.01	22.05
E6	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	21.80	21.80	21.80	21.81	21.83
E7	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	22.12	22.12	22.12	22.12	22.14
E8	Havenside LNR and LWS	30.94	30.90	30.80	31.04	31.72
E9	Havenside LNR and LWS	30.79	30.63	30.70	30.80	31.07
E10	Havenside LNR and LWS	30.58	30.54	30.70	30.80	30.54
E11	Havenside LNR and LWS	26.20	26.13	26.23	26.33	26.21
E12	Havenside LNR and LWS	26.16	26.16	26.13	26.27	26.20
E13	Botolphs Park Pond LWS	24.65	25.21	24.63	24.63	24.66
E14	Tytton Lane West Pits, West LWS	23.98	24.44	23.96	23.98	24.02
E15	Tytton Lane West Pits, East LWS	23.99	24.47	23.99	24.00	24.07
E16	Slippery Gowt Sea Bank South Forty Foot Drain LWS	26.27	26.25	26.23	26.38	26.30

5.4.6 Maximum predicted 24-hour mean NO_x concentrations at the receptor locations are summarised in Table 25.

Table 25 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	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.05	21.33	0.1	28.4
E2	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.06	21.68	0.1	28.9
E3	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.13	22.29	0.2	29.7
E4	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.05	22.03	0.1	29.4
E5	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.07	22.05	0.1	29.4
E6	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.05	21.83	0.1	29.1
E7	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.04	22.14	0.1	29.5
E8	Havenside LNR and LWS	1.40	31.72	1.9	42.3
E9	Havenside LNR and LWS	0.75	31.07	1.0	41.4
E10	Havenside LNR and LWS	0.48	30.80	0.6	41.1
E11	Havenside LNR and LWS	0.37	26.33	0.5	35.1
E12	Havenside LNR and LWS	0.31	26.27	0.4	35.0
E13	Botolphs Park Pond LWS	0.79	25.21	1.0	33.6
E14	Tytton Lane West Pits, West LWS	0.66	24.44	0.9	32.6
E15	Tytton Lane West Pits, East LWS	0.69	24.47	0.9	32.6
E16	Slippery Gowt Sea Bank South Forty Foot Drain LWS	0.42	26.38	0.6	35.2

5.4.7 As shown in Table 25, PCs were below 10% of the EQS at all SAC, SPA and Ramsar receptors and below 100% of the EQS at LNR and LWS receptors. As such, predicted impacts 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 26.

Table 26 Predicted Annual Nitrogen Deposition Rates

Receptor		Predicted Annual PC Nitrogen Deposition Rate (kgN/ha/yr)				
		2017	2018	2019	2020	2021
E1	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0001	0.0001	0.0001	0.0001	0.0002
E2	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	0.0003	0.0002	0.0002	0.0003
E3	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0005	0.0004	0.0005	0.0004	0.0006
E4	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	0.0001	0.0002	0.0002	0.0002
E5	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	0.0002	0.0002	0.0002	0.0002
E6	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	0.0001	0.0002	0.0002	0.0002
E7	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	0.0001	0.0001	0.0002	0.0002
E8	Havenside LNR and LWS	0.0073	0.0055	0.0057	0.0066	0.0061
E9	Havenside LNR and LWS	0.0046	0.0030	0.0035	0.0035	0.0034
E10	Havenside LNR and LWS	0.0028	0.0017	0.0023	0.0019	0.0022
E11	Havenside LNR and LWS	0.0023	0.0014	0.0019	0.0015	0.0018
E12	Havenside LNR and LWS	0.0018	0.0011	0.0015	0.0012	0.0015
E13	Botolphs Park Pond LWS	0.0012	0.0017	0.0019	0.0016	0.0018
E14	Tytton Lane West Pits, West LWS	0.0010	0.0014	0.0016	0.0014	0.0015
E15	Tytton Lane West Pits, East LWS	0.0011	0.0016	0.0017	0.0016	0.0017
E16	Slippery Gowt Sea Bank South Forty Foot Drain LWS	0.0028	0.0017	0.0024	0.0019	0.0023

5.4.9 Maximum predicted annual nitrogen deposition rates at the receptor locations are summarised in Table 27.

Table 27 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	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	19.6002	0.0	98.0	0.0	65.3
E2	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0003	19.5003	0.0	97.5	0.0	65.0
E3	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0006	19.5006	0.0	97.5	0.0	65.0
E4	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	19.0002	0.0	95.0	0.0	63.3
E5	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	19.0002	0.0	95.0	0.0	63.3
E6	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	18.3002	0.0	91.5	0.0	61.0
E7	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.0002	18.1002	0.0	90.5	0.0	60.3
E8	Havenside LNR and LWS	0.0073	19.6073	0.0	98.0	0.0	65.4
E9	Havenside LNR and LWS	0.0046	19.6046	0.0	98.0	0.0	65.3
E10	Havenside LNR and LWS	0.0028	19.6028	0.0	98.0	0.0	65.3
E11	Havenside LNR and LWS	0.0023	19.6023	0.0	98.0	0.0	65.3
E12	Havenside LNR and LWS	0.0018	19.6018	0.0	98.0	0.0	65.3
E13	Botolphs Park Pond LWS	0.0019	19.6019	-	-	-	-

Receptor		Maximum Predicted Annual Nitrogen Deposition Rate (kgN/ha/yr)		Proportion of EQS (%)			
		PC	PEC	Low EQS		High EQS	
				PC	PEC	PC	PEC
E14	Tytton Lane West Pits, West LWS	0.0016	19.6016	-	-	-	-
E15	Tytton Lane West Pits, East LWS	0.0017	19.6017	-	-	-	-
E16	Slippery Gowt Sea Bank South Forty Foot Drain LWS	0.0028	19.6028	0.0	98.0	0.0	65.3

5.4.10 As shown in Table 27, PCs were below 1% of the EQS at all SAC, SPA and Ramsar receptors and below 100% of the EQS at LNR and LWS receptors. As such, predicted impacts on nitrogen deposition are not considered to be significant in accordance with the stated criteria.

Acid Deposition

5.4.11 Predicted annual acid PC deposition rates are summarised in Table 28.

Table 28 Predicted Annual PC Acid Deposition Rates

Receptor		Predicted Annual PC Acid Deposition Rate (keq/ha/yr)				
		2017	2018	2019	2020	2021
E1	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00001	0.00001	0.00001	0.00001	0.00001
E2	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00001	0.00002	0.00002	0.00001	0.00002
E3	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00004	0.00003	0.00004	0.00003	0.00004
E4	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00002	0.00001	0.00001	0.00001	0.00001
E5	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00001	0.00001	0.00001	0.00001	0.00001

Receptor		Predicted Annual PC Acid Deposition Rate (keq/ha/yr)				
		2017	2018	2019	2020	2021
E6	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00001	0.00001	0.00001	0.00001	0.00001
E7	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00001	0.00001	0.00001	0.00001	0.00001
E8	Havenside LNR and LWS	0.00052	0.00039	0.00041	0.00047	0.00044
E9	Havenside LNR and LWS	0.00033	0.00021	0.00025	0.00025	0.00024
E10	Havenside LNR and LWS	0.00020	0.00012	0.00017	0.00013	0.00016
E11	Havenside LNR and LWS	0.00016	0.00010	0.00014	0.00011	0.00013
E12	Havenside LNR and LWS	0.00012	0.00008	0.00011	0.00009	0.00011
E13	Botolphs Park Pond LWS	0.00008	0.00012	0.00013	0.00012	0.00013
E14	Tytton Lane West Pits, West LWS	0.00007	0.00010	0.00011	0.00010	0.00011
E15	Tytton Lane West Pits, East LWS	0.00008	0.00011	0.00012	0.00012	0.00012
E16	Slippery Gowt Sea Bank South Forty Foot Drain LWS	0.00020	0.00012	0.00017	0.00014	0.00017

5.4.12 Maximum predicted annual acid deposition rates at the receptor locations are summarised in Table 29.

Table 29 Predicted Annual Acid Deposition Rates

Receptor		Maximum Predicted Annual Acid PC Deposition Rate (keq/ha/yr)	Proportion of EQS (%)
E1	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00001	-
E2	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00002	-
E3	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00004	-
E4	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00002	-

Receptor		Maximum Predicted Annual Acid PC Deposition Rate (keq/ha/yr)	Proportion of EQS (%)
E5	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00001	-
E6	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00001	-
E7	The Wash & North Norfolk Coast SAC, The Wash SPA and The Wash Ramsar	0.00001	-
E8	Havenside LNR and LWS	0.00052	-
E9	Havenside LNR and LWS	0.00033	-
E10	Havenside LNR and LWS	0.00020	-
E11	Havenside LNR and LWS	0.00016	-
E12	Havenside LNR and LWS	0.00012	-
E13	Botolphs Park Pond LWS	0.00013	-
E14	Tytton Lane West Pits, West LWS	0.00011	-
E15	Tytton Lane West Pits, East LWS	0.00012	-
E16	Slippery Gowt Sea Bank South Forty Foot Drain LWS	0.00020	-

5.5 Sensitivity Analysis

5.5.1 In accordance with EA requirements[13], a sensitivity analysis was undertaken to assess variation in model results associated with a number of individual inputs.

5.5.2 Review of the maximum concentrations for each pollutant and averaging period predicted by the original model, as shown in Table 17, indicated that annual mean NO_2 concentrations were closest to exceeding the relevant EQS. The sensitivity analysis therefore focused on the influence of different scenarios on annual mean NO_2 concentrations.

5.5.3 The maximum annual mean NO_2 PEC was predicted using the 2018 meteorological data set. All scenarios were therefore run for this assessment year.

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

5.5.4 A total of 10 scenarios were considered, each with a single change to modelling inputs. The following parameters were considered in the analysis:

- Building inputs;
- z_0 used to describe the dispersion site;
- MO used to describe the dispersion site;
- Grid spacing; and,
- Source of meteorological data.

5.5.5 A description of the modelling inputs for each scenario is provided in Table 30, with the varied input shown in **bold**. The original model, which is referred to as version 1 (V1), is included for completeness and ease of comparison.

Table 30 Sensitivity Analysis Scenarios

Scenario	Buildings	Z_0 Used to Describe Dispersion Site (m)	MO Length Used to Describe Dispersion Site (m)	Grid Spacing (m)	Met. Station Data
V1	On	0.5	10	10	Coningsby
V2	**Off**	0.5	10	10	Coningsby
V3	On	**1.0**	10	10	Coningsby
V4	On	**0.3**	10	10	Coningsby
V5	On	0.5	**1**	10	Coningsby
V6	On	0.5	**30**	10	Coningsby
V7	On	0.5	10	**5**	Coningsby
V8	On	0.5	10	**20**	Coningsby
V9	On	0.5	10	10	**Cranwell**
V10	On	0.5	10	10	**Wittering**

5.5.6 The maximum predicted annual mean NO_2 concentration at any location from each scenario is summarised in Table 31. The maximum impacts are shown in **bold**.

Table 31 Maximum Predicted Concentrations - Sensitivity Analysis

Scenario	EQS (μg/m³)	PC (μg/m³)	PC Proportion of EQS (%)	PEC (μg/m³)	PEC Proportion of EQS (%)
V1	40	13.51	33.8	24.51	61.3
V2	40	1.88	4.7	12.88	32.2
V3	40	13.04	32.6	24.04	60.1
V4	40	14.32	35.8	25.32	63.3
V5	40	13.18	32.9	24.18	60.4
V6	**40**	**14.44**	**36.1**	**25.44**	**63.6**
V7	40	13.51	33.8	24.51	61.3
V8	40	12.73	31.8	23.73	59.3
V9	40	11.84	29.6	22.84	57.1
V10	40	12.42	31.0	23.42	58.5

5.5.7 As shown in Table 31, the maximum concentration was predicted with the input parameters of model version 6. The PEC proportion of the EQS was 63.61%. As the PEC remains below the EQS, the findings of the sensitivity analysis support the conclusion that impacts as a result of the facility are not considered to be significant.

6.0 CONCLUSION

6.1.1 Redmore Environmental Ltd was commissioned by EHS Projects Ltd to undertake an Air Quality Assessment of atmospheric emissions from Greencore, Marsh Lane, Riverside Industrial Estate, Boston.

6.1.2 Atmospheric emissions from the site have the potential to cause air quality impacts at sensitive locations. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and quantify potential effects.

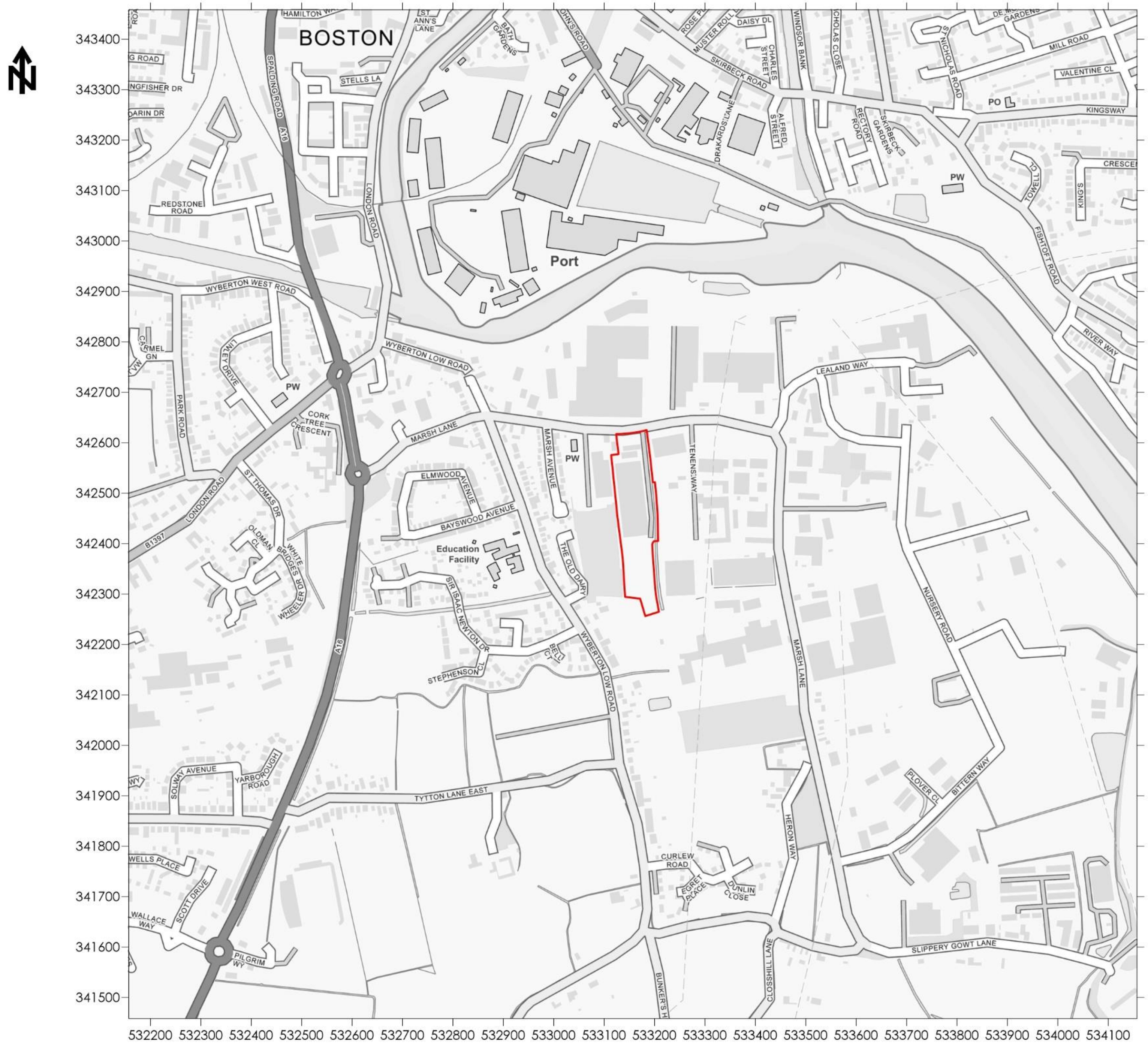
6.1.3 Dispersion modelling of NO_x and CO emissions was undertaken using ADMS-5. Impacts at sensitive receptors were quantified and the results compared with the relevant EQSs and significance criteria.

6.1.4 Impacts on pollutant levels at all human and ecological receptors were not predicted to be significant.

7.0 ABBREVIATIONS

APIS	Air Pollution Information System
AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
BBC	Boston Borough Council
CERC	Cambridge Environmental Research Consultants
CO	Carbon monoxide
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EQS	Environmental Quality Standard
LAQM	Local Air Quality Management
LNR	Local Nature Reserve
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
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5µm
SAC	Special Area of Conservation
SPA	Special Protection Area
z_0	Roughness length
%ile	Percentile

Figures



Legend

Site Boundary

Title

Figure 1 - Site Location

Project

Air Quality Assessment
Marsh Lane, Boston

Project Reference

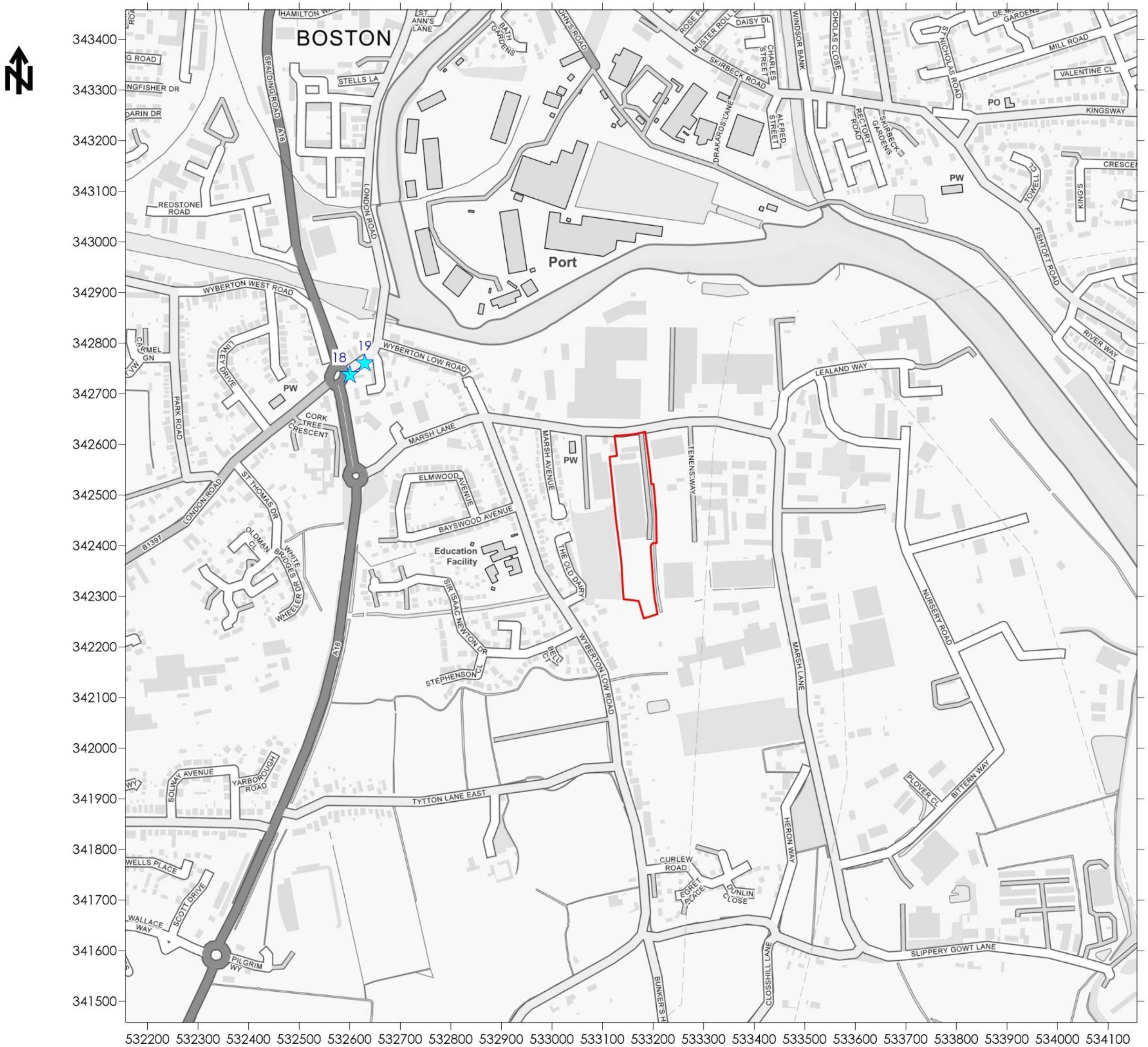
6237

Client

EHS Projects Ltd

Redmore environmental

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



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Site Boundary

Monitor

Title

Figure 2 - Monitoring Locations

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Site Boundary

Receptor

Title

Figure 3 - Sensitive Human Receptors

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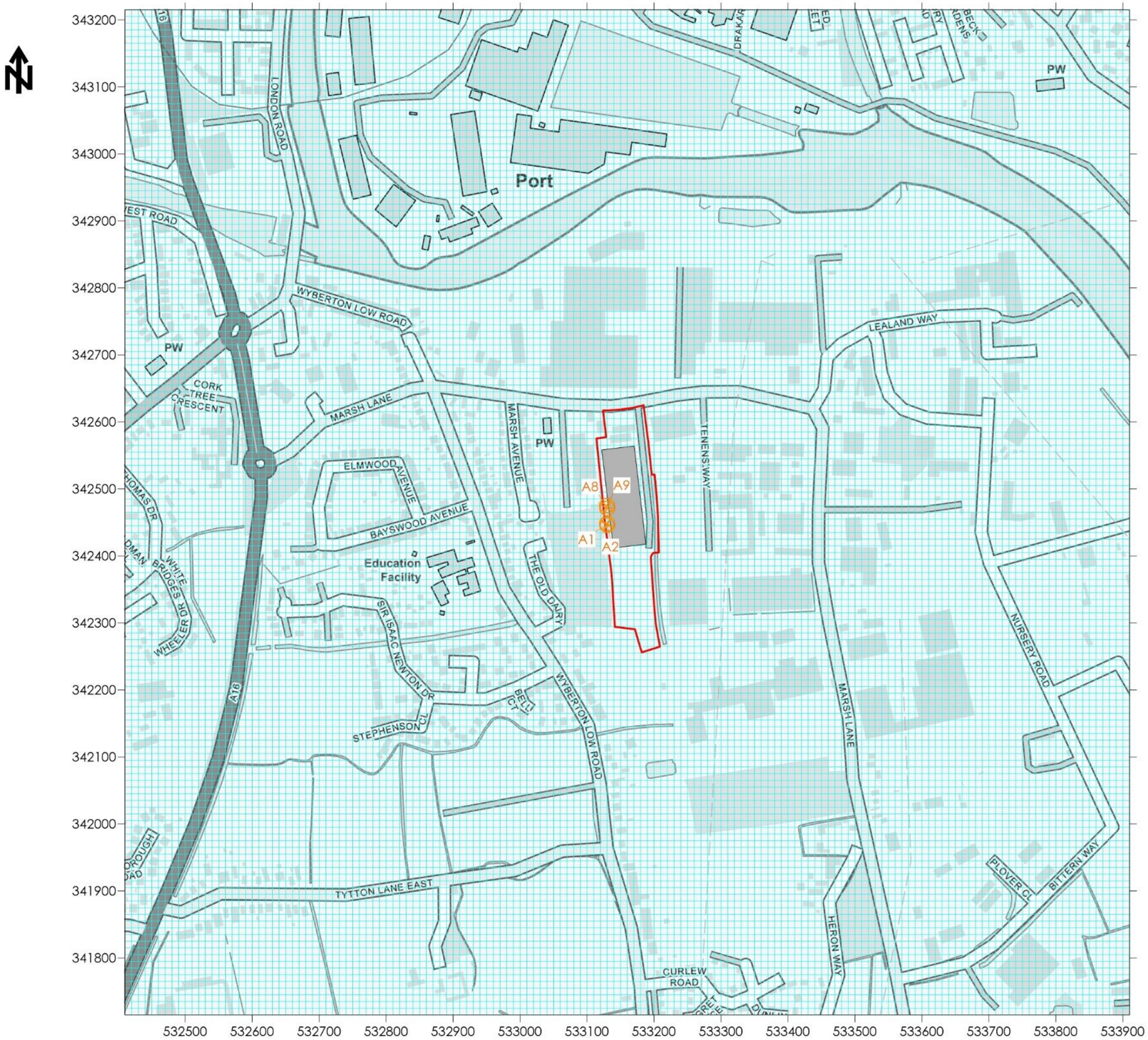

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Site Boundary

Stack

Assessment Grid

Building

Title
Figure 4 - ADMS-5 Inputs

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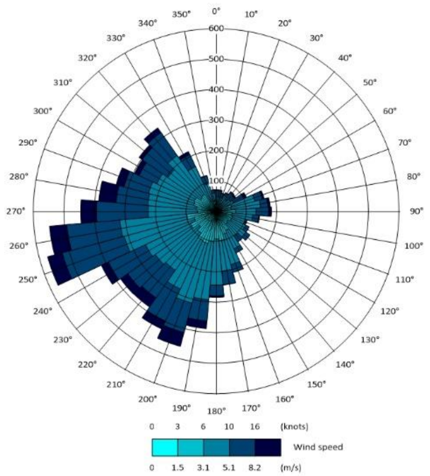
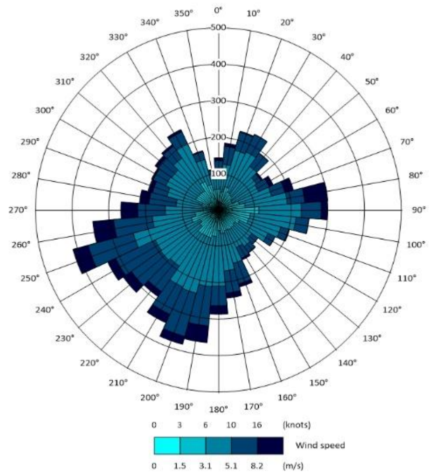
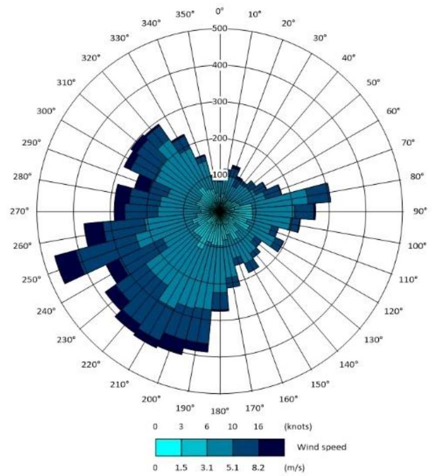


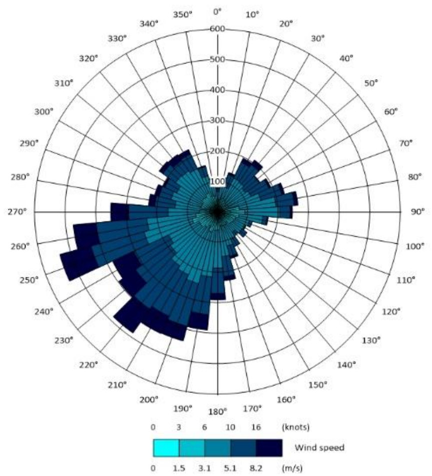
2017 Meteorological Data



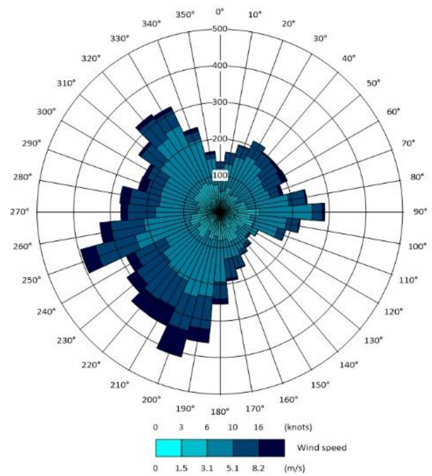
2018 Meteorological Data



2019 Meteorological Data



2020 Meteorological Data



2021 Meteorological Data

Legend

Title

Figure 5 - Wind Roses of 2017 to 2021 Coningsby Meteorological Station Data

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

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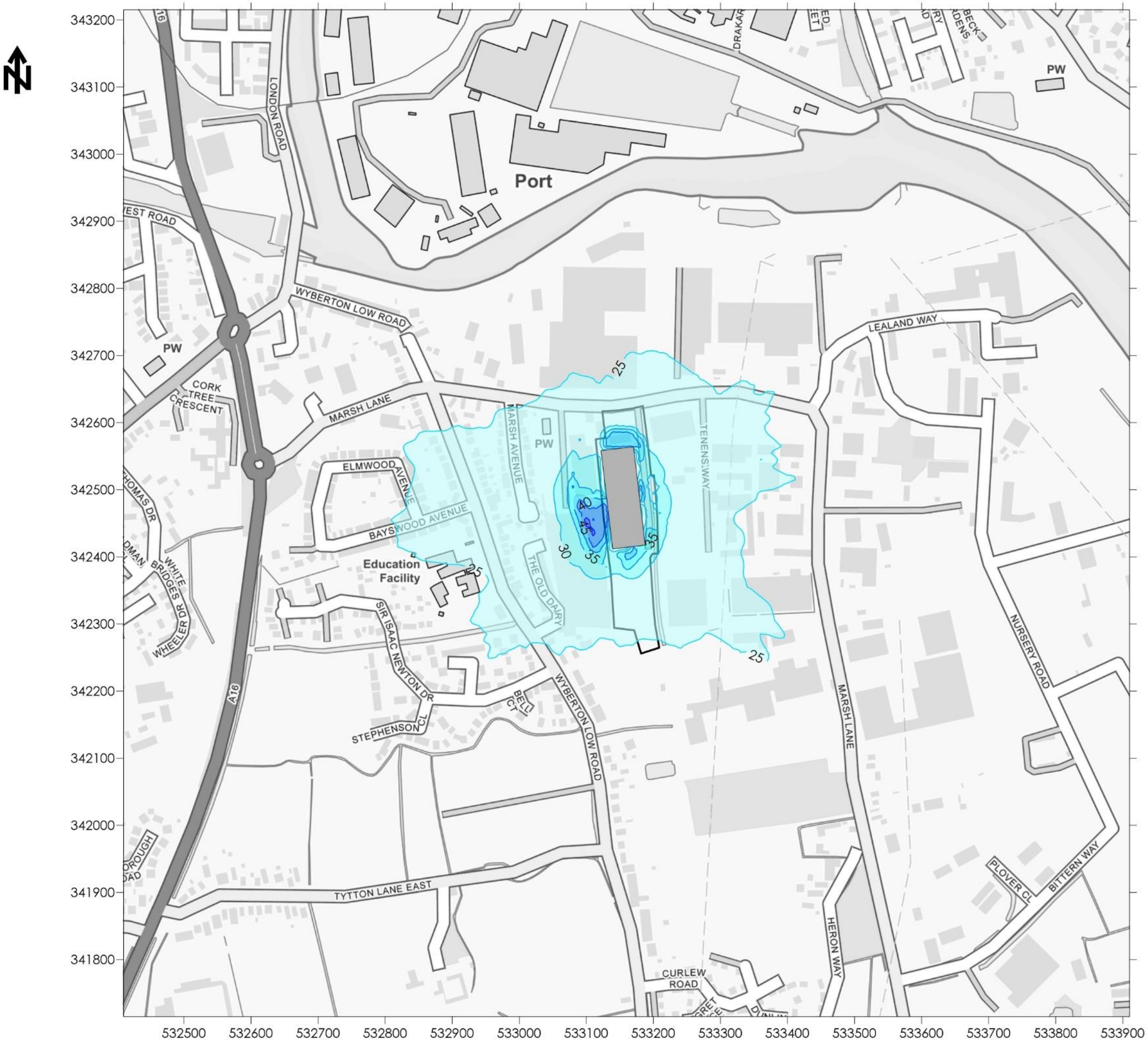

Legend

Site Boundary

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

50
45
40
35
30
25

Title

Figure 7 - Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations (µg/m³)
2021 Meteorological Data

Project

Air Quality Assessment
Marsh Lane, Boston

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