APPENDIX 7A: Air Quality Dispersion Modelling Assessment

EP SHB

South Humber Bank Energy Centre

South Marsh Road, Stallingborough, DN41 8BZ

Appendix 7A: Air Quality Dispersion Modelling Assessment

Applicant: EP SHB Limited
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GLOSSARY

Abbreviation	Description
As	Arsenic
CO	Carbon monoxide
Cd	Cadmium
Co	Cobalt
Cu	Copper
Cr	Chromium
Dioxins and Furans	Polychlorinated dibenzo-para-dioxins and polychlorinated dibenzo furans
DMRB	Design Manual for Roads and Bridges
EfW	Energy from Waste
ELV	Emission Limit Values
Env Std	Environmental Standard
HCl	Hydrogen chloride
HF	Hydrogen fluoride
HHRA	Human Health Risk Assessment
Hg	Mercury
IAQM	Institute of Air Quality Management
IED	Industrial Emissions Directive
IPPC	Integrated Pollution Prevention and Control
Mn	Manganese
NH_3	Ammonia
Ni	Nickel
NO_X	Oxides of Nitrogen
NO_2	Nitrogen dioxide
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PC	Process Contribution
PEC	Predicted Environmental Concentration (PC + Background)
PM_{10}	Particulate Matter of 10 µm diameter
$PM_{2.5}$	Particulate Matter of 5 µm diameter
WID	Waste Incineration Directive
SAC	Special Area of Conservation
SO_2	Sulphur Dioxide
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
Sb	Antimony
TI	Thallium
TOC	Total Organic Carbon
V	Vanadium
VOC	Volatile organic compounds

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APPENDICES

1.0 OVERVIEW

1.1 This air quality dispersion modelling report quantifies the potential impact of the operation of the South Humber Bank Energy Centre near Grimsby, North East Lincolnshire.

1.2 Emissions to air from the Proposed Development have the potential to adversely affect human health and sensitive ecosystems. This report details the results of a dispersion modelling assessment of emissions from the process and associated road traffic.

1.3 The magnitude of air quality impacts at sensitive human receptors are quantified for pollutants emitted from the main stacks of the Proposed Development. The impact of emissions on sensitive ecological receptors is considered in the context of relevant critical loads or critical levels for designated nature sites.

1.4 In addition to the topics listed above, the dispersion modelling exercise has provided inputs to the separate Human Health Risk Assessment (HHRA) that quantifies the potential long term impacts of emissions from the operation of the process on human health.

1.5 The assessment considers emissions from the Proposed Development during normal operational conditions. Non routine emissions, such as those which may occur during the commissioning process or other short-term events typically only occur on an infrequent basis, are detected by the process control system and rectified within a short time period and are tightly regulated by the Environment Agency (EA). For this reason, no detailed consideration of impacts associated with non-routine or emergency events is included within this assessment.

2.0 SCOPE

Combustion Plant Emissions

2.1 The assessment considers the impact of process emissions on local air quality, under normal operating conditions, from the main stacks serving the combustion process. The assessment considers impacts in the year in which the Proposed Development is due to commence operation, 2022.

2.2 The dispersion of emissions is predicted using the dispersion model ADMS 5. The results are presented in both tabular format and as contours of predicted ground level process contributions overlaid on mapping of the surrounding area.

2.3 Emissions to air from Energy from Waste facilities are currently governed by Directive 2010/75/EU, the Industrial Emissions Directive (IED) (European Commission, 2010), which was transposed into UK law in February 2013 (The Environmental Permitting (England and Wales) (Amendment) Regulations 2013). This Directive amends, consolidates and replaces seven Directives on pollution from industrial installations, including those relating to Integrated Pollution Prevention and Control (IPPC) and the Waste Incineration Directive (WID) (European Commission, 2000).

2.4 The IED contains measures relating to the control of emissions, including emissions to air, for example by specifying minimum standards for gas temperature and the residence time of combustion gases within the combustion chamber. The Directive sets limits on emissions of a wide range of air pollutants, and requires operators to monitor and report emissions to air as well as to other environmental media. The emissions limits to air for waste treatment facilities set out within the IED have been carried over from the Waste Incineration Directive.

2.5 The Proposed Development would be regulated under the Industrial Emissions Directive (IED) and in accordance with the waste incineration BREF. The revised draft of the waste incineration BREF (version D1) was published in May 2017. The BAT conclusions within the draft BREF are only draft at this stage, it is however envisaged that these conclusions will largely apply in the final version of the revised BREF, expected to be published at the end of 2018. At this point, the recommendations of the BREF will become enforceable through Environmental Permits and the EA would set specific limits on the Environmental Permit based on the BAT-associated emission levels (BAT-AELs).

2.6 The design of the flue gas treatment system needs to be fully compliant with current legislation, meeting the requirements of BAT as well as the EA guidance on risk assessment for environmental permits and the IED. In accordance with Article 15, paragraph 2, of the IED, the emission limits that the plant will be designed to meet are based on BAT. BAT-AELs are included in the BAT Reference document on Waste Incineration currently under review and these have been applied in the air impact assessment accordingly.

2.7 The pollutants considered within this assessment from the main stacks are:

- Oxides of nitrogen (NO_X), as Nitrogen Dioxide (NO_2);
- Particulate matter (as PM_{10} and $PM_{2.5}$ size fractions);
- Carbon monoxide (CO);
- Sulphur dioxide (SO_2);
- Hydrogen chloride (HCl);

- Hydrogen fluoride (HF);
- Twelve metals (cadmium (Cd), thallium (Tl), mercury (Hg), antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V));
- Polycyclic Aromatic Hydrocarbons (PAH), as benzo[a]pyrene.
- Polychlorinated dibenzo-para-dioxins and polychlorinated dibenzo furans (referred to as dioxins and furans); and
- Volatile organic compounds (VOCs), as benzene.

2.8 Emissions of ammonia (NH_3) from the Proposed Development have been included in the assessment, due to potential effects on sensitive ecosystems, directly through increased atmospheric concentrations, and indirectly as a component of acid and nutrient nitrogen deposition.

2.9 A comparison has been made between predicted model output concentrations, and short-term and long-term Environmental Standards (Env Std), set out within Environmental Agency Environmental Permit Guidance (EA, 2018).

2.10 The assessment also includes a consideration of visible plume generation.

Cumulative Impacts

2.11 Cumulative impacts from existing sources of pollution in the area have been accounted for in the adoption of site-specific background pollutant concentrations from archive sources and a programme of project-specific baseline air quality monitoring in close proximity to the Proposed Development. It is recognised, however, that there is a potential impact on local air quality from emission sources which were not present at the time of the survey but which have been consented.

2.12 The list of consented schemes included in the cumulative impact assessment include Vireol Plc Energy Centre (DM/0329/18/FUL), North Beck Energy Centre (DM/0026/18/FUL), Energy Pyrolysis Plant (DM/0333/17/FUL) and VPI Immingham (PA/SCO/2017/3).

2.13 The assessment of cumulative impacts is contained in Annex D of this report.

Sources of Information

2.14 The information used within this assessment includes:

- data on emissions to atmosphere from the process, taken from limit values in the IED and, BAT-AEL values or, (where not included in the IED or BAT-AEL) data provided by EP SHB Ltd.;
- details on the development layout provided by EP SHB Ltd.;
- Ordnance Survey mapping;
- Ordnance Survey terrain data;
- baseline air quality data from project specific monitoring, published sources and Local Authorities; and
- meteorological data supplied by ADM Ltd

Assessment Structure

2.15 The remainder of this assessment report is set out as follows:

- Section 3: Assessment criteria.
- Section 4: Assessment methodology.
- Section 5: Summary of baseline air quality.
- Section 6: Dispersion modelling results.
- Section 7: Assessment limitations and assumptions
- Section 8: Conclusions

3.0 ASSESSMENT CRITERIA

Environmental Standards for the Protection of Human Health

3.1 The Environmental Standards criteria for the protection of human health, against which impacts from the Proposed Development and road traffic are evaluated, are set out within Table 7A.1. The criteria are taken from the Environmental Benchmarks contained within EA's air emissions risk assessment guidance.

3.2 The Clean Air for Europe (CAFE) programme revisited the management of Air Quality within the EU and replaced the EU Framework Directive 96/62/EC (Council of European Communities, 1996), its associated Daughter Directives 1999/30/EC (Council of European Communities, 1999), 2000/69/EC (Council of European Communities, 2000), 2002/3/EC (Council of European Communities, 2002), and the Council Decision 97/101/EC (Council of European Communities, 1997) with a single legal act, the Ambient Air Quality and Cleaner Air for Europe Directive 2008/50/EC (Council of European Communities, 2008).

3.3 The Air Quality Directive is currently transposed into UK legislation by the Air Quality Standards Regulations 2010 SI No. 1001, which came into force on 11th June 2010. Subsequent amendments include the Air Quality Standards (Amendment) Regulations 2016. These Limit Values are binding on the UK and have been set with the aim of avoiding, preventing or reducing harmful effects on human health and on the environment as a whole. The Directive also lists a number of Target Values.

3.4 For substances not specified in the regulations, Environmental Standards (Env Std) criteria are taken from EA's air emissions risk assessment guidance.

Table 7A.1: Environmental Standards for Air (for the Protection of Human Health)

POLLUTANT	SOURCE	CONCENTRATION ($\mu g/m^3$)	MEASURED AS
NO_2	EU Air Quality Limit Values	40	Annual Mean
		200	1-hour mean, not to be exceeded more than 18 times per year
PM_{10}	EU Air Quality Limit Values	40	Annual Mean
		50	24-hour mean, not to be exceeded more than 35 times a year
$PM_{2.5}$	EU Air Quality Limit Values	25	Annual Mean
SO_2	WHO Guideline	50	Annual Mean
	UK Air Quality Strategy Objective	266	15-min mean, not be exceeded more than 35 times a year
	EU Air Quality Limit Values	350	1-hour mean, not to be exceeded more than 24-times a year

POLLUTANT	SOURCE	CONCENTRATION ($\mu g/m^3$)	MEASURED AS
	EU Air Quality Limit Values	125	24-hour mean, not to be exceeded more than 3 times a year
Benzene	UK Air Quality Strategy Objectives	16.25	Running annual mean
	EU Air Quality Limit Values	5	Annual Mean
CO	EU Air Quality Limit Values	10,000	Maximum daily running 8-hour mean
	EA Environmental Standards	30,000	1-hour maximum
HCl	EA Environmental Standards	750	1-hour maximum
HF	EA Environmental Standards	16	Monthly mean
		160	1-hour maximum
PAH, as BaP	EU Air Quality Target Value	0.001	Annual mean
	UK Air Quality Strategy Objectives	0.00025	Annual mean
Pb	EU Air Quality Limit Values	0.5	Annual mean
	UK Air Quality Strategy Objectives	0.25	Annual mean
Hg	EA Environmental Standards	0.25	Annual mean
		7.5	1-hour maximum
Sb	EA Environmental Standards	5	Annual mean
		150	1-hour maximum
As	EU Air Quality Target Values	0.006	Annual mean
	EA Environmental Standards	0.003	Annual mean
Cd	EU Air Quality Limit Values	0.005	Annual mean
Cr, as Cr (II) compounds and Cr (III) compounds	EA Environmental Standards	5	Annual mean
		150	1-hour maximum
Cr (VI), oxidation state in PM_{10} fraction	EA Environmental Standards	0.0002	Annual mean
Mn	EA Environmental Standards	0.15	Annual mean
		1,500	1-hour maximum
Ni	EA Environmental Standards	0.02	Annual mean
V	EA Environmental Standards	5	Annual mean
		1	1-hour maximum
NH_3	EA Environmental Standards	180	Annual mean
		2,500	1-hour maximum
PCBs	EA Environmental	0.2	Annual mean

POLLUTANT	SOURCE	CONCENTRATION ($\mu g/m^3$)	MEASURED AS
	Standards	6	1-hour maximum

Assessment Criteria for Sensitive Ecological Receptors

3.5 The UK is bound by the terms of the European Birds and Habitats Directives and the Ramsar Convention. The Conservation of Habitats and Species Regulations 2010 provides for the protection of European sites created under these polices, i.e. Special Areas of Conservation (SACs) designated under the Habitats Directive, Special Protection Areas (SPAs) designated under the Birds Directive, and Ramsar Sites designated as wetlands of international importance under the Ramsar Convention. The 2010 Regulations apply specific provisions of the European Directives to SACs, SPAs, candidate SACs (cSACs) and proposed SPAs (pSPAs), which require them to be given special consideration and further assessment by any development which is likely to lead to a significant effect upon them.

3.6 The legislation concerning the protection and management of designated sites and protected species within England is set out within the provisions of the 2010 Regulations, the Wildlife and Countryside Act 1981 (as amended) and the Countryside and Rights of Way Act 2000 (as amended).

3.7 The impact of emissions from the Proposed Development on sensitive ecological receptors are quantified within this assessment in two ways:

- as direct impacts arising due to increases in atmospheric pollutant concentrations; and
- indirect impacts arising through deposition of acids and nutrient nitrogen to the ground surface.

3.8 The critical levels for the protection of vegetation and ecosystems are set out in Table 7A.2, and apply regardless of habitat type. In the case of NH_3 and SO_2, the greater sensitivity of lichens and bryophytes to these pollutants is reflected in the application of stricter Environmental Standards at locations where such species are present. These values have been adopted as the assessment criteria for the impact of the process on designated nature sites.

Table 7A.2: Critical Level (CLe) Environmental Assessment Levels for Air (for the Protection of Designated Habitat Sites)

POLLUTANT	SOURCE	CONCENTRATION ($\mu g/m^3$)	MEASURED AS	NOTES
NH_3	Environmental Agency Environmental Permit Guidance	1	Annual mean	For sensitive lichen communities & bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's

POLLUTANT	SOURCE	CONCENTRATION ($\mu g/m^3$)	MEASURED AS	NOTES
				integrity
		3	Annual mean	For all higher plants (all other ecosystems)
SO_2	Environmental Agency Environmental Permit Guidance	10	Annual mean	For sensitive lichen communities & bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity
		20	Annual mean	For all higher plants (all other ecosystems)
NO_X (as NO_2)	Environmental Agency Environmental Permit Guidance	30	Annual mean	-
		75	Daily mean	-
HF	Environmental Agency Environmental Permit Guidance	<5	Daily mean	-
		<0.5	Weekly mean	-

3.9 Critical load criteria for the deposition of acids and nutrient nitrogen are dependent on the habitat type and species present, and are specific to the sensitive receptors considered within the assessment. The critical loads are set out on the Air Pollution Information System website (Centre for Ecology and Hydrology (CEH), 2018).

3.10 The critical load criteria adopted for the sensitive ecological receptors considered by the assessment are presented in the model results section of this report.

4.0 METHODOLOGY

Overview

4.1 This section describes the approach taken to the assessment of emissions associated with the operation of the Proposed Development. This has been broken down into two sub-sections.

- Qualitative assessment of construction dust;
- Modelling of combustion emissions from the EfW stacks;
- Modelling of operational phase road traffic emissions on local roads; and
- Modelling of construction phase road traffic emissions on local roads.

4.2 The outputs from the modelling of combustion emissions from the stacks and road traffic have been used to determine the combined change in concentrations of NO_2, PM_{10} and $PM_{2.5}$ at a number of receptors located in close proximity to local roads. The approach taken to the prediction of impacts is determined later within this section of the report.

Construction Phase – Demolition and Construction Dust Assessment

4.3 The following four potential activities have been screened as potentially significant, based on the nature of construction activities proposed (Institute of Air Quality Management, 2014):

- Enabling demolition works;
- Earthworks (soil stripping, spoil movement and stockpiling;
- Construction (including on-site concrete batching); and
- Trackout (HGV movements on unpaved roads and offsite mud on the highway).

<u>Magnitude Definitions</u>

4.4 The potential magnitude of dust emissions is categorised as detailed in Table 7A.3 below.

Table 7A.3: Example definition of magnitude of demolition and construction activities

MAGNITUDE	DEMOLITION	EARTHWORKS	CONSTRUCTION	TRACKOUT
Large	Total building volume >50,000 m^3, potentially dust construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level	Site area >1 ha potentially dusty soil type (e.g. clay). >10 heavy earth moving vehicles at once, bunds >8 m high, total material moved >100,000 tonnes	Total building volume >100,000 m^3, on-site concrete batching, sandblasting	>50 HDV (>3.5 tonne) peak outward movements per day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m

MAGNITUDE	DEMOLITION	EARTHWORKS	CONSTRUCTION	TRACKOUT
Medium	Total building volume 20,000 – 50,000 m^3, potentially dusty construction material, demolition activities 10 to 20 metres above ground level	Site area 0.25 – 1 ha, moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles at once, bunds 4-8 metres high, total material moved 20,000 – 100,000 tonnes	Total building volume 25,000 – 100,000 m^3, potentially dusty materials e.g. concrete, on-site concrete batching	10 – 50 HDV (>3.5 tonne) peak outward movements per day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 – 100 metres
Small	Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10 metres above ground level, demolition during wetter months	Site area <0.25 ha, large grain soil type (e.g. sand), <5 heavy earth moving vehicles at once, bunds <4 metre high, total material moved <20,000 tonnes	Total building volume <25,000 m^3, low dust potential construction materials .e.g. metal/timber	<10 HDV (>3.5 tonnes) peak outward movements per day, surface material low dust potential, unpaved road length <50 metres

Receptor Sensitivity Definitions

4.5 The assessment of demolition and construction dust has been made with respect to the receptor and area sensitivity definitions as outlined in Table 7A.4 to Table 7A.7 below. Sensitivity definitions have been made with reference to the IAQM guidance; receptors beyond 100 metres are defined as low sensitivity; ecological receptors (including statutory designations, and non-statutory ecological receptors of location importance such as county wildlife sites, national and local nature reserves) have been included as the Humber Estuary is within this 500 metre screening distance.

Table 7A.4: Receptor sensitivity to demolition and construction dust effects

POTENTIAL DUST EFFECT	HUMAN PERCEPTION OF DUST SOILING EFFECTS	PM_{10} HEALTH EFFECTS	ECOLOGICAL EFFECTS
High sensitivity	Enjoy a high level of amenity; appearance/ aesthetics/ value of	Public present for 8 hours per day or more, e.g.	Locations with an international or national

POTENTIAL DUST EFFECT	HUMAN PERCEPTION OF DUST SOILING EFFECTS	PM_{10} HEALTH EFFECTS	ECOLOGICAL EFFECTS
	property would be diminished by soiling; receptor expected to be present continuously/	residential, schools, car homes	designation and the designated features may be affected by dust soiling.
Moderate sensitivity	Enjoy a reasonable level of amenity; appearance/ aesthetics/ value of property could be diminished by soiling; receptor not expected to be present continuously/	Only workforce present (no residential or high sensitivity receptors) 8 hours per day or more	Locations where there is a particularly important plant species, where dust sensitivity is uncertain or unknown or locations with a national designation where the features may be affected by dust deposition
Low sensitivity	Enjoyment of amenity not reasonably expected; appearance/ aesthetics/ value of property not diminished by soiling; receptors are transient / present for limited period of time; e.g. playing fields, farmland, footpaths, short term car parks	Transient human exposure, e.g. footpaths, playing fields, parks	Locations with a local designation which may be affected by dust deposition.

4.6 Distance measured from source to receptor in bands of less than 20 metres, less than 50 metres, less than 100 metres and less than 350 metres for earthworks and construction. For trackout the receptor distance measured from receptor to trackout route (up to 50 metres) and up to 500 metres from the Site exit. These distances bands have been applied in Table 7A.5 and Table 7A.6. For sensitivity of an area ecological impacts the distance bands are for less than 20 metres and less than 50 metres for Table 7A.7.

Table 7A.5: Sensitivity of the area to dust soiling effects on people and property

RECEPTOR SENSITIVITY	NUMBER OF RECEPTORS	DISTANCE FROM THE SOURCE (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Moderate	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 7A.6: Sensitivity of the area to human health impacts

RECEPTOR SENSITIVITY	NUMBER OF RECEPTORS	DISTANCE FROM THE SOURCE (m)			
		<20	<50	<100	<350
High (annual mean PM_{10} concentration <24 µg/m^3	>100	Medium	Low	Low	Low
	10-100	Low	Low	Low	Low
	1-10	Low	Low	Low	Low
Medium (annual mean PM_{10} concentration (<24 µg/m^3)	>10	Low	Low	Low	Low
	1-10	Low	Low	Low	Low
Low	≥1	Low	Low	Low	Low

Table 7A.7: Sensitivity of the area to ecological impacts

RECEPTOR SENSITIVITY	DISTANCE FROM SOURCE (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Risk Definitions

4.7 The potential risks from emissions from unmitigated demolition and construction activities have been defined with reference to the magnitude of the potential emission and the sensitivity of the highest receptor(s) within the effect area, as summarised in Table 7A.8 below.

Table 7A.8: Classification of risk of unmitigated impacts

AREA OF SENSITIVITY TO ACTIVITY	MAGNITUDE		
	LARGE	MEDIUM	SMALL
Demolition			
High	High risk	Medium risk	Medium risk
Medium	High risk	Medium risk	Low risk
Low	Medium risk	Low risk	Negligible
Earthworks			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible
Construction			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible
Trackout			
High	High risk	Medium risk	Low risk

AREA OF SENSITIVITY TO ACTIVITY	MAGNITUDE		
	LARGE	MEDIUM	SMALL
Medium	Medium risk	Low risk	Negligible
Low	Low risk	Low risk	Negligible

Assessment of Demolition and Construction Dust

Magnitude Assessment

4.8 For the purpose of this assessment, the Proposed Development is considered to be a large emissions source for fugitive dust emissions from construction related activities.

Receptor Identification

Table 7A.9: Identification of receptors for construction dust assessment

ID	RECEPTOR NAME	RECEPTOR TYPE	APPROX. DISTANCE (m) FROM SITE BOUNDARY OR EXIT	APPROX. DISTANCE TO CONSTRUCTION ROUTE (m)	WITHIN SCREENING DISTANCE?	RECEPTOR SENSITIVITY TO DUST AND PARTICULATE MATTER
R1	Mauxhall Farm	Residential	3,780	420	No	-
R2	Property on North Moss Lane	Residential	1,300	850	No	-
R3	Property on South Marsh Road	Residential	1,680	1,150	No	-
R4	Property on South Marsh Road	Residential	1,760	1,230	No	-
R5	Property on South Marsh Road	Residential	1,800	1,290	No	-
R6	Property on South Marsh Road	Residential	1,900	1,380	No	-
R7	Primrose Cottage, north of A180	Residential	1,640	2,130	No	-
R8	Cress Cottage, north of A180	Residential	1,680	2,330	No	-
R9	The Meadows, south of A180	Residential	1,920	1,530	No	-
R10	Meadows Farm, south of A180	Residential	2,170	1,600	No	-
R11	Meadows Cottages, south of A180	Residential	2,170	1,600	No	-
R12	Property on South Marsh Road in Stallingborough	Residential	2,500	2,150	No	-

ID	RECEPTOR NAME	RECEPTOR TYPE	APPROX. DISTANCE (m) FROM SITE BOUNDARY OR EXIT	APPROX. DISTANCE TO CONSTRUCTION ROUTE (m)	WITHIN SCREENING DISTANCE?	RECEPTOR SENSITIVITY TO DUST AND PARTICULATE MATTER
R13	Property on Woad Lane in Grimsby	Residential	2,900	2,570	No	-
R14	Property on Kendal Road, Immingham	Residential	3,820	1,100	No	-
R15	Property on Hadleigh Road, Immingham	Residential	4,180	1,280	No	-
R16	Property on Arran Close, Immingham	Residential	4,400	1,190	No	-
R17	Property on Mull Way, Immingham	Residential	4,570	500	No	-
R18	Willows Court, Immingham	Residential	5,220	270	Yes	High
R19	Property north of Habrough	Residential	7,700	100	Yes	High
R20	Property on Station Road in Habrough	Residential	7,900	70	Yes	High
R21	Grimsby AQMA	Residential	5,470	5,290	No	-
PROW 1	Public Right of Way	Transient	720	60	Yes	Low
PROW 2		Transient	620	240	Yes	Low
PROW 3		Transient	510	380	No	-
PROW 4		Transient	500	440	No	-
PROW 5		Transient	490	460	No	-
PROW 6		Transient	405	360	Yes	Low
PROW 7		Transient	345	300	Yes	Low
PROW 8		Transient	390	390	No	-
PROW 9		Transient	470	470	Yes	Low
PROW 10		Transient	620	620	No	-

ID	RECEPTOR NAME	RECEPTOR TYPE	APPROX. DISTANCE (m) FROM SITE BOUNDARY OR EXIT	APPROX. DISTANCE TO CONSTRUCTION ROUTE (m)	WITHIN SCREENING DISTANCE?	RECEPTOR SENSITIVITY TO DUST AND PARTICULATE MATTER
PROW 11		Transient	880	880	No	-
PROW 12		Transient	1,050	1,050	No	-
Humber Estuary Ramsar, SAC, SPA	Location nearest to the boundary of the Site that is part of Humber Estuary Ramsar site, SAC, SPA	Ecology	680	680	No	-
E6_1	Laporte Road LWS		1,870	1,870	No	-
E6_2			1,920	1,920	No	-
E7_1	Stallingborough Fish Ponds LWS		1,850	1,850	No	-
E7_2			1,840	1,840	No	-
E8_1	Healing Cress Beds LWS		1,430	1,430	No	-
E8_2			1,500	1,500	No	-
E9_1	Sweedale Croft Drain LWS		1,850	1,850	No	-
E9_2			1,740	1,740	No	-
E9_3			1,680	1,680	No	-

Area Sensitivity Assessment

4.9 The receptor sensitivity to the effects of dust soiling and PM_{10} (human health) impacts has been determined for all activities, based on the closest distance from the identified receptors to those activities, as summarised in Table 7A.10 below. The overall area sensitivity to dust soiling and PM_{10} (human health) is considered to be 'low', whilst the area sensitivity to ecological dust impacts is considered to be 'medium'.

Table 7A.10: Area sensitivity for receptors of construction dust

ACTIVITY	POTENTIAL IMPACT	RECEPTOR SENSITIVITY AND DISTANCE TO ACTIVITY	AREA SENSITIVITY
Demolition	Dust soiling	No demolition occurring	-
	Health PM_{10}		
	Ecology		
Earthworks	Dust soiling	High sensitivity (<10 receptor) <100 m	Low
	Health PM_{10}	High sensitivity (<10 receptor) <100 m	Low
	Ecology	No sensitive receptors within 50 m	-
Construction	Dust soiling	High sensitivity (<10 receptor) <100 m	Low
	Health PM_{10}	High sensitivity (<10 receptor) <100 m	Low
	Ecology	No sensitive receptors within 50 m	-
Trackout	Dust soiling	High sensitivity (<10 receptor) <100 m	Low
	Health PM_{10}	High sensitivity (<10 receptor) <100 m	Low
	Ecology	No sensitive receptors within 50 m	-

4.10 The risk of impacts from unmitigated activities has been determined through combination of the potential dust emission magnitude and the sensitivity of the area, for each activity to determine the level of mitigation that should be applied. The risk of impacts from unmitigated activities are summarised in Table 7A.11 below.

Table 7A.11: Risk of impacts from unmitigated activities

ACTIVITY	DEMOLITION	EARTHWORKS	CONSTRUCTION	TRACKOUT
Dust	Not Applicable	Large	Large	Medium

ACTIVITY	DEMOLITION	EARTHWORKS	CONSTRUCTION	TRACKOUT
Emission Magnitude				
Risk of impacts from unmitigated activities				
Dust soiling (low sensitivity)	Not Applicable	Low Risk	Low Risk	Low Risk
Health PM_{10} (low sensitivity)	Not Applicable	Low Risk	Low Risk	Low Risk
Ecology	Not Applicable	Not Applicable	Not Applicable	Not Applicable

4.11 The risk assessment for construction dust indicates that there would be a low risk of dust impacts on human health (PM_{10}) and on dust soiling from unmitigated earthworks, construction and track out activities. These risk classifications are solely used to select the appropriate schedule of mitigation measures from IAQM guidance. For all but the smallest of sites the use of the high risk schedule of measures represents good working practice.

4.12 Mitigation measures to be embedded within the scheme will therefore be defined according to the highest risk category for these activities, by as listed in the 'low risk' schedule of measures listed in section 8.2 of the IAQM guidance. On consideration of the likely effectiveness of these measures, additional site-specific measures will be identified in CEMP if required.

Modelling of Combustion Emissions from the Stacks

Dispersion Model Selection

4.13 The assessment of emissions from the Proposed Development has been undertaken using version of ADMS (V5.2.2). ADMS is a modern dispersion model that has an extensive published validation history for use in the UK. This model has been extensively used throughout the UK to demonstrate regulatory compliance.

4.14 The assessment of emissions from road traffic associated with the Proposed Development has used the latest version of ADMS-Roads (V4.1.1) to quantify pollution levels at selected receptors. ADMS-Roads is a modern dispersion model that has a published track record of use in the UK for the assessment of local air quality impacts, including model validation and verification studies.

Modelled Scenarios

4.15 The dispersion modelling runs undertaken in the assessment of emissions from the main stacks are:

- modelling of maximum ground-level impacts at a range of release heights, between 60 m and 140 m, in order to evaluate the effect of increasing effective release height on dispersion;
- modelling of impacts on a variable resolution receptor grid and at discrete sensitive human receptors for all pollutants, at a release height of 100 m; and
- modelling of impacts at selected sensitive ecological receptors, at a release height of 100 m.

<u>Model Inputs</u>

4.16 The general model conditions used in the assessment are summarized in Table 7A.12. Other more detailed data used to model the dispersion of emissions is considered below.

Table 7A.12: General ADMS 5 Model Conditions

VARIABLE	INPUT
Surface roughness at source	0.2
Surface roughness at meteorological site	0.2
Receptors	Selected discrete receptors
	Nested receptor grid, variable spacing
Receptor location	X,Y co-ordinates determined by GIS,
	z = 1.5 m for residential receptors and AQMAs
	z = 0 m for ecological receptors
Source location	X,Y co-ordinates determined by GIS
Emissions	IED emission limits, BAT-AEL values and data provided by EP SHB Ltd.
Sources	2 x Stacks
Meteorological data	5 years of meteorological data, Humberside Airport Meteorological Station (2013 – 2017)
Terrain data	None
Buildings that may cause building downwash effects	Boiler Hall, RDF Reception, Control Room, Turbine Hall, Air Cooled Condenser, Gas Turbine & Steam Turbine, SHBPS Buildings 1 & 2 and NewLincs IWMF 1 (see Plots 7A.1 and 7A.2 below)

Emissions Data

4.17 The Proposed Development stacks would be the primary source of combustion emissions from the Proposed Development. There would be two stacks, one for each combustion line, which have been modelled at a height of 100 metres above ground level (the height considered to represent BAT for the Proposed Development based on the range of stack heights assessed), with an internal diameter of 2.75 metres.

4.18 The physical properties of the combustion emission sources, as represented within the model, is presented in Table 7A.13.

4.19 The position of the stacks within the modelled domain are illustrated in Figure A7. 1 of Annex A to this report.

Table 7A.13: Properties - Stacks

PARAMETER	UNIT	EFW STACK 1	EFW STACK 2
Stack position	(NGR) m	523169, 413484	523175, 413447
Stack release height	M	100	100
Effective internal stack diameter	M	2.75	2.75

PARAMETER	UNIT	EFW STACK 1	EFW STACK 2
Flue temperature	°C	120	120
Flue H_2O mass ratio	kg/kg	0.19	0.19
Flue O_2 content (dry)	%	7	7
Stack gas exit velocity	m/s	15	15
Stack flow (actual)	Am^3/s	89.2	89.2
Stack flow at reference conditions (STP, dry)	Nm^3/s	66.5	66.5

4.20 The modelled pollutant emission rates (in g/s) are determined by the daily average BAT-AEL values set out within the draft BREF or Emission Limit Values (ELVs) set out within the IED. The emissions limits assumed to apply to the Proposed Development are shown in Table 7A.14.

4.21 Pollutant mass emission rates from the waste combustion process (in g/s) have been calculated by multiplying the daily average and half hour average ELVs by the volumetric flow rate at reference conditions. The pollutant mass emission rates from the main stacks, as used within the dispersion modelling assessment, are presented in Table 7A.15.

4.22 Emissions of benzo[a]pyrene from the stacks are not included in the IED. Conservative emission rates for these pollutants have been assumed for this assessment, derived from the BRef for Waste Incineration.

4.23 Emissions of NH_3 have been provided by EP SHB Ltd.

4.24 This assessment assumes that the Proposed Development would operate at continuous design load (8,760 hours per year). No time-based variation in stack emissions has therefore been accounted for within the model. For the assessment of short term impacts, emissions have been modelled at the maximum emission rate, reflecting the assumption that it is not possible to predict when the operational hours may be.

4.25 For the purposes of the assessment of emission of particulate matter (as PM_{10}) and fine particulate matter ($PM_{2.5}$), the total particulate emissions have been assumed to be present in both the PM_{10} and $PM_{2.5}$ size fractions. This approach will result in the over-estimation of impacts on local PM_{10} and $PM_{2.5}$ concentrations.

4.26 Emissions of Group 1 metals (Cd and Tl) from the stacks have individually been taken to be emitted at the Environmental Standard for the whole group.

4.27 The BAT-associated energy efficiency levels (BAT-AELs) (Official Journal of the European Union, 2017) included in the current drafting of waste incineration BREF are included in Table 7A.14.

Table 7A.14: Air Emission Limit Values (ELVs) as Specified in the Industrial Emission Directive (IED, 2010/75/EU) and the BAT-AEELS (Official Journal of the European Union, 2017)

EMISSION LIMIT ($\mu g/m^3$)	EMISSION LIMIT ($\mu g/m^3$)	
	HALF-HOUR AVERAGE (BASED ON IED)	DAILY AVERAGE (BASED ON BAT-AEL)
NO_X (as NO_2)	400	120

EMISSION LIMIT ($\mu g/m^3$)	EMISSION LIMIT ($\mu g/m^3$)	
	HALF-HOUR AVERAGE (BASED ON IED)	DAILY AVERAGE (BASED ON BAT-AEL)
Total dust (assumed as PM_{10})	30	5
SO_2	200	30
TOC	20	10
CO	100	50
HCl	60	6
HF	4	1
Group 1 metals (Cd + Tl, total)		0.02
Group 2 metals (Hg)[1]		0.02
Group 3 metals (Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V, total)		0.3
Dioxins and furans[2]		0.00000006

Table 7A.15: Pollutant Emission Rates (per stack)

POLLUTANT	DAILY AVERAGE EMISSION RATE (G/S)	HALF HOUR AVERAGE EMISSION RATE (G/S)
NO_X (as NO_2)	7.985	26.616
Total dust (assumed to be PM_{10} and $PM_{2.5}$)	0.333	1.996
SO_2	1.996	13.308
TOC	0.665	1.331
CO	3.327	6.654
HCl	0.399	3.992
HF	0.0665	0.266
NH_3[3]	0.665	-
Group 1 metals[4] (Cd, Tl)	0.0013	-
Group 2 metals (Hg)	0.0013	-
Group 3 metals[4] (Sb, As, Pb, Cr (total), Co, Cu, Mn, Ni, Pb, V)	0.020	-
Dioxins and furans	3.99×10^{-09}	-
PAH, as benzo[a]pyrene	0.0007	-
PCBs	0.0003	-

[1] Sample averaging times for metals are 30 minutes to 8 hours
[2] Sample averaging times for dioxins are 6 hours to 8 hours, total concentrations of dioxins and furnace calculated as a toxic equivalent
[3] Not included in WID/IED. To include for ammonia slip the volume of 10 mg/Nm^3 was used.
[4] Emissions of the listed group 1 and 3 metals are taken as 100% the respective limit value for each metal group

Additional Consideration of Group 3 Metal Emissions

4.28 In April 2010 the EA published revised Environmental Standards for arsenic, nickel and chromium (VI) in its EA Permit Guidance (see Table A7.1). The new guidelines are lower than earlier Environmental Standards. In particular, the use of conservative assumptions for the assessment of Group 3 metal emissions make it possible that the assessment would identify a theoretical risk that the Environmental Standard value could be exceeded in the case of arsenic, nickel and chromium (VI). The EA has therefore provided guidance on the assessment of Group 3 metal releases from waste combustion processes (EA, 2016).

4.29 In the first instance, a worst case screening step is carried out, whereby each substance is modelled as being emitted at the ELV for all nine Group 3 metals, 0.3 mg/m^3. Actual emission rates at comparable facilities are normally well below the BAT-AEL, and as such the worst case screening step is very conservative. Where the initial appraisal results in a modelled result where the Process Contribution (PC) exceeds 1% of the long term Environmental Standard or 10% of the short term Environmental Standard for that substance, then the Predicted Environmental Concentration (PEC), which includes the background concentration, is compared with the Environmental Standard. Where the PEC is greater than 100% of the Environmental Standard, then emissions of those substances have been considered further in accordance with the second step of the guidance.

4.30 The second step requires the predictions to be revised with reference to a range of measured values recorded from testing on 18 operational municipal waste incinerators and waste wood incinerators between 2007 and 2015. As in the first step, where the Process Contribution (PC) exceeds 1% of the long term Environmental Standard or 10% of the short term Environmental Standard for that substance, then the Predicted Environmental Concentration (PEC) is compared with the Environmental Standard. This can be screened out where the PEC is less than 100% of the Environmental Standard. Further justification is required to be made to the EA if data lower than the listed maximum emission concentrations are used in the assessment.

Modelled Domain – Discrete Receptors

Sensitive Human Receptors

4.31 Ground-level concentrations of the modelled pollutants relevant to human health have been predicted at discrete air quality sensitive receptors, as listed in Table 3 5. The locations of these receptors are also shown in Figure 7A.1 of Annex A to this report. The receptors have been selected to be representative of residential dwellings in the area around the Proposed Development.

4.32 A number of receptors are also in close proximity to traffic routes which would experience changes to vehicle flows during the operation of the Proposed Development. The receptors which are located in close proximity to traffic routes have the prefix of R before the receptor number. At these locations, an assessment has been made of the combined effect of emissions from traffic and the main stacks on local concentrations of NO_2, PM_{10} and $PM_{2.5}$. These receptors are also listed in Table 7A.16.

4.33 The flagpole height of the all receptors listed in Table 7A.16 has been set within the model at 1.5 m.

Table 7A.16: Modelled Domain, Selected Discrete Human Receptor Locations

RECEPTOR REFERENCE	RECEPTOR DESCRIPTION	GRID REFERENCE	
		X	Y
R1	Mauxhall Farm	519164	413247
R2	Property on North Moss Lane	521290	413089
R3	Property on South Marsh Road	521591	413001
R4	Property on South Marsh Road	521298	412771
R5	Property on South Marsh Road	521258	412700
R6	Property on South Marsh Road	521171	412590
R7	Primrose Cottage, north of A180	521900	412105
R8	Cress Cottage, north of A180	521988	411994
R9	The Meadows, south of A180	522051	411669
R10	Meadows Farm, south of A180	521900	411653
R11	Meadows Cottages, south of A180	521900	411605
R12	Property on South Marsh Road in Stallingborough	520822	412113
R13	Property on Woad Lane in Grimsby	524372	410818
R14	Property on Kendal Road, Immingham	519215	414218
R15	Property on Hadleigh Road, Immingham	518810	414142
R16	Property on Arran Close, Immingham	518580	413796
R17	Property on Mull Way, Immingham	518388	413642
R18	Willows Court, Immingham	517721	413749
R19	Property north of Habrough	515237	414003
R20	Property on Station Road in Habrough	515087	414241
R21	Grimsby AQMA	527731	410459
PROW 1	Public Right of Way	522277	413722
PROW 2		522434	413788
PROW 3		522603	413840
PROW 4		522762	413932
PROW 5		522985	413983
PROW 6		523270	413886
PROW 7		523401	413749

RECEPTOR REFERENCE	RECEPTOR DESCRIPTION	GRID REFERENCE	
		X	Y
PROW 8		523538	413599
PROW 9		523644	413397
PROW 10		523787	413140
PROW 11		523985	413119
PROW 12		524146	412958

Sensitive Ecological Receptors

4.34 In accordance with the Environmental Agency's air emissions risk assessment guidance, the impacts associated with emissions from the combustion process on statutory sensitive ecological sites have been quantified. The assessment has considered SSSIs within 2 km and European designated sites within 10 km of the Proposed Development, as recommended by the risk assessment guidance. The most notable of these locations are Humber Estuary Ramsar site, SPA and SAC. The EA also identified further ecological sites which would need to be assessed; these were Laporte Road LWS (E6), Stallingborough Fish Ponds LWS (E7), Healing Cress Beds (E8), Sweedale Croft Drain LWS (E9). There were also two SNCIs; North Moss Lane Meadow and Field West of Power Station which were identified but no critical information can be drawn from these sites so they were not explicitly modelled.

4.35 Ground-level concentrations of the modelled pollutants relevant to sensitive ecological receptors have been predicted at locations listed in Table 7A.17. The locations of these receptors are also shown in Figure A7.2 of Annex A to this report.

4.36 For sensitive ecological receptors, the flagpole height has been set within the model at 0 m.

Table 7A.17: Modelled Domain – Ecological Receptor Locations, Critical Levels and Baseline Concentrations

RECEPTOR IDENTIFICATION	HUMBER ESTUARY RAMSAR SITE, SPA AND SAC LAND USE TYPE	GRID REFERENCE		NO_X ($\mu g/m^3$)		SO_2 ($\mu g/m^3$)		AMMONIA ($\mu g/m^3$)		HF ($\mu g/m^3$)	
		X	Y	CLE[5]	BASELINE	CLE[5]	BASELINE	CLE[5]	BASELINE	CLE[5]	BASELINE
E1_1	Atlantic Salt Meadows	523841	413152	30[6] 75[7]	29.19 43.79	20	4.87	3	1.23	0.5	0.006
E1_2	Atlantic Salt Meadows	523795	413177								
E1_3	Atlantic Salt Meadows	523891	413167								
E2_1	Atlantic Salt Meadows	525875	411461		27.34 41.04		6.41		0		
E2_2	Atlantic Salt Meadows	526051	411348		28.7 43.05		4.59				
E2_3	Atlantic Salt Meadows	526204	411085								
E2_4	Atlantic Salt Meadows	526384	411077								
E3_1	Atlantic Salt Meadows	527221	410770		37.10 55.65		4.34				
E4_1	Acid Fixed	531237	408287		22.75		2.73		0.89		

[5] Critical Level
[6] Annual mean
[7] Daily mean: Baseline daily mean concentration is calculated by multiplying the annual mean by 2 to derive the one hour mean and then by 0.5 to derive the 24 hour mean

RECEPTOR IDENTIFICATION	HUMBER ESTUARY RAMSAR SITE, SPA AND SAC LAND USE TYPE	GRID REFERENCE		NO_X ($\mu g/m^3$)		SO_2 ($\mu g/m^3$)		AMMONIA ($\mu g/m^3$)		HF ($\mu g/m^3$)	
		X	Y	CLE[5]	BASELINE	CLE[5]	BASELINE	CLE[5]	BASELINE	CLE[5]	BASELINE
	Dunes				34.13						
E4_2	Acid Fixed Dunes	531313	408200								
E4_3	Acid Fixed Dunes	531397	408097								
E4_4	Acid Fixed Dunes	531499	408035								
E4_5	Acid Fixed Dunes	531547	407962		21.22 31.83		2.56				
E4_6	Acid Fixed Dunes	531540	407912								
E5_1	Atlantic Salt Meadows	531682	408046		22.75 34.13		2.73				
E5_2	Atlantic Salt Meadows	531750	407998		21.22 31.83		2.56				
E5_3	Atlantic Salt Meadows	531793	407923								
E5_4	Atlantic Salt Meadows	531863	407852								
E5_5	Atlantic Salt Meadows	531926	407779								
E5_6	Atlantic Salt Meadows	532034	407667		19.55 29.33		2.58				
E5_7	Atlantic Salt Meadows	532175	407545								
E5_8	Atlantic Salt Meadows	532324	407415								

RECEPTOR IDENTIFICATION	HUMBER ESTUARY RAMSAR SITE, SPA AND SAC LAND USE TYPE	GRID REFERENCE		NO_X ($\mu g/m^3$)		SO_2 ($\mu g/m^3$)		AMMONIA ($\mu g/m^3$)		HF ($\mu g/m^3$)	
		X	Y	CLE[5]	BASELINE	CLE[5]	BASELINE	CLE[5]	BASELINE	CLE[5]	BASELINE
E5_9	Atlantic Salt Meadows	532520	407260								
E5_10	Atlantic Salt Meadows	532616	407081								
E6_1	Laporte Road LWS	521571	414727		30.25 45.375		3.73	1	1.23		
E6_2	Laporte Road LWS	521576	414769								
E7_1	Stallingborough Fish Ponds LWS	521306	412565		25 37.5						
E7_2	Stallingborough Fish Ponds LWS	521391	412451								
E8_1	Healing Cress Beds LWS	522076	412246		23.95 35.93						
E8_2	Healing Cress Beds LWS	522170	412159								
E9_1	Sweedale Croft Drain LWS	523451	411593		31.17 46.76						
E9_2	Sweedale Croft Drain LWS	523599	411714								
E9_3	Sweedale	523710	411805								

RECEPTOR IDENTIFICATION	HUMBER ESTUARY RAMSAR SITE, SPA AND SAC LAND USE TYPE	GRID REFERENCE		NO_X (µg/m^3)		SO_2 (µg/m^3)		AMMONIA (µg/m^3)		HF (µg/m^3)	
		X	Y	CLE[5]	BASELINE	CLE[5]	BASELINE	CLE[5]	BASELINE	CLE[5]	BASELINE
	Croft Drain LWS										

Modelled Domain – Receptor Grid

4.37 Emissions from the main stacks have also been modelled on a receptor grid of variable spacing, in order to determine:

- the location and magnitude of maximum ground level impacts; and
- to enable the generation of pollutant isopleth plots.

4.38 The dispersion model output is reported at specific receptors and as a nested grid of values. The inner grid extends 300 m at a resolution of 20 m x 20 m. The middle grid extends from 300 m to 1,000 m at a resolution of 50 m x 50 m. The outer grid extends from 1,000 m to 3,000 m at a resolution of 100 m x 100 m. Details of the receptor grid are summarised in Table 7A. 18. All gridded model outputs are reported at a height above ground level of 1.5 m.

Table 7A. 18: Modelled Domain, Receptor Grid

GRID SPACING (m)	DIMENSIONS (m)	NUMBER OF NODES IN EACH DIRECTION	NATIONAL GRID REFERENCE OF SOUTH-WEST CORNER
20	600 x 600	16	522200, 412450
50	2000 x 2000	21	519200, 409450
100	6000 x 6000	31	513200, 403450

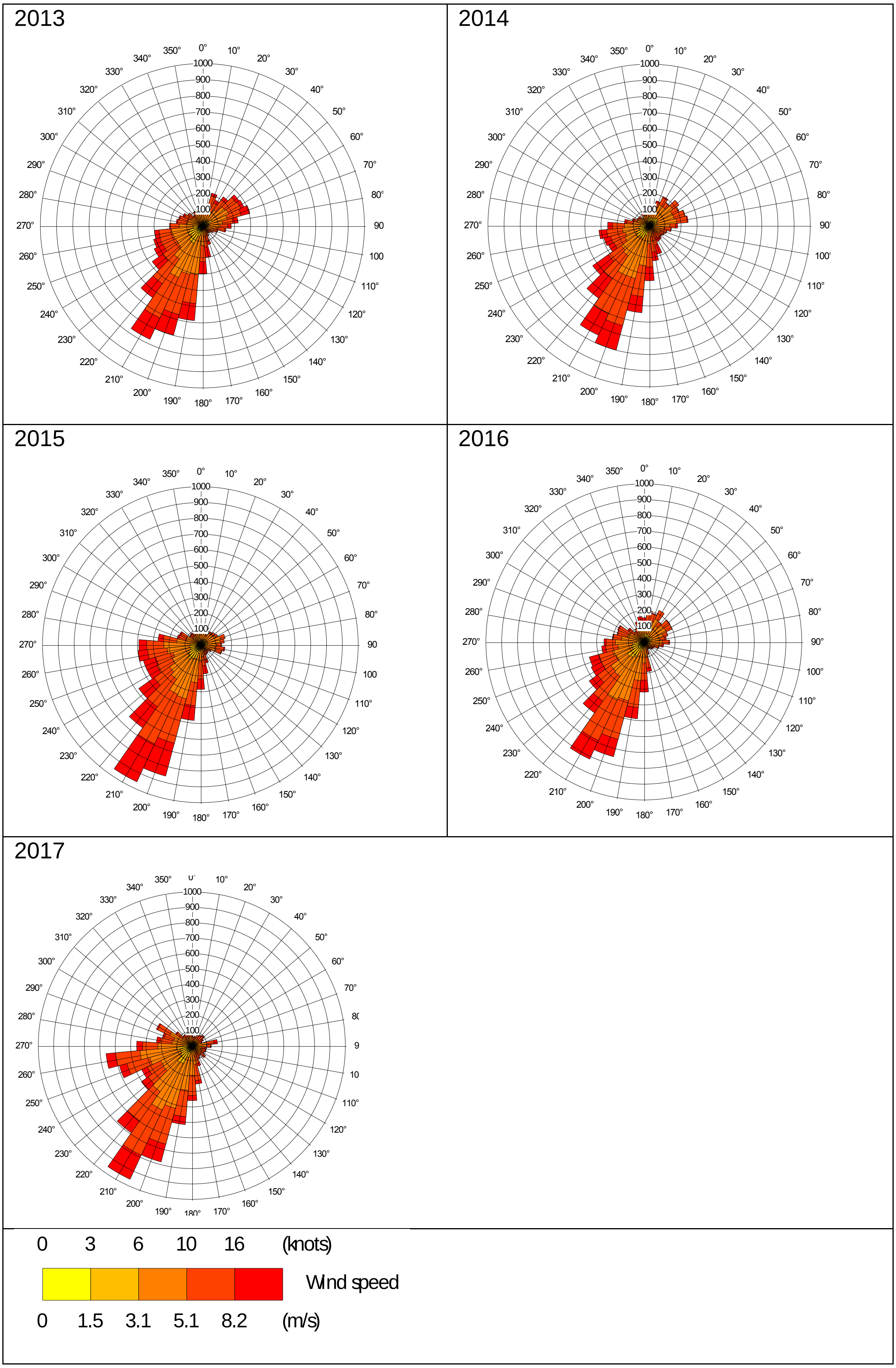
Meteorological Data

4.39 Actual measured hourly-sequential meteorological data is available for input into dispersion models, and it is important to select data as representative as possible for the development modelled. This is usually achieved by selecting a meteorological station as close to the Site as possible, although other stations may be used if the local terrain and conditions vary considerably, or if the station does not provide sufficient data.

4.40 The meteorological site that was selected for the assessment is Humberside Airport, located approximately 13 km west of the Site, at a flat airfield in a principally agricultural area, and therefore a surface roughness of 0.2 m (representative of an agricultural area) has been selected for the meteorological site.

4.41 The modelling for this assessment has utilised 5 years of meteorological data for the period 2013 – 2017. Wind roses for each of the years within this period are shown in Figure 7A.2.

Figure 7A.2: Wind roses for Humberside Airport, 2013 to 2017



Building Downwash Effects

4.42 The buildings that make up the Proposed Development have the potential to affect the dispersion of emissions from the main stacks. The ADMS buildings effect module has therefore been used to incorporate building downwash effects as part of the modelling procedure. Buildings greater than one third of the range of stack heights modelled have been included within the modelling assessment.

4.43 Buildings associated with the Proposed Development that are considered to be of sufficient height and volume to potentially impact on the dispersion of emissions from the Proposed Development stacks include the boiler hall, fuel reception hall, control room, turbine hall and air cooled condenser. The heights for these buildings were calculated from cross sections and a 3-D model produced by EP SHB Ltd.

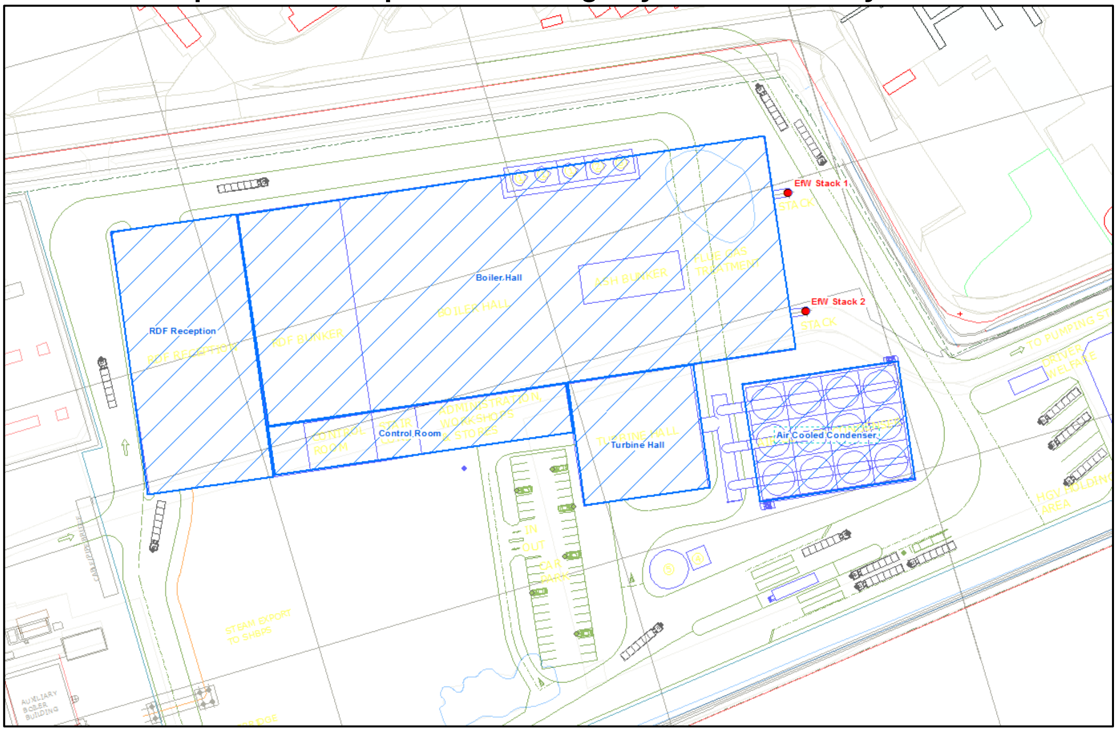
4.44 Nearby buildings within 5 times the preferred stack heights were also included in the dispersion model. These are the existing power station buildings and the NewLincs IWMF. The height of the Gas Turbine and Steam Turbine building were provided by EP SHB Ltd. The dimensions of the New Lincs IWMF were estimated from Google images.

4.45 Parameters representing the buildings included in the model are shown in Table 7A.19 and a plan showing the buildings layout used in the ADMS simulation is illustrated in Plot 7A.1 – 2 below. The dimensions of the buildings have been rounded to the nearest whole number in Table 7A.19. The boiler hall is the highest part of the main structure, and has a 2 m high parapet wall running around the edge of the roof. This wall has not been included in the modelling and the boiler hall has been modelled at a height of 55 m above ground level.

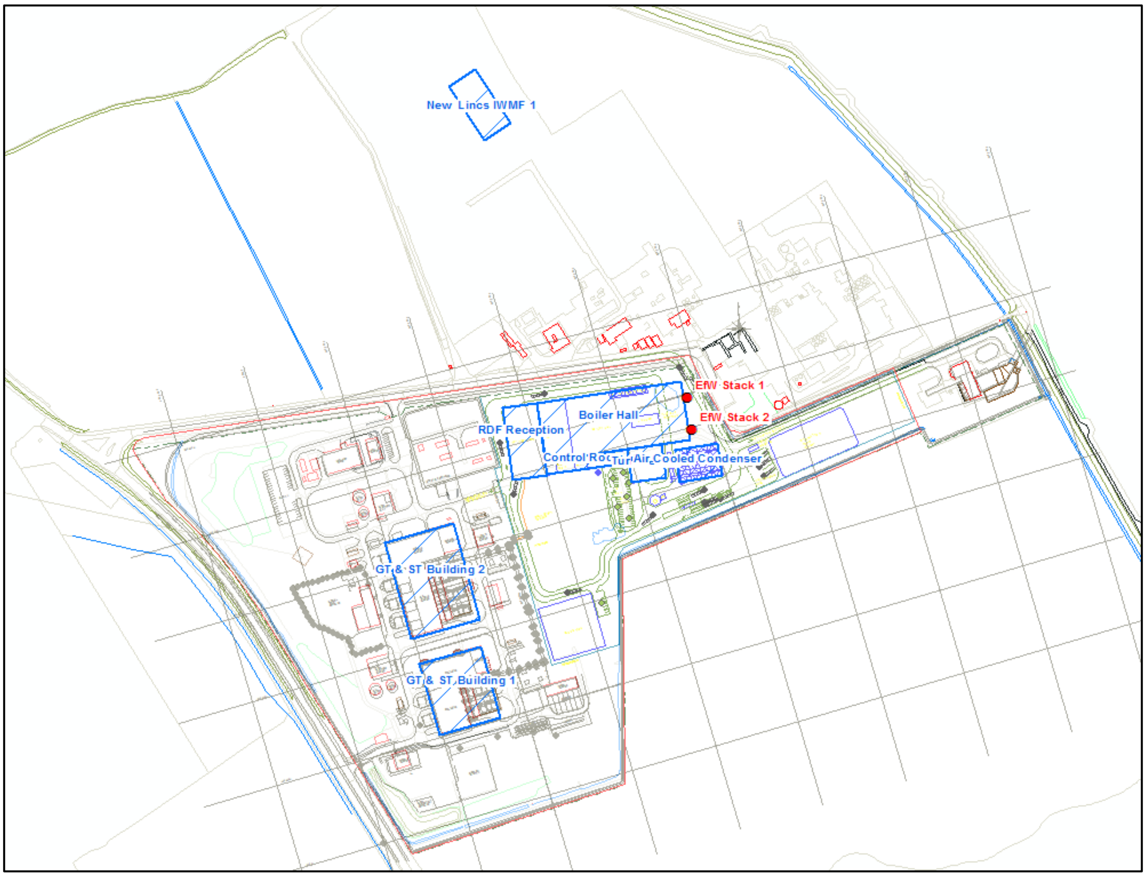
Table 7A.19: Buildings incorporated into the modelling assessment

BUILDING	BUILDING CENTRE GRID REFERENCE (X,Y)	HEIGHT (m)	LENGTH (m)	WIDTH (m)	ANGLE (°)
Proposed Development Buildings					
Boiler Hall	523083, 413456	55	169	68	82
RDF Reception	522980, 413433	30	40	84	82
Control Room	523053, 413410	30	96	16	82
Turbine Hall	523122, 413408	28	41	39	82
Air Cooled Condenser	523182, 413409	26	50	38	82
Nearby Development Buildings					
Turbine Building 1	522906, 413145	31	74	86	74
Turbine Building 2	522874, 413272	30	82	115	74
NewLincs IWMF 1	522928, 413823	30	74	36	147

Plot 7A.1: Proposed Development Building Layout Modelled by ADMS



Plot 7A.2: Sites near to the Proposed Development Building Layout modelled in ADMS 5



4.46 The local area upwind and downwind of the Site is flat, and predominantly industrial and agricultural to the north, south and west. To the east is the Humber Estuary. A surface roughness of 0.2 m, corresponding to the minimum value associated with agricultural areas, has therefore been selected to represent the local terrain.

4.47 Site-specific terrain data has not been used in the model, as typically terrain data will only have a marked effect on predicted concentrations where hills with gradient of more than 1 in 10 are present in the vicinity of the source, which is not the case in the area around the Proposed Development.

NO_X to NO_2 Conversion

4.48 Emissions of nitrogen oxides from industrial point sources are typically dominated by nitric oxide (NO), with emissions from combustion sources typically in the ratio of nitric oxide to nitrogen dioxide of 9:1. However, it is nitrogen dioxide that has specified Environmental Standards due to its potential impact on human health. In the ambient air, nitric oxide is oxidised to nitrogen dioxide by the ozone present, and the rate of oxidation is dependent on the relative concentrations of nitric oxide and ozone in the ambient air.

4.49 For the purposes of detailed modelling, and in accordance with EA technical guidance it is assumed that 70% of nitric oxide emitted from main stacks is oxidised to nitrogen dioxide in the long term and 35% of the emitted nitric oxide is oxidised to nitrogen dioxide in the local vicinity of the Proposed Development in the short-term.

Calculation of Deposition at Sensitive Ecological Receptors

4.50 The deposition of nutrient nitrogen and acid at sensitive ecological receptors is calculated, using the modelled process contribution predicted at the receptor points. The deposition rates are determined using conversion rates and factors contained within EA guidance (EA, 2011), which account for variations deposition mechanisms in different types of habitat.

4.51 The conversion rates and factors used in the assessment are detailed in Table 7A.20 and Table 7A.21.

Table 7A.20: Conversion Factors – Calculation of Nutrient Nitrogen Deposition

POLLUTANT	DEPOSITION VELOCITY GRASSLANDS (M/S)	DEPOSITION VELOCITY FORESTS (M/S)	CONVERSION FACTOR (µg/m^3/S TO KG/HA/YR)
NO_X as NO_2	0.0015	0.003	96
NH_3	0.02	0.03	259.7

Table 7A.21: Conversion Factors – Calculation of Acid Deposition

POLLUTANT	DEPOSITION VELOCITY GRASSLANDS (M/S)	DEPOSITION VELOCITY FORESTS (M/S)	CONVERSION FACTOR (µg/m^3/S TO KG/HA/YR)	CONVERSION FACTOR (KG/HA/YR TO KEQ/HA/YR)
SO_2	0.012	0.024	157.7	0.0625
NO_2	0.0015	0.003	96	0.0714
NH_3	0.02	0.03	259.7	0.0714
HCl	0.025	0.06	306.7	0.0282
HF	0.025	0.06	306.7	0.0282

4.52 As HCl is readily soluble in water, wet deposition processes can also significantly contribute to total acid deposition. The conservative assumption has therefore been made in this assessment that the wet deposition will be equal to dry deposition, in effect doubling the predicted process contribution from HCl at the sensitive receptor.

Specialized Model Treatments

4.53 Emissions have been modelled such that they are not subject to dry and wet deposition or depleted through chemical reactions. The assumption of continuity of mass is likely to result in an over-estimation of impacts at receptors.

Modelling of Emissions from Road Traffic

Modelled Scenarios

4.54 A quantitative assessment of the impact of exhaust emissions from additional road traffic has been undertaken, in order to assess the change in air quality statistics at sensitive receptors in close proximity to the designated access routes to the Proposed Development. The latest version of 'ADMS-Roads' (V4.1.1) has been used to model the dispersion of road traffic emissions, allowing the quantification of pollution levels at selected receptors.

4.55 The approach taken to the assessment of road traffic emissions is outlined further within the remainder of this section.

Model Inputs

4.56 The general model conditions used in the assessment of road traffic emissions are summarised in Table 7A.22. Other more detailed data used to model the dispersion of emissions is considered below.

Table 7A.22: General ADMS Roads Model Conditions

VARIABLE	INPUT
Surface Roughness at source	0.2 m
Receptors	Selected discrete receptors
Receptor location	X,Y co-ordinates determined by GIS. The height of residential receptors and AQMAs were set at 1.5 metres
Emissions	NO_X, PM_{10} and $PM_{2.5}$
Emission Factors	Emission Factor Toolkit version 8.0.1 for 2015 for all scenarios
Meteorological Data	1 year of hourly sequential data, Humberside (2017)
Emission Profiles	None used
Terrain Types	Flat terrain
Model Output	Long-term annual mean NO_X concentration (µg/m^3)
	Long-term annual mean PM_{10} concentration (µg/m^3)
	Long-term annual mean $PM_{2.5}$ concentration (µg/m^3)

Traffic Data

4.57 The traffic data used in this assessment have been provided by AECOM.

4.58 Data used in the road traffic dispersion modelling have been for the following scenarios:

- 2017 Baseline Scenario (for model verification process);
- 2020 Base + Committed Development Scenario;
- 2020 Base + Committed + Peak Construction Scenario;
- 2022 Base + Committed Development Scenario; and
- 2022 Base + Committed + Operation Scenario

4.59 The traffic data used in the modelling of road traffic emissions are presented in Annex B to this report.

Emissions Data

4.60 The magnitude of road traffic emissions for the baseline and with development scenarios are calculated from traffic flow data using the Defra's current emission factor database tool EFT 8.0.1 (Defra, 2018a). The assessment considers the operational phase impact of road traffic emissions at receptors adjacent to roads in the vicinity of the Proposed Development.

Modelled Domain – Discrete Receptors

4.61 The receptors for which the impact of road traffic emissions have been predicted are listed in Table 7A.7. At these locations, an assessment has also been made of the combined effect of emissions from the Proposed Development stacks.

Meteorological Data

4.62 As for the model runs carried out for the Proposed Development, hourly sequential data from Humberside has been used for 2017, consistent with the year chosen to verify the performance of the model against measured nitrogen dioxide concentrations.

Consideration of Terrain

4.63 Emissions from road traffic make the greatest contribution to pollutant concentrations at sensitive receptors adjacent to the source (i.e. at the roadside). For this reason, there is not normally a large variation in height between the emission source and residential properties next to the roads included in the model. Therefore, terrain has not been included in the road traffic modelling assessment.

NO_X to NO_2 Conversion

4.64 To accompany the publication of the guidance document LAQM.TG(16) (Defra, 2016), a NO_X to NO_2 converter was made available as a tool to calculate the road NO_2 contribution from modelled road NO_X contributions. The tool comes in the form of an MS Excel spreadsheet and uses borough specific data to calculate annual mean concentrations of NO_2 from dispersion model output values of annual mean concentrations of NO_X. Version 6.1 (October 2017) (Defra, 2018b) of this tool was used to calculate the total NO_2 concentrations at receptors from the modelled road NO_X contribution and associated background concentration. Due to the location of the Proposed Development, North East Lincolnshire Council has been specified as the local authority and the 'All other urban UK traffic' mix selected.

Bias Adjustment of Road Contribution NO_X, PM_{10} and $PM_{2.5}$

4.65 The modelled road NO_X contributions from the ADMS-Roads model have been adjusted for bias following the method described in LAQM.TG(16).

4.66 In order to inform model verification, the first three months of a six month NO_2 diffusion tube monitoring survey in the study area, for the period 29th June 2018 to 20th September 2018 was used. The locations of the diffusion tubes are presented in Table 7A.23 and in Figure A-1 of Annex A of this report. The diffusion tube results are presented in Annex C.

Table 7A.23: Location of Diffusion Tubes

DIFFUSION TUBE	LOCATION	SITE TYPE	NATIONAL GRID REFERENCE
KOA T1	Humber Estuary Salt Marsh	Other[8]	523788, 413171
KOA T2	Woad Lane, Great Coates	Roadside	524383, 410798
KOA T3	Ephams Lane near Stallingborough	Roadside	521151, 412579

[8] Determination of NO_2 concentration near Humber Estuary Ramsar, SAC and SPA

DIFFUSION TUBE	LOCATION	SITE TYPE	NATIONAL GRID REFERENCE
KOA T4	South Marsh Road, Stallingborough	Roadside	520825, 412134
KOA T5	Stallingborough Road, Immingham	Roadside	517727, 413762
KOA T6	Station Road, Habrough	Roadside	515250, 413997

4.67 A direct comparison can be made between concentrations modelled at the roadside diffusion tube locations and measured concentrations. Table 7A.24 provides a summary of the bias adjustment process. KOA T1 was placed at a salt marsh section of the Humber Estuary Ramsar site, SAC and SPA and is not suitable for traffic model verification due to the distance between the measurement site and the nearest affect road link. However this tube location was used as the source of background concentration during the verification process.

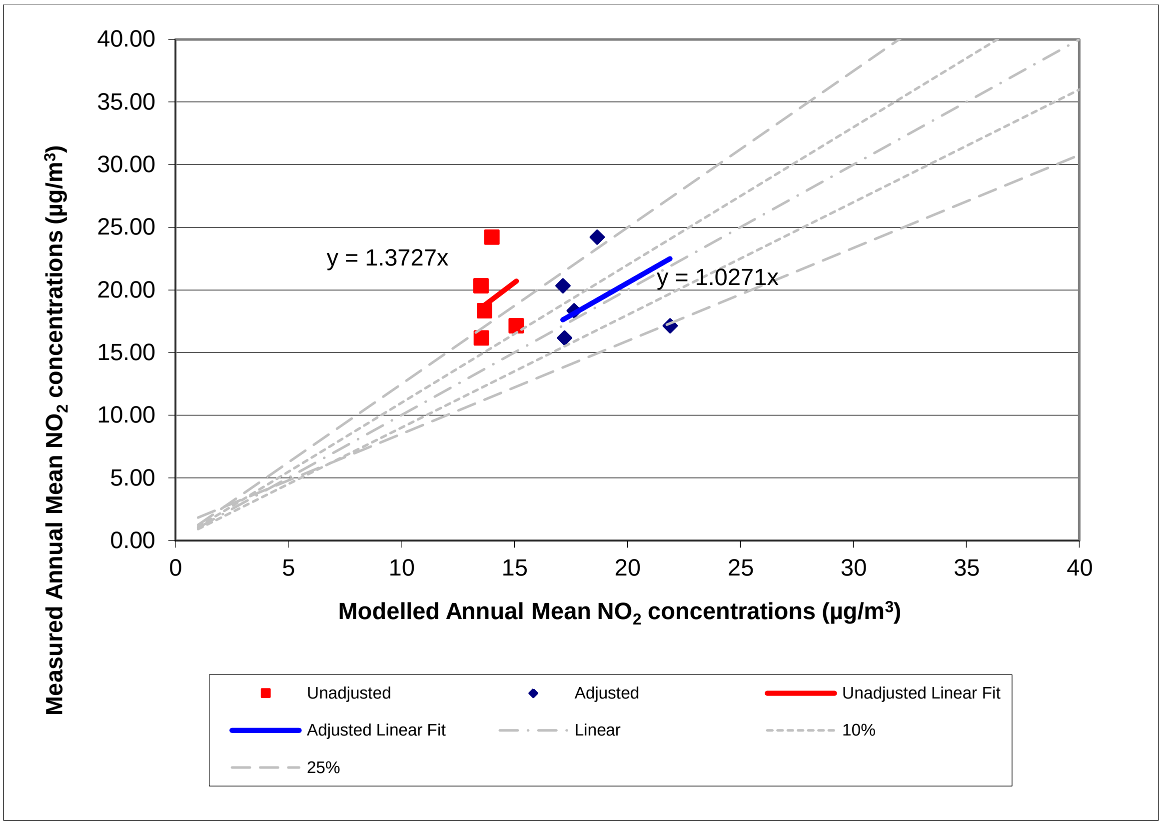
Table 7A.24: Summary of Bias Adjustment Process

DIFFUSION TUBE	2017 ANNUALISED MONITORED ROAD NO_X	2015 ANNUAL MEAN MODELLED ROAD NO_X (µg/m^3) *BEFORE ADJUSTMENT*	2015 ANNUAL MEAN MODELLED ROAD NO_X (µg/m^3) *AFTER ADJUSTMENT*	VERIFICATION FACTOR FOR ROAD NO_X ADJUSTMENT
KOA T2	18.3	3.5	11.2	3.17
KOA T3	17.1	6.2	19.7	
KOA T4	16.1	3.3	10.3	
KOA T5	24.2	4.2	13.2	
KOA T6	20.3	3.2	10.2	

4.68 The red dots on the graph (Graph 7A.1) show the variation of the unadjusted modelled concentration of total annual mean NO_2 at the measurement locations in the whole traffic study area. The blue dots show the adjusted modelled concentration at the total annual mean at the measurement locations. The comparison of measured and modelled concentrations here suggests that the model over-predicted and under-predicted at various locations in the study area. Therefore a bias adjustment factor was required; the factor of 3.17 was applied to the modelled road NO_X.

4.69 The uncertainty in the model has been assessed by comparing the adjusted modelled predictions to the measured concentrations of NO_2 and calculating the RMSE. LAQM TG(16) (Defra, 2016) identifies a standard of model uncertainty expressed as an RMSE value that is within 10% of the objective value as the idea for annual mean nitrogen dioxide 10% of the objective value is 4 µg/m^3. A RMSE value for the whole study area of 3.6 µg/m^3 was obtained for the adjusted model predictions, which being below 4 µg/m^3, is evidence of a robust level of performance from the model.

Graph 7A.1: Modelled NO_2 verses Monitored NO_2 for the whole road traffic study area



4.70 There is insufficient roadside measurement data for the primary pollutants PM_{10} or $PM_{2.5}$ within the study area. The same bias adjustment factor derived for the modelled contributions of the primary pollutant NO_X has been applied to the modelled road PM_{10} and $PM_{2.5}$ contributions, as recommended in LAQM.TG(16).

Calculation of Combined Impacts on Annual Mean NO_2, PM_{10} and $PM_{2.5}$ Concentrations (Stacks and Road Traffic Emissions)

4.71 The combined impact of stack emissions and road traffic emissions has been determined for a selection of sensitive receptors in close proximity to local roads affected by the development. These receptors are listed in Table 7A.16.

4.72 In the case of NO_2, the conversion of NO_X to NO_2 is calculated separately for each emission source, using the methods set out above. The combined change in annual mean NO_2 concentrations is calculated by adding together the respective changes predicted from the two assessments.

4.73 The combined change in annual mean PM_{10} and $PM_{2.5}$ concentrations is calculated by adding together the changes predicted in the respective process emission and road traffic emission assessments.

Predicting the Number of Days in which the Particulate Matter 24-hour Mean Objective is Exceeded

4.74 The guidance document LAQM.TG(03) (Defra, 2003) sets out the method by which the number of days in which the particulate matter 24 hr objective is exceeded can be obtained based on a relationship with the predicted particulate matter annual mean concentration. The most recent guidance LAQM.TG(16) suggests no change to this method. As such, the formula used within this assessment is:

$$No.of\ Exceedances = 0.0014 * \ C^3 + \frac{206}{C} - 18.5$$

4.75 Where C is the annual mean concentration of PM_{10}.

Predicting the Number of Days in which the Nitrogen Dioxide Hourly Mean Objective is Exceeded

4.76 Research projects completed on behalf of Defra and the Devolved Administrations (Laxen and Marner, 2003, AEAT, 2008), have concluded that the hourly mean nitrogen dioxide objective is unlikely to be exceeded if annual mean concentrations are predicted to be less the 60 µg/m^3.

4.77 In 2003, Laxen and Marner concluded:

"…local authorities could reliably base decisions on likely exceedances of the 1-hour objective for nitrogen dioxide alongside busy streets using an annual mean of 60 µg/m^3 and above."

4.78 The findings presented by Laxen and Marner (2003) are further supported by AEAT (2008) who revisited the investigation to complete an updated analysis including new monitoring results and additional monitoring sites. The recommendations of this report are:

"Local authorities should continue to use the threshold of 60 µg/m^3 NO_2 as the trigger for considering a likely exceedance of the hourly mean nitrogen dioxide objective."

4.79 Therefore this assessment will evaluate the likelihood of exceeding the hourly mean nitrogen dioxide objective by comparing predicted annual mean nitrogen dioxide concentrations at all receptors to an annual mean equivalent threshold of 60 µg/m^3 nitrogen dioxide. Where predicted concentrations are below this value, it can be concluded that the hourly mean nitrogen dioxide objective (200 µg/m^3 NO_2 not to be exceeded more than 18 times per year) will be achieved.

Specialized Model Treatments

4.80 No specialised model treatments have been used in the assessment of road traffic emissions.

5.0 BASELINE AIR QUALITY

Overview

5.1 This section presents the information used to evaluate the background and baseline ambient air quality in the area surrounding the Proposed Development. The following steps have been taken in the determination of background values. Where appropriate, the study focuses on data gathered in the vicinity of the Site:

- Identification of Air Quality Management Areas;
- Review of North East Lincolnshire District Council ambient monitoring data;
- Review of data from data from Defra's Automatic Urban and Rural Network (AURN);
- Review of other monitoring undertaken in the area around the Site; and
- Review of background data and Site relevant critical loads from the APIS website.

Air Quality Management Areas

5.2 North East Lincolnshire District Council has one Air Quality Management Area (AQMA) declared. The Grimsby AQMA was declared in 2010 and includes several properties on Cleethorpe Road in Grimsby. This AQMA has been declared due to an exceedance of the annual mean NO_2 air quality objective values. This AQMA is located 5.2 km south-east of the Proposed Development.

Local Authority Ambient Monitoring Data

North East Lincolnshire District Council

5.3 NELDC currently undertake monitoring within Immingham and Grimsby (NELDC, 2017). NELDC report 32 locations for NO_2 diffusion tube monitoring, and three continuous monitors (three for NO_2, and one for PM_{10}). The nearest NO_2 continuous monitor CM2 is located on Kings Road in Immingham 3.7 km north-east of the Site.

5.4 The majority of the monitoring locations are below the annual mean nitrogen dioxide objective of 40 µg/m^3. However, the continuous monitoring located within Grimsby AQMA has recorded annual mean concentrations above the nitrogen dioxide objective value between 2014 and 2016.

5.5 A summary of the pollutant concentrations obtained from continuous monitoring stations and diffusion tube sites near to the Proposed Development operated by North East Lincolnshire District Council are presented in Table 7A.25. The prefix DIF represents diffusion tube and CM represents continuous monitor.

Table 7A.25: Summary of Monitored Annual Mean Concentrations of NO_2 within North East Lincolnshire District Council

SITE NAME	SITE LOCATION	NATIONAL GRID REFERENCE	DISTANCE TO FACILITY	ANNUAL MEAN CONCENTRATION (µg/m^3)		
				2014	2015	2016
DIF14	113 Cleethorpe Road, Grimsby	527761, 410446	5.3 km south-east	36.8	34.7	37.3
DIF15	123 Cleethorpe Road,	527802, 410436	5.3 km south-east	38.2	30.8	35.7

SITE NAME	SITE LOCATION	NATIONAL GRID REFERENCE	DISTANCE TO FACILITY	ANNUAL MEAN CONCENTRATION (µg/m^3)		
				2014	2015	2016
	Grimsby					
DIF16	6 Freeman Street, Grimsby	527693, 410423	5.3 km south-east	32.2	28.8	33.0
DIF21	9 Pyewipe Road, Grimsby	526074, 410112	4.2 km south-east	33.2	31.2	33.2
DIF22	Great Coates/ Yarborough Road, Grimsby	524593, 408863	4.4 km south-east	30.7	26.0	28.6
CM3	Cleethorpe Road, Grimsby	527551, 410428	5.3 km south-east	**47.2**	**46.5**	**41.6**
DIF23	Kings Road, Immingham	519193, 415279	3.8 km north-west	31.1	28.6	32.6
DIF24	Kings Road, Immingham	519193, 415279	3.8 km north-west	29.8	31.0	32.4
DIF25	Kings Road, Immingham	519193, 415279	3.8 km north-west	33.0	30.5	34.9
CM2	Kings Road, Immingham	519193, 415279	3.8 km north-west	33.4	27.2	28.2

Defra Background Data

5.6 Defra's 2015-based background maps (Defra, 2018b) are available at a 1x1 km resolution for the UK for the years 2015– 2030. These projections of pollution concentrations across England are available for NO_2, NO_X, PM_{10} and $PM_{2.5}$.

5.7 Background concentrations from the Defra 2015-based background maps are presented for the year 2015 in Table 7A.15, taken for the grid square in which the Proposed Development is located for NO_X, NO_2, PM_{10} and $PM_{2.5}$. Background concentrations for SO_2, CO and benzene are not available for the most recent Defra maps. Therefore 2001-based background concentrations are presented in Table 7A.26. The NH_3 background concentration is from the APIS website, concentrations of which are presented in Table 7A.17 (CEH, 2018).

Table 7A.26: Defra Background Concentrations

POLLUTANT	BACKGROUND CONCENTRATION (µg/m^3)
NO_X	26.7
NO_2	18.2
PM_{10}	15.6
$PM_{2.5}$	10.7

POLLUTANT	BACKGROUND CONCENTRATION (µg/m^3)
SO_2	16.7
Benzene	0.368
CO	258

Project Specific Monitoring

5.8 Table 7A.16 summarises the diffusion tube monitoring carried out near to the Site from the 29th June 2016 to 20th September 2018. The diffusion tubes have been adjusted for seasonal bias using Hull Freetown, York Bootham and Scunthorpe Town AURN sites, and the Staffordshire Scientifics bias adjustment factor for 20% TEA in water of 0.88 has been applied.

Table 7A.27: Summary of Project Specific Diffusion Tube Monitoring in 2018

LOCATION	AVERAGE FOR MONTH 1 TO 3 (29/06/18 TO 20/09/18) (µg/m^3)	BIAS ADJUSTED TO 2017 ANNUAL MEAN NO_2 CONCENTRATION (µg/m^3)
KOA T1	9.8	11.8
KOA T2	15.2	18.3
KOA T3	14.2	17.1
KOA T4	13.4	16.1
KOA T5	20.0	24.2
KOA T6	16.5	20.3

5.9 All of the diffusion tubes located in the study area have annualised nitrogen dioxide concentrations below the Environmental Standard of 40 µg/m^3.

5.10 Background NO_X concentrations were derived from NO_2 measurement data recorded at location KOA T1. The ratio of NO_2 and NO_X from Defra background squares near to the ecological receptor location E1 were compared, and the average ratio of NO_X to NO_2 was 1.45. This conversion was then applied the KOA T1 NO_2 value of 11.8 µg/m^3, to give an NO_X concentration of 17.1 µg/m^3.

5.11 For the background 24-hour mean NO_X concentration, the annual mean value of 17.1 µg/m^3 was multiplied by 1.5.

Summary of Background Air Quality

5.12 The selected background concentrations for each of the pollutants considered within the assessment are listed in Table 7A.17. The background annual mean concentration values for NO_2, PM_{10} and $PM_{2.5}$ presented in Table 7A.17 do not account for the variation of existing concentrations made by road traffic across the modelled domain. Baseline concentrations (background plus road traffic) of these pollutants are considered further in

5.13 Table 7A.28 to Table 7A.31.

5.14 In order to represent a conservative approach, it has been assumed that background concentrations will not decrease in future years. Therefore the current background concentrations have been assumed to apply to` the projected opening year of 2022.

5.15 The background NO_2, PM_{10} and $PM_{2.5}$ concentrations have been sourced from Defra's 2015 based 1x1 km projected background maps. The only exception is in the case of R21, where the background NO_2 concentration was sourced from the measured 2016 concentration at DFT 124 located near to the Grimsby AQMA.

5.16 The background NO_X concentrations for ecological receptors were sourced from APIS using the location specific tool for the Humber Estuary. For the salt marsh in closest proximity to the Proposed Development, a background NO_X concentration for E1 was derived based on NO_2 measured at this location a part of the project specific monitoring survey.

5.17 The background concentration for benzene, SO_2 and CO has been taken from Defra's 2001-based 1x1 km projected background maps.

5.18 The background concentration used for NH_3 is the Humber Estuary Salt Marsh (E1_1 to E1_3) concentration obtained from the APIS website.

5.19 Background concentrations of HF have been taken from the EPAQS report on Halogens and Hydrogen Halides in Ambient Air, which includes a consideration of background concentrations of these pollutants in the UK (EPAQS, 2006).

5.20 Background concentrations of HCl have been obtained from Stoke Ferry for 2015 (Defra, 2018c).

5.21 The PAH, Pb, As, Cd, Cr, Cu, Mn, Ni and V concentration have been obtained from Scunthorpe Low Santon for 2017 (Defra, 2018c).

5.22 The Hg and Sb concentrations were obtained from the maximum monitored concentration at all urban industrial sites across the UK from 2012 to 2016.

5.23 The PCB, dioxin and furan concentrations were sourced from Manchester Law Courts from 2016 to 2017. This site was most representative of the industrial nature of the Proposed Development (Defra, 2018c).

5.24 The ratio of total Cr to Cr(VI) in ambient air varies, depending on local emission sources. A review of information by the UK's Expert Panel on Air Quality Standards (EPAQS) indicates that Cr(VI) constitutes between 3% and 33% of airborne Chromium (EPAQS, 2009) , while the US Department of Health suggests the ratio is between 10% and 20% (US Department of Health and Human Services Public Health Service Agency for Toxic Substances and Disease Registry, 2008). For this assessment, it is considered that a 20% Cr (VI) to total Cr ratio is a conservative assumption, given the lack of known local sources of this substance.

Where Defra data have been used in the assessment, short-term background concentrations have been calculated by multiplying the selected annual mean background concentration by a factor of two LAQM TG(16). For 24-hour PM_{10} background concentration the annual mean background concentration was multiplied by a factor of 1.5. For these data, the values for the grid square in which the stacks lie are presented in

5.25 Table 7A.28, although concentrations applied to receptors in the assessment vary according to which 1x1 km grid square they lie in.

Table 7A.28: Background Concentrations Selected for use in the Assessment

POLLUTANT	BACKGROUND CONCENTRATION (µg/m^3)		SOURCE
	LONG-TERM	SHORT-TERM	
NO_2	11.8	23.6	Project specific monitoring, measured concentration annualised to 2017. Short-term concentration is 2 times long-term concentration. Used for receptors R1 to R20.
NO_2	37.3	-	North-east Leicestershire Council diffusion tube 14 located within Grimsby AQMA. Used as the background NO_2 concentration for R21.
NO_X	29.19 17.11	43.79 25.67	E1 from APIS E1 from project specific monitoring
	27.34	41.01	E2_1 from APIS
	28.70	43.05	E2_2 to E2_4 from APIS
	37.1	55.65	E3 from APIS
	22.75	34.13	E4_1 to E4_4 from APIS
	21.22	31.83	E4_5 to E4_6 and E5_2 to E5_5 from APIS
	22.75	34.13	E5_1 from APIS
	19.55	29.33	E5_6 to E5_10 from APIS
PM_{10}	15.6	23.5	Defra background value for 2015. 24-hour concentration is 1.5 times long-term concentration
$PM_{2.5}$	10.7	-	Defra background value for 2015. Short-term concentration is double long-term concentration
SO_2	16.7	33.4	Defra background value for 2001. Short-term concentration is double long-term concentration
Benzene	0.368	-	Defra background value for 2001. Short-term concentration is double long-term concentration
HCl	0.2	0.4	Background concentration from Stoke Ferry for 2015.
HF	0.003	0.006	Long-term background concentrations from EPAQS. Short-term concentration is double long-term concentration.
CO	129	258	Defra background value for 2001. Short-term concentration is double long-term concentration
Total PAH	8.23×10^{-4}	-	Measured concentration from Scunthorpe Low Stanton for 2017
B[a]P	8.23×10^{-4}	-	Measured concentration from Scunthorpe Low Stanton for 2017
Pb	1.85×10^{-1}	-	Measured concentration from

POLLUTANT	BACKGROUND CONCENTRATION ($\mu g/m^3$)		SOURCE
	LONG-TERM	SHORT-TERM	
			Scunthorpe Low Stanton for 2017
Cd	4.72×10^{-4}	-	Measured concentration from Scunthorpe Low Stanton for 2017
Hg	2.0×10^{-3}	4.0×10^{-3}	Maximum monitored concentration at all urban industrial sites across the UK 2012 to 2016
Sb	7.8×10^{-4}	1.56×10^{-3}	Maximum monitored concentration at all urban industrial sites across the UK 2012 to 2016
As	1.01×10^{-3}	-	Measured concentration from Scunthorpe Low Stanton for 2017
Cr, as Cr (II) compounds and Cr (III) compounds	4.02×10^{-3}	8.04×10^{-3}	Measured concentration from Scunthorpe Low Stanton for 2017
Cu	5.72×10^{-3}	1.14×10^{-2}	Measured concentration from Scunthorpe Low Stanton for 2017
Mn	1.06×10^{-1}	2.12×10^{-1}	Measured concentration from Scunthorpe Low Stanton for 2017
Ni	1.22×10^{-3}	-	Measured concentration from Scunthorpe Low Stanton for 2017
V	1.17×10^{-2}	2.34×10^{-2}	Measured concentration from Scunthorpe Low Stanton for 2017
NH_3	1.23	2.46	APIS website for the salt marsh (E1_1 to E1_3) part of Humber Estuary. Short-term concentration is double long-term concentration
PCBs	1.05×10^{-5}	2.10×10^{-5}	Measured concentration from Manchester Law Courts for 2016 to 2017.
Dioxins and furans	1.2×10^{-5}	-	Measured concentration from Manchester Law Courts for 2016 to 2017.

Predicted Baseline Pollutant Concentrations of NO_2, PM_{10} and $PM_{2.5}$ at Discrete Receptors Close to Roads

5.26 The direct contribution of baseline road traffic emissions to annual mean background concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been calculated using the ADMS-Roads model, in order to account for the contribution of traffic emissions to the concentration of these pollutants at receptors near to the access route to the Proposed Development. The predicted baseline (background plus road traffic) pollutant concentrations for the scenarios outlined in paragraph 4.58 are presented in Table 7A.29, Table 7A.30, Table 7A.31.

5.27 All receptors within the study area have annual mean NO_2, PM_{10} and $PM_{2.5}$, concentrations below the objective. The 24 hour mean concentrations of PM_{10} are also well below the relevant air quality objective value. The highest predicted baseline NO_2

concentration in the projected opening year is in the area around receptor R21 in the Grimsby AQMA, which is 37.6 µg/m^3 or 94% of the Environmental Standard.

Table 7A.29: Predicted Annual Mean NO_2 Concentrations at Discrete Receptors, Baseline Scenarios

RECEPTOR	BACKGROUND	ANNUAL MEAN CONCENTRATION (BACKGROUND + ROAD TRAFFIC) (µg/m^3)		
		2017 BASELINE	2020 BASE + COMMITTED DEVELOPMENT	2022 BASE + COMMITTED DEVELOPMENT
R1	11.8	18.9	19.5	20.0
R2	11.8	16.3	16.6	16.8
R3	11.8	16.5	16.8	17.0
R4	11.8	18.5	19.0	19.3
R5	11.8	19.2	19.7	20.0
R6	11.8	21.7	22.4	22.7
R7	11.8	24.9	25.7	26.1
R8	11.8	28.2	29.2	29.7
R9	11.8	19.6	20.1	20.4
R10	11.8	17.0	17.4	17.6
R11	11.8	16.4	16.7	16.9
R12	11.8	17.0	17.4	17.6
R13	11.8	18.8	19.3	19.5
R14	11.8	14.5	14.7	14.9
R15	11.8	14.7	15.0	15.2
R16	11.8	15.8	16.2	16.4
R17	11.8	17.0	17.4	17.7
R18	11.8	19.3	19.9	20.3
R19	11.8	17.7	18.2	18.5
R20	11.8	29.8	31.2	32.0
R21	37.3	37.6	37.6	37.6

Table 7A.30: Predicted Annual Mean PM_{10} Concentrations at Discrete Receptors, Baseline Scenarios

RECEPTOR	BKG	2017 BASELINE		2020 BASE + COMMITTED DEVELOPMENT		2022 BASE + COMMITTED DEVELOPMENT	
		ANNUAL MEAN PM_{10} CONC (µg/m^3)	NUMBER OF DAYS 24 HOUR MEAN PM_{10} CONCOF MORE THAN 50 µg/m^3	ANNUAL MEAN PM_{10} CONC (µg/m^3)	NUMBER OF DAYS 24 HOUR MEAN PM_{10} CONCENTRATIONS OF MORE THAN 50 µg/m^3	ANNUAL MEAN PM_{10} CONC (µg/m^3)	NUMBER OF DAYS 24 HOUR MEAN PM_{10} CONC OF MORE THAN 50 µg/m^3
R1	15.6	16.7	1	16.8	1	16.9	1
R2	15.6	16.3	1	16.4	1	16.4	1
R3	15.6	16.4	1	16.4	1	16.5	1

RECEPTOR	BKG	2017 BASELINE		2020 BASE + COMMITTED DEVELOPMENT		2022 BASE + COMMITTED DEVELOPMENT	
		ANNUAL MEAN PM_{10} CONC ($\mu g/m^3$)	NUMBER OF DAYS 24 HOUR MEAN PM_{10} CONCOF MORE THAN 50 $\mu g/m^3$	ANNUAL MEAN PM_{10} CONC ($\mu g/m^3$)	NUMBER OF DAYS 24 HOUR MEAN PM_{10} CONCENTRATIONS OF MORE THAN 50 $\mu g/m^3$	ANNUAL MEAN PM_{10} CONC ($\mu g/m^3$)	NUMBER OF DAYS 24 HOUR MEAN PM_{10} CONC OF MORE THAN 50 $\mu g/m^3$
R4	15.6	16.7	1	16.8	1	16.8	1
R5	15.6	16.8	1	16.9	1	17.0	1
R6	15.6	17.3	1	17.4	1	17.4	1
R7	15.6	17.8	2	18.0	2	18.1	2
R8	15.6	18.4	2	18.6	2	18.7	3
R9	15.6	16.9	1	17.0	1	17.0	1
R10	15.6	16.5	1	16.5	1	16.6	1
R11	15.6	16.4	1	16.4	1	16.5	1
R12	15.6	16.5	1	16.5	1	16.6	1
R13	15.6	16.8	1	16.9	1	16.9	1
R14	15.6	16.1	1	16.1	1	16.1	1
R15	15.6	16.1	1	16.1	1	16.2	1
R16	15.6	16.3	1	16.3	1	16.4	1
R17	15.6	16.5	1	16.5	1	16.6	1
R18	15.6	16.8	1	16.9	1	17.0	1
R19	15.6	16.6	1	16.7	1	16.7	1
R20	15.6	18.7	3	18.9	3	19.1	3
R21	15.6	15.7	1	15.7	1	15.7	1

Table 7A.31: Predicted Annual Mean $PM_{2.5}$ Concentrations at Discrete Receptors, Baseline Scenarios

RECEPTOR	BACKGROUND	ANNUAL MEAN CONCENTRATION (BACKGROUND + ROAD TRAFFIC) ($\mu g/m^3$)		
		2017 BASELINE	2020 BASE + COMMITTED	2022 BASE+ COMMITTED
R1	10.7	11.4	11.4	11.5
R2	10.7	11.1	11.1	11.2
R3	10.7	11.1	11.2	11.2
R4	10.7	11.3	11.4	11.4
R5	10.7	11.4	11.5	11.5
R6	10.7	11.7	11.7	11.8
R7	10.7	12.0	12.1	12.2
R8	10.7	12.4	12.5	12.6
R9	10.7	11.5	11.5	11.5
R10	10.7	11.2	11.2	11.3
R11	10.7	11.1	11.2	11.2

RECEPTOR	BACKGROUND	ANNUAL MEAN CONCENTRATION (BACKGROUND + ROAD TRAFFIC) (μg/m^3)		
		2017 BASELINE	2020 BASE + COMMITTED	2022 BASE+ COMMITTED
R12	10.7	11.2	11.2	11.2
R13	10.7	11.4	11.4	11.5
R14	10.7	10.9	11.0	11.0
R15	10.7	11.0	11.0	11.0
R16	10.7	11.1	11.1	11.1
R17	10.7	11.2	11.2	11.3
R18	10.7	11.4	11.5	11.5
R19	10.7	11.3	11.3	11.3
R20	10.7	12.6	12.7	12.8
R21	10.7	10.7	10.7	10.7

6.0 DISPERSION MODELLING RESULTS

Evaluation of Stack Heights

6.1 This section reports the results of an evaluation of the release height for the stacks serving the combustion process, using the ADMS 5 dispersion model. The selection of an appropriate stack release heights requires a number of factors to be taken into account, the most important of which is the need to balance a release height sufficient to achieve adequate dispersion of pollutants against other constraints such as visual impact.

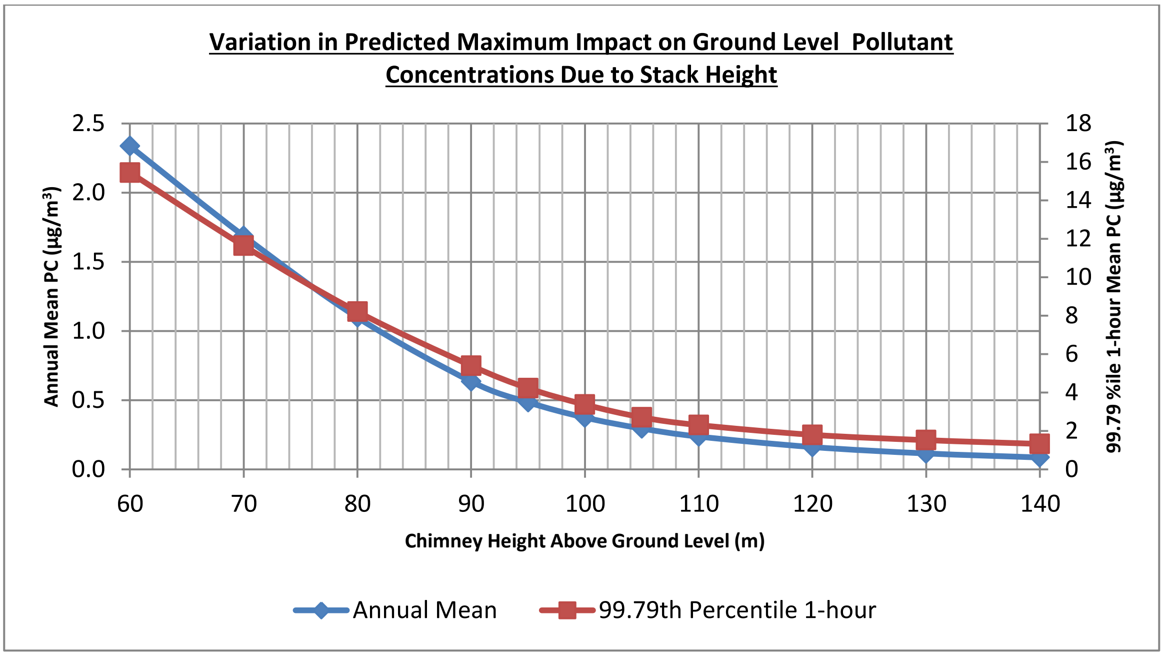
6.2 Emissions from the main stacks have been modelled at heights between 60 m and 140 m, at 10 m increments except for between 90 and 105 where a 5 m increment was used. A graph, showing the PC to annual mean and maximum 1-hour pollutant concentrations for a modelled unit emission rate is presented in Figure 7A.5. The purpose of the graph is to evaluate the optimum release height in terms of the dispersion of pollutants which would occur, against the visual constraints of further increases in release height.

6.3 Analysis of the annual mean curve shows that the benefit of incremental increases in release height up to 90 m is relatively pronounced. At heights above 100 m, the air quality benefit of increasing release height further is reduced.

6.4 The relative benefit of increasing the release height on maximum 1-hour concentrations follows a similar pattern to the annual mean curve. A flattening of the curve is seen at heights of greater than 100 m, above which a reduced improvement in ground level concentrations is predicted with increasing release height.

6.5 The design release height of the main stacks is 100 m above ground level. The graph illustrates that the use of stacks releasing emissions at 100 m above ground level or greater would be capable of mitigating both the short-term and long-term impacts of the modelled emissions of all pollutants, such that no significant adverse effects would occur at any receptor. The incremental benefit of further increases in the release height become less effective in reducing the PC to annual mean ground-level concentrations. It is therefore considered that 100 m represents a height at which the visual impacts of further increases in stack release heights begin to outweigh the benefits to air quality, in terms of human health.

Figure 7A.5: Predicted Process Contribution to Annual Mean Ground Level Pollutant Concentrations at Stacks Release Heights between 60 m and 140 m



Sensitivity of Results to Meteorological Data

6.6 The dispersion modelling assessment has been undertaken using meteorological data from Humberside Airport, for the years 2013 to 2017. Table 7A.32, below, presents the maximum predicted ground-level impact, for a number of the averaging periods evaluated throughout the assessment, for each year of meteorological data within the dataset. The comparison is based on a unit emission rate from the main EFW stacks at a release height of 100 m, and the figure highlighted in bold is the highest value obtained from the five years of meteorological data modelled.

Table 7A.32: Maximum Modelled Impact on Ground Level Concentrations, 1 g/s Emission Rate

MET YEAR	AVERAGING PERIOD AND STATISTIC							
	ANNUAL AVERAGE	1 HR MAX	1 HR 99.79TH %ILE	1 HR 99.73RD %ILE	24 HR 99.18TH %ILE	24 HR 90.41ST %ILE	15 MIN 99.9TH %ILE	MAX 8 HR RUNNING MEAN
2013	0.26	4.93	3.33	3.29	1.90	**0.87**	3.62	3.18
2014	0.27	5.62	**3.37**	3.35	2.09	0.94	3.63	3.24
2015	**0.37**	6.54	3.36	**3.33**	**2.27**	1.13	**3.62**	**3.30**
2016	0.26	**7.01**	3.29	3.27	1.74	0.87	3.59	3.09
2017	0.29	4.48	3.31	3.28	2.11	0.95	3.63	3.04

6.7 The results presented in Table 7A.21 demonstrate that there is a variation in the meteorological dataset for which the maximum modelled impact is reported for each averaging period. For this reason, the values reported in the table are the maximum value obtained from modelling each of the five years meteorological data within the assessment. The reported values can therefore be considered to represent a worst-case assessment of impacts that would be experienced during typical meteorological conditions.

Modelling Results for NO_2

Stack Emissions

6.8 Oxides of nitrogen are emitted in the largest quantity (in terms of mass) from the stacks. In view of existing baseline pollutant concentrations and the proximity of major traffic routes near to the Site (the main source of NO_2 in urban areas), emissions of this pollutant would also potentially have the greatest impact on local air quality. This section focuses on the change in local annual mean NO_X and NO_2 concentrations that would occur as a result of the operation of the main stacks and associated road traffic.

6.9 A contour plot, showing the modelled PC to annual mean NO_2 concentrations due to emissions from the main stacks, is presented in Figure 7A-3 of Annex A to this report for the 2015 meteorological year (maximum modelled concentrations). An isoline plot of PC (sometimes referred to as a 'contour' plot) showing the PC to 99.79th percentile of 1-hr NO_2 concentrations is presented in Figure 7A-4 of Annex A to this report for the 2014 meteorological year (maximum modelled concentrations).

6.10 The annual mean contour plot indicates that, with a release height of 100 m above ground level, the maximum PC to ground level NO_2 concentrations would occur approximately 370 m to the north-east of the location of the main stacks in an uninhabited area on the Humber Estuary. At this location, the predicted annual mean NO_2 PC is 1.8 µg/m^3, which is 4.5% of the Environmental Standard. The PEC is 20 µg/m^3 which is 50% of the Environmental Standard.

6.11 The area where there is a predicted impact on annual mean NO_2 concentrations of 0.4 µg/m^3 or more is restricted to an area extending approximately 370 m to the north-east of the Proposed Development. This area represents 1% of the annual mean Environmental Standard for NO_2. Beyond this distance, the direct effect of emissions from the Proposed Development stacks on annual mean NO_2 concentrations can be considered to be insignificant.

6.12 The largest predicted increase in 99.79th percentile of hourly means NO_2 concentrations occur in close proximity to the main stacks. The maximum predicted PC to short term NO_2 concentrations is 13.6 µg/m^3. Such an impact is 6.8% of the 99.79th percentile 1-hour Environmental Standard for NO_2 of 200 µg/m^3.The PEC in the area around the location of maximum impact is 50 µg/m^3, which is 25% of the Environmental Standard.

Change in Annual Mean NO_2 Concentrations at Discrete Receptors during the Construction Phase

6.13 The predicted change in annual mean NO_2 concentrations, that would occur during the traffic associated with construction works, at the selected sensitive receptors, are presented in Table 7A.34. Any errors in the addition of PC to the baseline concentrations are due to rounding only.

6.14 The maximum predicted change in annual mean NO_2 concentrations at selected receptors is +0.1 µg/m^3, and this would occur in the vicinity of receptors near to South Marsh Lane and North Moss Lane. The reported change in concentration at this location is predominantly due to the impact of emissions from construction road traffic. The annual mean NO_2 PEC at all of the receptors would remain below the annual mean NO_2 Environmental Standard, therefore the change is not predicted to lead to a risk of the annual mean air quality standard being exceeded.

6.15 The receptor with the highest PEC is receptor R21 at Grimsby AQMA. At this location annual mean NO_2 concentrations are predicted to be 37.5 µg/m^3. At this receptor, a change in annual mean concentrations of +<0.1 µg/m^3 is predicted. Therefore, with the Proposed Development being constructed, annual mean concentrations would remain below the annual mean Environmental Standard for NO_2.

6.16 The significance of the predicted change in annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations during construction in planning terms is discussed in Chapter 7: Air Quality, of the Environmental Statement (ES) Volume I.

Table 7A.33: Predicted Change in Annual Mean NO_2 Concentrations at Discrete Receptors (µg/m^3) due to Emissions construction road traffic emissions, with Comparison against Environmental Standard Criteria

RECEPTOR	2020 BASELINE	CHANGE DUE TO ROAD	PC % ENV STD	PEC	PEC % ENV STD
R1	19.5	+0.1	0.3	19.6	49.1
R2	16.6	+0.1	0.2	16.7	41.8
R3	16.8	+0.1	0.3	16.9	42.3
R4	19.0	+0.1	0.3	19.1	47.8
R5	19.7	+0.1	0.3	19.9	49.6
R6	22.4	+0.1	0.3	22.5	56.2
R7	25.7	+0.1	0.2	25.8	64.4
R8	29.2	+0.1	0.2	29.3	73.1
R9	20.1	+<0.1	0.1	20.1	50.3
R10	17.4	+<0.1	0.1	17.4	43.5
R11	16.7	+<0.1	0.1	16.8	41.9
R12	17.4	+0.1	0.3	17.5	43.7
R13	19.3	+<0.1	0.1	19.3	48.2
R14	14.7	+<0.1	0.1	14.8	37.0
R15	15.0	+<0.1	0.1	15.0	37.5
R16	16.2	+<0.1	0.1	16.2	40.6
R17	17.4	+<0.1	0.1	17.5	43.7
R18	19.9	+<0.1	0.1	19.9	49.8
R19	18.2	+<0.1	0.1	18.2	45.5
R20	31.2	+<0.1	0.1	31.2	78.1
R21	37.6	+<0.1	0.0	37.6	94.0

Change in Annual Mean NO_2 Concentrations at Discrete Receptors during Operational Phase

6.17 The predicted change in annual mean NO_2 concentrations, that would occur during the operation of the Proposed Development, at the selected sensitive receptors, is presented in Table 7A.34. Any errors in the addition of PC to the baseline concentrations are due to rounding only.

6.18 Some of these receptors would also be subject to an increase in annual mean NO_2 concentrations from operational road traffic emissions on the Site access route, in addition to those from the main stacks and the results showing the combined impact of main stacks and road traffic emissions is presented in Table 7A.34.

6.19 The maximum predicted change in annual mean NO_2 concentrations at selected receptors is +0.8 µg/m^3, and this would occur in the vicinity of receptors just north of the A180 and near to South Marsh Lane and North Moss Lane (with +0.6 µg/m^3 from road traffic and +0.2 µg/m³ from the Proposed Development). The reported change in concentration at this location is predominantly due to the impact of emissions from road traffic. The annual mean NO_2 PEC at all receptors would remain below the annual mean NO_2 Environmental Standard, therefore the change is not predicted to lead to a risk of the annual mean air quality standard being exceeded.

6.20 The receptor with the highest PEC is receptor R21 in Grimsby AQMA. At this location annual mean NO_2 concentrations are predicted to be 37.3 µg/m³. At this receptor, a change in annual mean concentrations of +0.1 µg/m³ is predicted (+<0.1 µg/m³ from road traffic and +0.1 µg/m³ from stack emissions. Therefore, with the Proposed Development in operation, annual mean concentrations would remain below the annual mean Environmental Standard for NO_2, and any measured exceedance at this location would not be directly caused by the operation of the Proposed Development.

6.21 The discrete receptor most affected by emissions from the main stacks is receptor R8 located on north of the A180, with a PC to annual mean NO_2 concentrations of 0.8 µg/m³ with 0.6 µg/m³ of annual mean NO2 concentration sourced from road traffic emissions.

6.22 Based on the results of the modelling, it is predicted that the operation of the Proposed Development would not directly increase the risk of an exceedance of the annual mean Environmental Standard for NO_2. At receptors exposed to annual mean concentrations of NO_2 of 40 µg/m³ or less, it is also highly unlikely that the hourly mean limit value would be exceeded at receptors located near to affected traffic routes.

6.23 The significance of the predicted change in annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations during operation is discussed in Chapter 7: Air Quality in ES Volume I.

Table 7A.34: Predicted Change in Annual Mean NO_2 Concentrations at Discrete Receptors (µg/m³) due to Emissions from the Proposed Development and operational road traffic emissions, with Comparison against Environmental Standard Criteria

RECEPTOR	2022 BASELINE SCENARIO	CHANGE DUE TO ROAD	PC PROPOSED DEVELOPMENT STACKS	TOTAL PC % ENV STD	PEC	PEC % ENV STD
R1	20.0	+0.4	+0.1	1.2	20.5	51.2
R2	16.8	+0.3	+0.2	1.4	17.4	43.5
R3	17.0	+0.3	+0.3	1.6	17.6	44.1
R4	19.3	+0.4	+0.3	1.6	19.9	49.7
R5	20.0	+0.4	+0.3	1.6	20.7	51.6
R6	22.7	+0.4	+0.3	1.7	23.4	58.5
R7	26.1	+0.5	+0.3	1.8	26.9	67.2
R8	29.7	+0.6	+0.2	2.0	30.5	76.2
R9	20.4	+0.3	+0.2	1.2	20.8	52.1
R10	17.6	+0.2	+0.2	1.0	17.9	44.9
R11	16.9	+0.2	+0.2	0.9	17.3	43.1
R12	17.6	+0.3	+0.2	1.1	18.0	45.0
R13	19.5	+0.2	+0.1	0.8	19.8	49.5
R14	14.9	+0.2	+0.1	0.6	15.1	37.8
R15	15.2	+0.1	+0.1	0.5	15.3	38.4
R16	16.4	+0.2	+0.1	0.6	16.7	41.6
R17	17.7	0.2	0.1	0.7	18.0	44.9
R18	20.3	0.2	0.1	0.7	20.5	51.4

RECEPTOR	2022 BASELINE SCENARIO	CHANGE DUE TO ROAD	PC PROPOSED DEVELOPMENT STACKS	TOTAL PC % ENV STD	PEC	PEC % ENV STD
R19	18.5	0.2	+<0.1	0.5	18.7	46.6
R20	32.0	0.4	+<0.1	1.0	32.4	81.1
R21	37.6	+<0.1	0.1	0.2	37.7	94.2

Modelling Results for PM_{10} and $PM_{2.5}$ for construction phase

6.24 Change in annual mean PM_{10} and $PM_{2.5}$ concentrations at discrete receptors that would occur from the road traffic associated with the construction of the Proposed Development, at the selected sensitive receptors, is presented in Table 7A.35 and Table 7A.36. Any errors in the addition of PC to the baseline concentrations are due to rounding only.

6.25 The maximum predicted change in annual mean PM_{10} and $PM_{2.5}$ concentrations at the selected receptors is +<0.1 µg/m^3. This change in annual mean PM_{10} and $PM_{2.5}$ concentrations would not be a perceptible at air quality sensitive receptors, nor would it result in additional days on which the PM_{10} 24-hour objective is exceeded.

6.26 The modelling results show that predicted annual mean concentrations are well below the respective Environmental Standards for PM_{10} and $PM_{2.5}$.

Table 7A.35: Predicted Change in Annual Mean PM_{10} Concentrations at Discrete Receptors (µg/m^3) due to Emissions from road traffic associated with construction of the Proposed Development, with Comparison against Environmental Standard

RECEPTOR	2020 BASELINE	CHANGE DUE TO ROAD	PC % ENV STD	PEC	PEC % ENV STD
R1	16.8	+<0.1	0.0	16.8	42.1
R2	16.4	+<0.1	0.0	16.4	41.0
R3	16.4	+<0.1	0.0	16.4	41.1
R4	16.8	+<0.1	0.1	16.8	42.0
R5	16.9	+<0.1	0.0	16.9	42.3
R6	17.4	+<0.1	0.1	17.4	43.5
R7	18.0	+<0.1	0.0	18.0	45.0
R8	18.6	+<0.1	0.0	18.6	46.6
R9	17.0	+<0.1	0.0	17.0	42.5
R10	16.5	+<0.1	0.0	16.5	41.4
R11	16.4	+<0.1	0.0	16.4	41.1
R12	16.5	+<0.1	0.0	16.5	41.3
R13	16.9	+<0.1	0.0	16.9	42.2
R14	16.1	+<0.1	0.0	16.1	40.2
R15	16.1	+<0.1	0.0	16.1	40.3
R16	16.3	+<0.1	0.0	16.3	40.8
R17	16.5	+<0.1	0.0	16.5	41.3
R18	16.9	+<0.1	0.0	16.9	42.4
R19	16.7	+<0.1	0.0	16.7	41.7
R20	18.9	+<0.1	0.0	19.0	47.4
R21	15.7	+<0.1	0.0	15.7	39.2

Table 7A.36: Predicted Change in Annual Mean $PM_{2.5}$ Concentrations at Discrete Receptors ($\mu g/m^3$) due to Emissions from road traffic associated with construction with Comparison against Environmental Standard

RECEPTOR	2020 BASELINE	CHANGE DUE TO ROAD	PC % ENV STD	PEC	PEC % ENV STD
R1	11.4	+<0.1	0.0	11.4	45.7
R2	11.1	+<0.1	0.0	11.2	44.6
R3	11.2	+<0.1	0.0	11.2	44.7
R4	11.4	+<0.1	0.0	11.4	45.6
R5	11.5	+<0.1	0.0	11.5	45.9
R6	11.7	+<0.1	0.1	11.8	47.0
R7	12.1	+<0.1	0.0	12.1	48.5
R8	12.5	+<0.1	0.0	12.5	50.1
R9	11.5	+<0.1	0.0	11.5	46.1
R10	11.2	+<0.1	0.0	11.2	45.0
R11	11.2	+<0.1	0.0	11.2	44.7
R12	11.2	+<0.1	0.0	11.2	44.9
R13	11.4	+<0.1	0.0	11.4	45.7
R14	11.0	+<0.1	0.0	11.0	43.9
R15	11.0	+<0.1	0.0	11.0	44.0
R16	11.1	+<0.1	0.0	11.1	44.4
R17	11.2	+<0.1	0.0	11.2	44.9
R18	11.5	+<0.1	0.0	11.5	45.9
R19	11.3	+<0.1	0.0	11.3	45.2
R20	12.7	+<0.1	0.0	12.7	50.9
R21	10.7	+<0.1	0.0	10.7	42.9

Modelling Results for PM_{10} and $PM_{2.5}$ for operational phase

6.27 Change in annual mean PM_{10} and $PM_{2.5}$ concentrations at discrete receptors from the operation of the Proposed Development and associated road traffic, at the selected sensitive receptors, is presented in Table 7A.37 and Table 7A.38.

6.28 The maximum predicted change in annual mean PM_{10} and $PM_{2.5}$ concentrations at the selected receptors is +<0.1 $\mu g/m^3$. This change in annual mean PM_{10} and $PM_{2.5}$ concentrations would not be a perceptible at air quality sensitive receptors, nor would it result in additional days on which the PM_{10} 24-hour objective is exceeded.

6.29 The modelling results show that predicted annual mean concentrations are well below the respective Environmental Standards for PM_{10} and $PM_{2.5}$.

Table 7A.37: Predicted Change in Annual Mean PM_{10} Concentrations at Discrete Receptors ($\mu g/m^3$) due to stack emissions and road traffic emissions, with Comparison against Environmental Standard

RECEPTOR	2022 BASELINE	CHANGE DUE TO ROAD	PC PROPOSED DEVELOPMENT STACKS	PC % ENV STD	PEC	PEC % ENV STD
R1	16.9	+<0.1	+<0.1	0.1	16.9	42.4
R2	16.4	+<0.1	+<0.1	0.1	16.5	41.2
R3	16.5	+<0.1	+<0.1	0.1	16.5	41.3

RECEPTOR	2022 BASELINE	CHANGE DUE TO ROAD	PC PROPOSED DEVELOPMENT STACKS	PC % ENV STD	PEC	PEC % ENV STD
R4	16.8	+<0.1	+<0.1	0.2	16.9	42.2
R5	17.0	+0.1	+<0.1	0.2	17.0	42.6
R6	17.4	+0.1	+<0.1	0.2	17.5	43.8
R7	18.1	+0.1	+<0.1	0.2	18.1	45.4
R8	18.7	+0.1	+<0.1	0.3	18.8	47.0
R9	17.0	+<0.1	+<0.1	0.1	17.1	42.7
R10	16.6	+<0.1	+<0.1	0.1	16.6	41.5
R11	16.5	+<0.1	+<0.1	0.1	16.5	41.2
R12	16.6	+<0.1	+<0.1	0.1	16.6	41.5
R13	16.9	+<0.1	+<0.1	0.1	16.9	42.3
R14	16.1	+<0.1	+<0.1	0.1	16.1	40.3
R15	16.2	+<0.1	+<0.1	0.1	16.2	40.4
R16	16.4	+<0.1	+<0.1	0.1	16.4	41.0
R17	16.6	+<0.1	+<0.1	0.1	16.6	41.5
R18	17.0	+<0.1	+<0.1	0.1	17.0	42.6
R19	16.7	+<0.1	+<0.1	0.1	16.7	41.8
R20	19.1	+0.1	+<0.1	0.2	19.2	47.9
R21	15.7	+<0.1	+<0.1	0.0	15.7	39.2

Table 7A.38: Predicted Change in Annual Mean $PM_{2.5}$ Concentrations at Discrete Receptors ($\mu g/m^3$) due to stack emissions and road traffic emissions, with Comparison against Environmental Standard

RECEPTOR	2022 BASELINE	CHANGE DUE TO ROAD	PC PROPOSED DEVELOPMENT STACKS	PC % ENV STD	PEC	PEC % ENV STD
R1	11.5	+<0.1	+<0.1	0.1	11.5	46.0
R2	11.2	+<0.1	+<0.1	0.1	11.2	44.8
R3	11.2	+<0.1	+<0.1	0.2	11.2	44.9
R4	11.4	+<0.1	+<0.1	0.2	11.5	45.8
R5	11.5	+<0.1	+<0.1	0.2	11.5	46.2
R6	11.8	+<0.1	+<0.1	0.2	11.8	47.3
R7	12.2	+<0.1	+<0.1	0.2	12.2	48.9
R8	12.6	+0.1	+<0.1	0.3	12.6	50.6
R9	11.5	+<0.1	+<0.1	0.1	11.6	46.3
R10	11.3	+<0.1	+<0.1	0.1	11.3	45.1
R11	11.2	+<0.1	+<0.1	0.1	11.2	44.9
R12	11.2	+<0.1	+<0.1	0.1	11.3	45.1
R13	11.5	+<0.1	+<0.1	0.1	11.5	45.9
R14	11.0	+<0.1	+<0.1	0.1	11.0	44.0
R15	11.0	+<0.1	+<0.1	0.1	11.0	44.1
R16	11.1	+<0.1	+<0.1	0.1	11.1	44.6
R17	11.3	+<0.1	+<0.1	0.1	11.3	45.1
R18	11.5	+<0.1	+<0.1	0.1	11.5	46.2
R19	11.3	+<0.1	+<0.1	0.1	11.4	45.4
R20	12.8	+<0.1	+<0.1	0.2	12.9	51.4

RECEPTOR	2022 BASELINE	CHANGE DUE TO ROAD	PC PROPOSED DEVELOPMENT STACKS	PC % ENV STD	PEC	PEC % ENV STD
R21	10.7	+<0.1	+<0.1	0.0	10.7	42.9

Modelling Results for All Pollutants from the Stacks (for the Protection of Human Health)

6.30 The maximum Process Contribution (PC) and Predicted Environmental Concentration (PEC) within the modelled domain, for each pollutant and averaging period, are summarised in Table 7A.39. The results are based on emissions from the Proposed Development as presented in Table 7A.39 with 100 m stacks. Predicted concentrations at discrete receptors, incorporating contributions from road traffic sources, are detailed in Table 7A.33 to Table 7A.38, above. In Table 7A.39, it is assumed that Group 3 metals are emitted at 100% of the BAT-AEL (i.e. 0.3 mg/m^3) which is considered to be a worst case scenario.

6.31 The PC listed, in respect of each pollutant and averaging period assessed, is the maximum impact reported from the modelling of five years of meteorological data. The background values used in the calculation of PEC concentrations are as described in Table 7A.17.

6.32 The results show that the maximum PC and PEC values for most of the modelled pollutants are well within their respective Environmental Standard criteria for the protection of human health. The exceptions to this statement are:

- PAH (as B[a]P);
- arsenic; and
- chromium (VI).

6.33 Therefore, the impact on concentrations of these substances have undergone additional consideration, in accordance with EA Group 3 metal stack emission guidance. Use has been made of additional information on emissions of B[a]P from other facilities in the UK in the following sections.

Table 7A.39: 100 m Stacks, Maximum Process Contribution and Predicted Environmental Concentration, all Modelled Pollutants, for the Worst Case Meteorological Data Year

POLLUTANT	AVERAGING PERIOD	ENV STD (µg/m^3)	PC	PC % ENV STD	PEC	PEC % ENV STD
NO_2	Annual Mean	40	2.09	5.2	13.9	35
	99.79th %ile of 1-hour means	200	9.42	4.7	33.0	17
PM_{10}	Annual Mean	40	0.12	0.3	15.8	39
	90.41st %ile of 24-hour means	50	0.38	0.8	23.8	48
$PM_{2.5}$	Annual Mean	25	0.12	0.5	10.8	43
SO_2	Annual Mean	50	0.75	1.5	17.4	35
	99.9th %le of	266	7.25	2.7	40.7	15

POLLUTANT	AVERAGING PERIOD	ENV STD (µg/m^3)	PC	PC % ENV STD	PEC	PEC % ENV STD
	15-min means					
	99.73rd %ile of 1-hour means	350	6.69	1.9	40.1	11
	99.18th %ile of 24-hour means	125	4.53	3.6	37.9	30
VOC, as Benzene	Annual Mean	5	0.25	5.0	0.62	12
CO	Max daily 8-hr running mean	10,000	10.98	0.1	269.0	3
	Max 1-hour mean	30,000	23.34	0.1	281.3	1
HCl	Max 1-hour mean	750	2.80	0.4	3.00	0.4
HF	Monthly mean	16	0.47	2.9	0.47	3
	Max 1-hour mean	160	0.47	0.3	0.47	0.3
PAH (as BaP)	Annual Mean	0.00025	0.00025	99.6	0.001	429
Pb	Annual Mean	0.25	0.00747	3.0	0.192	77
Cd	Annual Mean	0.005	0.0005	10.0	0.0010	19
Hg	Annual Mean	0.25	0.00050	0.2	0.00250	1
	Max 1-hr mean	7.5	0.01	0.1	0.01334	0.2
Sb	Annual Mean	5	0.007	0.1	0.008	0.2
	Max 1-hr mean	150	0.14	0.1	0.14	0.1
As	Annual Mean	0.003	0.01	249.0	0.008	283
Total Cr	Annual Mean	5	0.0075	0.1	0.0115	0.2
	Max 1-hour mean	150	0.1400	0.1	0.1481	0.1
Cr (VI) oxidation state in PM_{10} fraction	Annual Mean	0.0002	0.0075	3735	0.0083	4137
Cu (dusts and mists)	Annual Mean	10	0.0075	0.1	0.013	0.1
	Max 1-hr mean	200	0.140	0.1	0.15	0.1
Mn	Annual Mean	0.15	0.0075	5.0	0.113	76
	Max 1-hr mean	1500	0.1400	0.01	0.35	0.02
Ni	Annual Mean	0.02	0.0075	37.4	0.009	43
V	Annual Mean	5	0.0075	0.1	0.019	0.4
	Max 1-hr mean	1	0.140	14.0	0.16	16

POLLUTANT	AVERAGING PERIOD	ENV STD (µg/m³)	PC	PC % ENV STD	PEC	PEC % ENV STD
NH_3	Annual Mean	180	0.25	0.14	1.48	1
	Max 1-hr mean	2500	4.67	0.19	7.13	0.3
PCBs	Annual Mean	0.2	1.25×10^{-4}	0.06	1.35×10^{-04}	0.07
	Max 1-hr mean	6	2.33×10^{-3}	0.04	2.35×10^{-03}	0.04
Dioxins and Furans	Annual Mean	n/a	1.49×10^{-9}	-	1.20×10^{-05}	-

Additional Consideration of Group 3 Metals Using EA Guidance

6.34 The EA has released guidance on the assessment of Group 3 metals in light of the revised lower Environmental Standard for arsenic, nickel and chromium (VI). As both arsenic and chromium (VI) have PECs above their respective Environmental Standards when modelled on a worst-case screening basis, these metals are considered further following this guidance.

6.35 The second step in the assessment is to revise the predicted impacts using emissions data which have been measured by the EA at municipal waste incinerators. Table 7A.40 presents the revised PC and PEC values within the modelled domain, for arsenic and chromium (VI) using the mean, maximum and minimum emission concentrations provided by the EA guidance.

6.36 The results show that the although the PC with minimum and mean Cr(VI) emission concentrations can be screened out as insignificant, the maximum PC is slightly above 1% of the Environmental Standard. The PEC for Cr(VI) is above the Environmental Standard criteria for the maximum emission scenario, due to the background value used. As can be seen in Figure 7A-3, however, the location of predicted maximum annual mean impacts is within the Humber Estuary where there is no human presence. The impact on concentrations in air on land, at sensitive receptor locations where relevant exposure occurs, would in practice be far below (less than half) the maximum and it can therefore be concluded with confidence that the impact on annual mean Cr(VI) concentrations within the study area would not be significant, even if the Proposed Development emits the maximum concentration within the range presented by the EA.

6.37 The arsenic PC calculated using the EA's maximum emission concentrations represents 15% of the Environmental Standard. Taking into account the measured background, the PEC is only 54% of the Environmental Standard and it is therefore concluded that there would not be a risk of annual mean arsenic concentrations of more than the air quality standard occurring with the Proposed Development in operation, and arsenic can be screened out as not significant.

Table 7A.40: 100 m Stacks, Maximum Process Contribution and Predicted Environmental Concentration, for As and Cr (VI), for the Worst Case Meteorological Year

POLLUTANT	AVERAGING PERIOD	ENV STD (µg/m³)	PC	PC % ENV STD	PEC	PEC % ENV STD

POLLUTANT		AVERAGING PERIOD	ENV STD (µg/m³)	PC	PC % ENV STD	PEC	PEC % ENV STD
Cr (VI)	Mean emissions	Annual Mean	0.0002	8.72×10^{-7}	0.44	8.05×10^{-4}	402
	Max emissions	Annual Mean	0.0002	3.24×10^{-6}	1.62	8.07×10^{-4}	404
	Min emissions	Annual Mean	0.0002	5.73×10^{-8}	0.03	8.04×10^{-4}	402
As	Mean emissions	Annual Mean	0.003	2.49×10^{-5}	0.83	1.03×10^{-3}	34
	Max emissions	Annual Mean	0.003	6.23×10^{-4}	20.8	1.63×10^{-3}	54
	Min emissions	Annual Mean	0.003	4.98×10^{-6}	0.17	1.01×10^{-3}	34

Additional Consideration of Benzo[a]Pyrene Emissions

6.38 The results presented in Table 7A.39 showed that the initial assumption that all emissions of PAH from the Proposed Development are composed of benzo[a]pyrene, combined with the assumption that the emission occurs continuously at the ELV, results in a PEC of more than the annual mean Environmental Standard, when combined with the measured background concentration.

6.39 Benzo[a]pyrene emissions have been considered using an emission rate derived from benzo[a]pyrene concentrations measured at a comparable facility operating within the UK. This provides a more realistic basis for assessment, based on emissions from a comparable process.

6.40 The benzo[a]pyrene emission rate used is derived from a measured concentration from the Sheffield ERF in 2012, of 9.7×10^{-6} mg/Nm³. This gives a mass emission rate of 3×10^{-7} g/s per stack. This value has been taken from a published assessment undertaken for another proposed EfW by AECOM (AECOM, 2016).

6.41 Using this revised emission rate for benzo[a]pyrene gives a maximum predicted PC of 0.1% of the Environmental Standard. This can be screened out as insignificant.

Table 7A.41: 100 m Stacks, Predicted Process Contribution and Predicted Environmental Concentration, for Cr (VI) and B[a]P, for the Worst Case Meteorological Data Year, using measured Emissions Data from a comparable facility

POLLUTANT	AVERAGING PERIOD	ENV STD (µg/m³)	PC	PC % ENV STD	PEC	PEC % ENV STD
B[a]P	Annual Mean	2.5×10^{-4}	2.42×10^{-7}	0.10	8.23×10^{-4}	329

Modelling Results: Short Term Emissions

6.42 The IED half hour emission rate limit values set out in Table 7A.14 are short term standards permitted over a 30 minute averaging period. Although short term fluctuations in emission rates can occur, the daily mean emission limit still needs to be achieved so these excursions would be required to be short-term and infrequent in nature. For this reason, the use of daily emission rates in the dispersion modelling is considered to be a robust approach to the assessment of the impact of the Proposed Development. Additionally, the short-term Environmental Standards for the pollutants considered within the assessment are largely expressed as averaging periods of one hour or more. Overall, higher emissions of less than 30 minutes duration are unlikely to have a significant impact on short-term air quality.

6.43 On a hypothetical basis, however, if the half-hour IED limits are used to evaluate short term impacts, then the modelling confirms that predicted concentrations would remain well within the Environmental Standards. The predicted impacts on short-term pollutant concentrations on the basis of emissions at the half-hour-limit values in Table 7A.14 are presented in Table 7A.42 below.

Table 7A.42: 100 m Stacks, Maximum Process Contribution and Predicted Environmental Concentration, all Modelled Pollutants, for the Worst Case Meteorological Data Year with Emissions at Half Hour IED Emission Limits

POLLUTANT	AVERAGING PERIOD	ENV STD (µg/m^3)	PC (µg/m^3)	PC % ENV STD	PEC (µg/m^3)	PEC % ENV STD
NO_2	99.79th %ile of 1-hour means	27.8	31.4	15.7	55.0	28
PM_{10}	90.41st %ile of 24-hour means	50	2.3	4.5	25.7	51
SO_2	99.9th %le of 15-min means	266	48.4	18.2	81.8	31
	99.73rd %ile of 1-hour means	350	44.6	12.7	78.0	22
	99.18th %ile of 24-hour means	125	30.2	24.2	63.6	51
HCl	Max 1-hour mean	750	28.0	3.7	28.2	4
HF	Max 1-hour mean	160	1.9	1.2	1.9	1

Modelling Results: Impact on Designated Nature Sites

6.44 The results of the dispersion modelling of predicted impacts on sensitive ecological receptors are presented in Table 7A.43 to Table 7A.49. The tables set out the predicted PC to atmospheric concentrations of NO_X, SO_2, NH_3 and HF, and also acid deposition and nutrient nitrogen deposition.

6.45 Specific significance criteria relating to impacts on sensitive designated ecological receptors are set out within the Environmental Agency air emissions risk assessment guidance. The impact of stack emissions can be regarded as insignificant at sites with statutory designations if:

- The long term PC is less than 1% of the critical load or critical level, or if greater than 1% then the PEC is less than 70% of the critical load or critical level.

- The short term PC is less than 10% of the critical load or critical level.

6.46 The impact of stack emissions can be regarded as insignificant at sites of local importance if:

- The long term PC is less than 100% of the critical load or critical level;
- The short term PC is less than 100% of the critical load or critical level

6.47 The assessment results show that the predicted impacts are within the above criteria for insignificance at most of the selected receptors. PCs of more than 1% of the long term critical load or critical level and 10% of a short term critical level have been predicted to occur at the following designated site:

- Humber Estuary Ramsar site, SAC and SPA Atlantic Salt Meadows section (E1_1 to E1_3), in respect of annual mean NO_X.

6.48 At the Humber Estuary SAC and SPA Atlantic Salt Meadows section (E1_1 to E1_3), the PC to annual mean NO_X is predicted to be up to 2.5% of the critical level, and the PEC 100% of the critical level. As most of the reported concentration is due to the standard APIS background value used in the calculations, further analysis was undertaken using background NO_X concentrations from an NO_2 diffusion tube located at E1 during the project specific monitoring survey. This further analysis is displayed in Table 7A.50.

6.49 The alternative background NO_X concentration was derived from NO_2 measurement data recorded at location KOA T1. The ratio of NO_2 and NO_X from Defra background squares near to the ecological receptor location E1 were compared, and the average ratio of NO_X to NO_2 was 1.45. This conversion was then applied the KOA T1 NO_2 value of 11.8 $\mu g/m^3$, to give an NO_X concentration of 17.1 $\mu g/m^3$.

6.50 Using site-specific monitoring, the annual mean NOx is 2.5% of the critical level, however the PEC is 59% of the critical level. This can be screened out as insignificant.

6.51 For the 24 hour mean, the PC is 15.3% of the critical level at the closest affected receptor, the PEC at E1_1 to E1_3 is above 70%.

6.52 The effect of atmospheric NO_X concentrations, nitrogen deposition rates and acid deposition rates on the Humber Estuary Ramsar site, SPA and SAC has been considered in detail in the report to inform the Habitats Regulations Assessment (HRA) Signposting (Appendix 10G in ES Volume III). Please refer to the Chapter 10 in ES Volume 1 for discussion about the significance of stack emissions on sensitive ecological receptors.

Table 7A.43: Dispersion Modelling Results for Humber Estuary Ecological Receptors using APIS background concentrations - NO_X

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKG µg/m³	CRITICAL LEVEL	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m³	CRITICAL LEVEL	PC	PC/ CL	PEC	PEC/CL
E1_1	Humber Estuary (Atlantic Salt Meadows)	29.2	30	0.7	2.4	29.9	100	43.8	75	11.8	15.7	55.6	74
E1_2	Humber Estuary (Atlantic Salt Meadows)	29.2	30	0.7	2.4	29.9	100	43.8	75	11.6	15.5	55.4	74
E1_3	Humber Estuary (Atlantic Salt Meadows)	29.2	30	0.7	2.5	29.9	100	43.8	75	12.2	16.3	56.0	75
E2_1	Humber Estuary (Atlantic Salt Meadows)	27.3	30	0.1	0.5	27.5	92	41.0	75	2.8	3.7	43.8	58
E2_2	Humber Estuary (Atlantic Salt Meadows)	28.7	30	0.1	0.4	28.8	96	43.1	75	2.6	3.5	45.7	61
E2_3	Humber Estuary (Atlantic Salt Meadows)	28.7	30	0.1	0.4	28.8	96	43.1	75	2.3	3.1	45.4	61
E2_4	Humber Estuary (Atlantic Salt	28.7	30	0.1	0.4	28.8	96	43.1	75	2.3	3.0	45.3	60

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKG µg/m³	CRITICAL LEVEL	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m³	CRITICAL LEVEL	PC	PC/ CL	PEC	PEC/CL
	Meadows)												
E3_1	Humber Estuary (Atlantic Salt Meadows)	37.1	30	0.1	0.4	37.2	124	55.7	75	1.7	2.3	57.3	76
E4_1	Humber Estuary (Acid Fixed Dunes)	22.8	30	0.05	0.2	22.8	76	34.1	75	0.7	0.9	34.8	46
E4_2	Humber Estuary (Acid Fixed Dunes)	22.8	30	0.05	0.2	22.8	76	34.1	75	0.6	0.9	34.8	46
E4_3	Humber Estuary (Acid Fixed Dunes)	22.8	30	0.05	0.2	22.8	76	34.1	75	0.6	0.9	34.8	46
E4_4	Humber Estuary (Acid Fixed Dunes)	22.8	30	0.05	0.2	22.8	76	34.1	75	0.6	0.8	34.8	46
E4_5	Humber Estuary (Acid Fixed Dunes)	21.2	30	0.05	0.2	21.3	71	31.8	75	0.6	0.8	32.5	43
E4_6	Humber Estuary (Acid Fixed Dunes)	21.2	30	0.04	0.1	21.3	71	31.8	75	0.6	0.8	32.5	43
E5_1	Humber Estuary (Atlantic Salt Meadows)	22.8	30	0.05	0.2	22.8	76	34.1	75	0.6	0.8	34.7	46
E5_2	Humber Estuary (Atlantic Salt	21.2	30	0.05	0.2	21.3	71	31.8	75	0.6	0.8	32.4	43

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKG µg/m³	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL	BKG µg/m³	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
	Meadows)												
E5_3	Humber Estuary (Atlantic Salt Meadows)	21.2	30	0.05	0.2	21.3	71	31.8	75	0.6	0.8	32.4	43
E5_4	Humber Estuary (Atlantic Salt Meadows)	21.2	30	0.04	0.1	21.3	71	31.8	75	0.6	0.8	32.4	43
E5_5	Humber Estuary (Atlantic Salt Meadows)	21.2	30	0.04	0.1	21.3	71	31.8	75	0.6	0.8	32.4	43
E5_6	Humber Estuary (Atlantic Salt Meadows)	19.6	30	0.04	0.1	19.6	65	29.3	75	0.6	0.8	29.9	40
E5_7	Humber Estuary (Atlantic Salt Meadows)	19.6	30	0.04	0.1	19.6	65	29.3	75	0.6	0.8	29.9	40
E5_8	Humber Estuary (Atlantic Salt Meadows)	19.6	30	0.04	0.1	19.6	65	29.3	75	0.6	0.7	29.9	40
E5_9	Humber Estuary (Atlantic Salt Meadows)	19.6	30	0.04	0.1	19.6	65	29.3	75	0.6	0.7	29.9	40
E5_10	Humber	19.6	30	0.0	0.1	19.6	65	29.3	75	0.6	0.8	29.9	40

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKG µg/m³	CRITICAL LEVEL	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m³	CRITICAL LEVEL	PC	PC/ CL	PEC	PEC/CL
	Estuary (Atlantic Salt Meadows)			4									
E6_1	Laporte Road (neutral grassland)	30.25	30	0.1	0.4	30.4	101	45.38	75	3.7	4.9	49.0	65
E6_2	Laporte Road (neutral grassland)	30.25	30	0.1	0.4	30.4	101	45.38	75	3.6	4.8	49.0	65
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	25	30	0.4	1.3	25.4	85	37.50	75	5.4	7.2	42.9	57
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	25	30	0.4	1.3	25.4	85	37.50	75	5.5	7.3	43.0	57
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	23.95	30	0.4	1.4	24.4	81	35.93	75	8.7	11.6	44.6	60
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	23.95	30	0.4	1.2	24.3	81	35.93	75	8.2	10.9	44.1	59
E9_1	Sweedale	31.17	30	0.2	0.6	31.3	104	46.76	75	5.0	6.7	51.8	69

RECEPT OR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKG µg/m³	CRITICAL LEVEL	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m³	CRITICAL LEVEL	PC	PC/ CL	PEC	PEC/CL
	Croft Drain (Fen, Marsh and Swamp)												
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	31.17	30	0.2	0.6	31.3	104	46.76	75	4.6	6.2	51.4	69
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	31.17	30	0.2	0.6	31.3	104	46.76	75	4.4	5.9	51.2	68

Table 7A.44: Dispersion Modelling Results for Humber Estuary Ecological Receptors – SO_2

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
E1_1	Humber Estuary (Atlantic Salt Meadows)	4.9	20	0.2	0.9	5.1	25
E1_2	Humber Estuary (Atlantic Salt Meadows)	4.9	20	0.2	0.9	5.1	25
E1_3	Humber Estuary (Atlantic Salt Meadows)	4.9	20	0.2	0.9	5.1	25
E2_1	Humber Estuary (Atlantic Salt Meadows)	6.4	20	0.04	0.2	6.4	32
E2_2	Humber Estuary (Atlantic Salt Meadows)	4.6	20	0.03	0.2	4.6	23
E2_3	Humber Estuary (Atlantic Salt Meadows)	4.6	20	0.03	0.1	4.6	23
E2_4	Humber Estuary (Atlantic Salt Meadows)	4.6	20	0.03	0.1	4.6	23
E3_1	Humber Estuary (Atlantic Salt Meadows)	4.3	20	0.03	0.1	4.4	22
E4_1	Humber Estuary (Acid Fixed Dunes)	2.7	20	0.01	0.1	2.7	14
E4_2	Humber Estuary (Acid Fixed Dunes)	2.7	20	0.01	0.1	2.7	14
E4_3	Humber Estuary (Acid Fixed Dunes)	2.7	20	0.01	0.1	2.7	14

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
E4_4	Humber Estuary (Acid Fixed Dunes)	2.7	20	0.01	0.1	2.7	14
E4_5	Humber Estuary (Acid Fixed Dunes)	2.6	20	0.01	0.1	2.6	13
E4_6	Humber Estuary (Acid Fixed Dunes)	2.6	20	0.01	0.1	2.6	13
E5_1	Humber Estuary (Atlantic Salt Meadows)	2.7	20	0.01	0.1	2.7	14
E5_2	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.01	0.1	2.6	13
E5_3	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.01	0.1	2.6	13
E5_4	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.01	0.1	2.6	13
E5_5	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.01	0.1	2.6	13
E5_6	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.01	0.1	2.6	13
E5_7	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.01	0.1	2.6	13
E5_8	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.01	0.1	2.6	13
E5_9	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.01	0.0	2.6	13
E5_10	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.01	0.0	2.6	13
E6_1	Laporte Road (neutral grassland)	3.73	20	0.03	0.2	3.8	19
E6_2	Laporte Road (neutral grassland)	3.73	20	0.03	0.2	3.8	19
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	3.73	20	0.1	0.5	3.8	19
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	3.73	20	0.1	0.5	3.8	19
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	3.73	20	0.1	0.5	3.8	19
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	3.73	20	0.1	0.5	3.8	19
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	3.73	20	0.04	0.2	3.8	19
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	3.73	20	0.04	0.2	3.8	19
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	3.73	20	0.04	0.2	3.8	19

Table 7A.45: Dispersion Modelling Results for Humber Estuary Ecological Receptors – NH_3

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
E1_1	Humber Estuary (Atlantic Salt Meadows)	1.2	3	0.06	2.0	1.3	43
E1_2	Humber Estuary (Atlantic Salt Meadows)	1.2	3	0.06	2.0	1.3	43
E1_3	Humber Estuary (Atlantic Salt Meadows)	1.2	3	0.06	2.1	1.3	43
E2_1	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.01	0.4	0.012	0
E2_2	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.01	0.4	0.011	0
E2_3	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.01	0.3	0.009	0
E2_4	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.01	0.3	0.010	0
E3_1	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.01	0.3	0.009	0
E4_1	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.004	0.1	0.9	30
E4_2	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.004	0.1	0.9	30
E4_3	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.004	0.1	0.9	30
E4_4	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.004	0.1	0.9	30
E4_5	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.004	0.1	0.9	30
E4_6	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.004	0.1	0.9	30
E5_1	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.004	0.1	0.9	30
E5_2	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.004	0.1	0.9	30
E5_3	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.004	0.1	0.9	30
E5_4	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.004	0.1	0.9	30
E5_5	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.004	0.1	0.9	30
E5_6	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.004	0.1	0.9	30
E5_7	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.003	0.1	0.9	30
E5_8	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.003	0.1	0.9	30
E5_9	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.003	0.1	0.9	30
E5_10	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.003	0.1	0.9	30
E6_1	Laporte Road (neutral grassland)	1.23	1	0.01	0.4	1.2	41
E6_2	Laporte Road (neutral grassland)	1.23	1	0.01	0.4	1.2	41

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	1.23	1	0.03	1.1	1.3	42
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	1.23	1	0.03	1.1	1.262	42
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	1.23	1	0.03	1.1	1.264	42
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	1.23	1	0.03	1.0	1.261	42
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	1.23	1	0.01	0.5	1.244	41
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	1.23	1	0.01	0.5	1.244	41
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	1.23	1	0.01	0.5	1.2	41

Table 7A.46: Dispersion Modelling Results for Humber Estuary Ecological Receptors – HF

RECEPTOR ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m³)						168 HOUR MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL	BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
E1_1	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.10	2.0	0.10	2	0.006	0.5	0.03	5.7	0.03	7
E1_2	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.10	1.9	0.10	2	0.006	0.5	0.03	5.8	0.04	7

RECEPTOR ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m³)						168 HOUR MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL	BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
E1_3	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.10	2.0	0.11	2	0.006	0.5	0.03	6.3	0.04	8
E2_1	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.02	0.5	0.03	1	0.006	0.5	0.01	2.0	0.02	3
E2_2	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.02	0.4	0.03	1	0.006	0.5	0.01	1.9	0.02	3
E2_3	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.02	0.4	0.03	1	0.006	0.5	0.01	1.6	0.01	3
E2_4	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.02	0.4	0.02	0	0.006	0.5	0.01	1.6	0.01	3
E3_1	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.3	0.02	0	0.006	0.5	0.01	1.3	0.01	3
E4_1	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.1	0.01	0	0.006	0.5	0.003	0.5	0.01	2
E4_2	Humber Estuary (Acid	0.006	5	0.01	0.1	0.01	0	0.006	0.5	0.003	0.5	0.01	2

RECEPTOR ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m³)						168 HOUR MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL	BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
	Fixed Dunes)												
E4_3	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.1	0.01	0	0.006	0.5	0.003	0.5	0.01	2
E4_4	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.1	0.01	0	0.006	0.5	0.003	0.5	0.01	2
E4_5	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.1	0.01	0	0.006	0.5	0.003	0.5	0.01	2
E4_6	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.1	0.01	0	0.006	0.5	0.002	0.5	0.01	2
E5_1	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.1	0.01	0	0.006	0.5	0.002	0.5	0.01	2
E5_2	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.1	0.01	0	0.006	0.5	0.002	0.5	0.01	2
E5_3	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.005	0.1	0.01	0	0.006	0.5	0.002	0.5	0.01	2
E5_4	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.005	0.1	0.01	0	0.006	0.5	0.002	0.5	0.01	2

RECEPTOR ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m^3)						168 HOUR MEAN (µg/m^3)					
		BKGD (µg/m^3)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL	BKGD (µg/m^3)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
E5_5	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.005	0.1	0.01	0	0.006	0.5	0.002	0.5	0.01	2
E5_6	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.005	0.1	0.01	0	0.006	0.5	0.002	0.5	0.01	2
E5_7	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.005	0.1	0.01	0	0.006	0.5	0.002	0.5	0.01	2
E5_8	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.005	0.1	0.01	0	0.006	0.5	0.002	0.4	0.01	2
E5_9	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.005	0.1	0.01	0	0.006	0.5	0.002	0.4	0.01	2
E5_10	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.005	0.1	0.01	0	0.006	0.5	0.002	0.4	0.01	2
E6_1	Laporte Road (neutral grassland)	0.006	5	0.03	0.6	0.04	1	0.006	5	0.01	1.5	0.01	3
E6_2	Laporte Road (neutral	0.006	5	0.03	0.6	0.04	1	0.006	5	0.01	1.6	0.01	3

RECEPTOR ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m^3)						168 HOUR MEAN (µg/m^3)					
		BKGD (µg/m^3)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL	BKGD (µg/m^3)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
	grassland)												
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	0.006	5	0.04	0.9	0.05	1	0.006	5	0.02	3.8	0.03	5
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	0.006	5	0.05	0.9	0.05	1	0.006	5	0.02	4.2	0.03	5
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	0.006	5	0.07	1.5	0.08	2	0.006	5	0.03	6.6	0.04	8
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	0.006	5	0.07	1.4	0.07	1	0.006	5	0.03	5.3	0.03	7
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	0.006	5	0.04	0.8	0.05	1	0.006	5	0.02	3.8	0.03	5

RECEPTOR ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m³)						168 HOUR MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL	BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	0.006	5	0.04	0.8	0.04	1	0.006	5	0.01	2.8	0.02	4
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	0.006	5	0.04	0.7	0.04	1	0.006	5	0.01	2.3	0.02	4

Table 7A.47: Dispersion Modelling Results for Humber Estuary Ecological Receptors – Nutrient Nitrogen Deposition (kg/ha/yr)

RECEPTOR ID	SITE NAME & LAND USE TYPE	BACKGROUND NITROGEN DEPOSITION (KG N/HA/YR)	CRITICAL LOAD	PC	PC % CRITICAL LOAD	PEC	PEC % CRITICAL LOAD
E1_1	Humber Estuary (Atlantic Salt Meadows)	15.7	20	0.4	2.1	16.1	81
E1_2	Humber Estuary (Atlantic Salt Meadows)	15.7	20	0.4	2.1	16.1	81
E1_3	Humber Estuary (Atlantic Salt Meadows)	15.7	20	0.4	2.1	16.1	81
E2_1	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.08	0.4	12.7	63
E2_2	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.08	0.4	12.7	63
E2_3	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.06	0.3	12.7	63

RECEPTOR ID	SITE NAME & LAND USE TYPE	BACKGROUND NITROGEN DEPOSITION (KG N/HA/YR)	CRITICAL LOAD	PC	PC % CRITICAL LOAD	PEC	PEC % CRITICAL LOAD
E2_4	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.07	0.3	12.7	63
E3_1	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.06	0.3	12.7	63
E4_1	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.03	0.4	12.5	156
E4_2	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.03	0.3	12.5	156
E4_3	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.03	0.3	12.5	156
E4_4	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.03	0.3	12.5	156
E4_5	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.03	0.3	12.5	156
E4_6	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.03	0.3	12.5	156
E5_1	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.03	0.1	12.5	62
E5_2	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.03	0.1	12.5	62
E5_3	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.03	0.1	12.5	62
E5_4	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.03	0.1	12.5	62
E5_5	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.03	0.1	12.5	62
E5_6	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.02	0.1	12.5	62
E5_7	Humber Estuary (Atlantic	12.5	20	0.02	0.1	12.5	62

RECEPTOR ID	SITE NAME & LAND USE TYPE	BACKGROUND NITROGEN DEPOSITION (KG N/HA/YR)	CRITICAL LOAD	PC	PC % CRITICAL LOAD	PEC	PEC % CRITICAL LOAD
	Salt Meadows)						
E5_8	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.02	0.1	12.5	62
E5_9	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.02	0.1	12.5	62
E5_10	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.02	0.1	12.5	62
E6_1	Laporte Road (neutral grassland)	15.7	20	0.08	0.4	15.8	79
E6_2	Laporte Road (neutral grassland)	15.7	20	0.08	0.4	15.8	79
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	24.5	10	0.28	2.8	24.8	248
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	24.5	10	0.28	2.8	24.8	248
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	24.5	10	0.29	2.9	24.8	248
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	24.5	10	0.27	2.7	24.8	248
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	15.7	10	0.10	1.0	15.8	158
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	15.7	10	0.10	1.0	15.8	158
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	15.7	10	0.10	1.0	15.8	158

Table 7A.48: Dispersion Modelling Results for Humber Estuary Ecological Receptors – Total Acid Deposition N + S (keq/ha/yr)

RECEPTOR ID	SITE NAME & LAND USE TYPE	ACID DEPOSITION (KEQ/HA/YR)[9]				TOTAL ACID DEPOSITION (KEQ/HA/YR)[10]			
		CRITICAL LOAD[11]	BASELINE	TOTAL	% OF CRITICAL LOAD	PC	% OF CRITICAL LOAD	PEC	PEC% OF CRITICAL LOAD
E1_1	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E1_2	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E1_3	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E2_1	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E2_2	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E2_3	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E2_4	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E3_1	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E4_1	Humber Estuary (Acid Fixed Dunes)	Min CL Min N	N: 0.89 S: 0.26	1.15	178.8	0.004	0.6	1.15	179.4

[9] Acid Deposition Critical Loads
[10] Process Contribution and Process Environmental Contribution as percentages of the relevant Critical Load have been calculated using the Min CL Max N
[11] Critical Load (as obtained from APIS, July 2018)

RECEPTOR ID	SITE NAME & LAND USE TYPE	ACID DEPOSITION (KEQ/HA/YR)[9]				TOTAL ACID DEPOSITION (KEQ/HA/YR)[10]			
		CRITICAL LOAD[11]	BASELINE	TOTAL	% OF CRITICAL LOAD	PC	% OF CRITICAL LOAD	PEC	PEC% OF CRITICAL LOAD
E4_2	Humber Estuary (Acid Fixed Dunes)	0.223 Min CL Max N 0.643 Min CL Max S 0.42		1.15	178.8	0.004	0.6	1.15	179.4
E4_3	Humber Estuary (Acid Fixed Dunes)			1.15	178.8	0.003	0.5	1.15	179.4
E4_4	Humber Estuary (Acid Fixed Dunes)			1.15	178.8	0.003	0.5	1.15	179.4
E4_5	Humber Estuary (Acid Fixed Dunes)			1.15	178.8	0.003	0.5	1.15	179.4
E4_6	Humber Estuary (Acid Fixed Dunes)			1.15	178.8	0.003	0.5	1.15	179.4
E5_1	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_2	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_3	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_4	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_5	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_6	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_7	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_8	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_9	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_10	Humber Estuary	Not sensitive to Acid Deposition							

RECEPTOR ID	SITE NAME & LAND USE TYPE	ACID DEPOSITION (KEQ/HA/YR)[9]				TOTAL ACID DEPOSITION (KEQ/HA/YR)[10]			
		CRITICAL LOAD[11]	BASELINE	TOTAL	% OF CRITICAL LOAD	PC	% OF CRITICAL LOAD	PEC	PEC% OF CRITICAL LOAD
	(Atlantic Salt Meadows)								
E6_1	Laporte Road (neutral grassland)	Min CL Min N 1.071 Min CL Max N 5.071 Min CL Max S 4.0	N: 1.12 S: 0.39	1.51	29.8	179.4	0.2	1.52	30.0
E6_2	Laporte Road (neutral grassland)			1.51	29.8	179.4	0.2	1.52	30.0
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	Min CL Min N 0.357 Min CL Max N 11.119 Min CL Max S 10.762	N:1.75 S:0.45	2.2	19.8	0.029	0.3	2.23	20.0
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)			2.2	19.8	0.029	0.3	2.23	20.0
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	Min CL Min N 0.357 Min CL Max N 11.118 Min CL Max S 10.761	N: 1.75 S: 0.45	2.2	19.8	0.030	0.3	2.23	20.1
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)			2.2	19.8	0.028	0.2	2.23	20.0
E9_1	Sweedale Croft Drain (Fen, Marsh and	Not sensitive to Acid Deposition							

RECEPTOR ID	SITE NAME & LAND USE TYPE	ACID DEPOSITION (KEQ/HA/YR)[9]				TOTAL ACID DEPOSITION (KEQ/HA/YR)[10]			
		CRITICAL LOAD[11]	BASELINE	TOTAL	% OF CRITICAL LOAD	PC	% OF CRITICAL LOAD	PEC	PEC% OF CRITICAL LOAD
	Swamp)								
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	Not sensitive to Acid Deposition							
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	Not sensitive to Acid Deposition							

Table 7A.49: Impact on Humber Estuary Ecological Receptors – Summary

RECEPTOR ID	SITE NAME & LAND USE TYPE	TOTAL ACID DEPOSITION PC (KG/HA/YR)	NUTRIENT NITROGEN DEPOSITION PC (KG/HA/YR)	NO_X ANNUAL MEAN PC (μg/m^3)	NO_X 24 HR MEAN PC (μg/m^3)	SO_2 ANNUAL MEAN PC (μg/m^3)	NH_3 ANNUAL MEAN PC (μg/m^3)	HF 24 HR MEAN PC (μg/m^3)	HF WEEKLY MEAN PC (μg/m^3)
E1_1	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition	0.4	0.7	11.8	0.2	0.06	0.10	0.03
E1_2	Humber Estuary (Atlantic Salt Meadows)		0.4	0.7	11.6	0.2	0.06	0.10	0.03
E1_3	Humber Estuary (Atlantic Salt Meadows)		0.4	0.7	12.2	0.2	0.06	0.10	0.03
E2_1	Humber Estuary (Atlantic Salt Meadows)		0.08	0.1	2.8	0.04	0.01	0.02	0.01
E2_2	Humber Estuary (Atlantic Salt		0.08	0.1	2.6	0.03	0.01	0.02	0.01

RECEPTOR ID	SITE NAME & LAND USE TYPE	TOTAL ACID DEPOSITION PC (KG/HA/YR)	NUTRIENT NITROGEN DEPOSITION PC (KG/HA/YR)	NO_X ANNUAL MEAN PC ($\mu g/m^3$)	NO_X 24 HR MEAN PC ($\mu g/m^3$)	SO_2 ANNUAL MEAN PC ($\mu g/m^3$)	NH_3 ANNUAL MEAN PC ($\mu g/m^3$)	HF 24 HR MEAN PC ($\mu g/m^3$)	HF WEEKLY MEAN PC ($\mu g/m^3$)
	Meadows)								
E2_3	Humber Estuary (Atlantic Salt Meadows)		0.06	0.1	2.3	0.03	0.01	0.02	0.01
E2_4	Humber Estuary (Atlantic Salt Meadows)		0.07	0.1	2.3	0.03	0.01	0.02	0.01
E3_1	Humber Estuary (Atlantic Salt Meadows)		0.06	0.1	1.7	0.03	0.01	0.01	0.01
E4_1	Humber Estuary (Acid Fixed Dunes)	0.004	0.03	0.05	0.7	0.01	0.004	0.01	0.003
E4_2	Humber Estuary (Acid Fixed Dunes)	0.004	0.03	0.05	0.6	0.01	0.004	0.01	0.003
E4_3	Humber Estuary (Acid Fixed Dunes)	0.003	0.03	0.05	0.6	0.01	0.004	0.01	0.003
E4_4	Humber Estuary (Acid Fixed Dunes)	0.003	0.03	0.05	0.6	0.01	0.004	0.01	0.003
E4_5	Humber Estuary (Acid Fixed Dunes)	0.003	0.03	0.05	0.6	0.01	0.004	0.01	0.003
E4_6	Humber Estuary (Acid Fixed Dunes)	0.003	0.03	0.04	0.6	0.01	0.004	0.01	0.002
E5_1	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition	0.03	0.05	0.6	0.01	0.004	0.01	0.002
E5_2	Humber Estuary (Atlantic Salt Meadows)		0.03	0.05	0.6	0.01	0.004	0.01	0.002

RECEPTOR ID	SITE NAME & LAND USE TYPE	TOTAL ACID DEPOSITION PC (KG/HA/YR)	NUTRIENT NITROGEN DEPOSITION PC (KG/HA/YR)	NO_X ANNUAL MEAN PC (µg/m^3)	NO_X 24 HR MEAN PC (µg/m^3)	SO_2 ANNUAL MEAN PC (µg/m^3)	NH_3 ANNUAL MEAN PC (µg/m^3)	HF 24 HR MEAN PC (µg/m^3)	HF WEEKLY MEAN PC (µg/m^3)
E5_3	Humber Estuary (Atlantic Salt Meadows)		0.03	0.05	0.6	0.01	0.004	0.005	0.002
E5_4	Humber Estuary (Atlantic Salt Meadows)		0.03	0.04	0.6	0.01	0.004	0.005	0.002
E5_5	Humber Estuary (Atlantic Salt Meadows)		0.03	0.04	0.6	0.01	0.004	0.005	0.002
E5_6	Humber Estuary (Atlantic Salt Meadows)		0.02	0.04	0.6	0.01	0.004	0.005	0.002
E5_7	Humber Estuary (Atlantic Salt Meadows)		0.02	0.04	0.6	0.01	0.003	0.005	0.002
E5_8	Humber Estuary (Atlantic Salt Meadows)		0.02	0.04	0.6	0.01	0.003	0.005	0.002
E5_9	Humber Estuary (Atlantic Salt Meadows)		0.02	0.04	0.6	0.01	0.003	0.005	0.002
E5_10	Humber Estuary (Atlantic Salt Meadows)		0.02	0.04	0.6	0.01	0.003	0.005	0.002
E6_1	Laporte Road (neutral grassland)	0.01	0.08	0.1	3.7	0.03	0.01	0.03	0.01
E6_2	Laporte Road (neutral grassland)	0.01	0.08	0.1	3.6	0.03	0.01	0.03	0.01
E7_1	Stallingborough Fish	0.029	0.28	0.4	5.4	0.1	0.03	0.04	0.02

RECEPTOR ID	SITE NAME & LAND USE TYPE	TOTAL ACID DEPOSITION PC (KG/HA/YR)	NUTRIENT NITROGEN DEPOSITION PC (KG/HA/YR)	NO_X ANNUAL MEAN PC (µg/m^3)	NO_X 24 HR MEAN PC (µg/m^3)	SO_2 ANNUAL MEAN PC (µg/m^3)	NH_3 ANNUAL MEAN PC (µg/m^3)	HF 24 HR MEAN PC (µg/m^3)	HF WEEKLY MEAN PC (µg/m^3)
	Bonds (Broadleaved, mixed and yew woodland)								
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	0.029	0.28	0.4	5.5	0.1	0.03	0.05	0.02
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	0.030	0.29	0.4	8.7	0.1	0.03	0.07	0.03
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	0.028	0.27	0.4	8.2	0.1	0.03	0.07	0.03
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	Not sensitive to Acid Deposition	0.10	0.2	5.0	0.04	0.01	0.04	0.02
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)		0.10	0.2	4.6	0.04	0.01	0.04	0.01
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)		0.10	0.2	4.4	0.04	0.01	0.04	0.01

Table 7A.50: Dispersion Modelling Results for Humber Estuary Ecological Receptors using KOA T1 background concentrations - NO_X

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL	BKGD (µg/m³)	CRITICAL LEVEL	PC	PC/CL	PEC	PEC/CL
E1_1	Humber Estuary (Atlantic Salt Meadows)	17.1	30	0.7	2.4	17.8	59	25.7	75	11.8	15.7	37.4	50
E1_2	Humber Estuary (Atlantic Salt Meadows)	17.1	30	0.7	2.4	17.8	59	25.7	75	11.6	15.5	37.3	50
E1_3	Humber Estuary (Atlantic Salt Meadows)	17.1	30	0.7	2.5	17.9	60	25.7	75	12.2	16.3	37.9	50

Modelling Results: Plume Visibility

6.53 For the purposes of this assessment a stack plume is described as being 'visible' when condensed water is present in the plume. This definition does not take account of whether or not the plume can be seen. The visibility of the plume from the stacks of the Proposed Development has been predicted using ADMS 5. Although the latest version of EA risk assessment guidance does not include the requirement to undertake an assessment of plume visibility, an assessment has been undertaken so that the outputs can be reported in the Landscape and Visual Impact Assessment. The procedure used in this assessment is based on that outlined in the 2003 version of the H1 horizontal guidance (now superseded) (EA, 2003).

6.54 The model setup is identical to that used for the main assessment, except for the selection of plume visibility and the input of initial water content in the plume. The initial water vapour mixing ratio of the plume 0.19 kg/kg (mass of water vapour per unit mass of dry release at the stacks). ADMS 5 defines the plume to be 'visible' at a particular downwind distance if the ambient humidity at the plume centreline is below 98%, above which it is considered the plume would be indistinguishable from clouds.

6.55 The results from the model runs have been summarised in Table 7A.51. The results are per stack. This shows that for up to 82% of the time there is a visible plume, and that the plume is longer than 100 metres (the height of the main stacks) for between 33% and 37% of the time.

6.56 The plume visibility modelling was based on a very conservative assessment of the mass of water which could be present in the plume released from the stack. During normal operation the moisture content in the stack gas would be between 11% and 14%, however it is thought that this could increase to as much as 19% when the maximum water content in the fuel is present. For this reason, the length of visible plumes seen from the main stacks are likely to be shorter than the conservative values reported by Table 7A.51 under normal operational conditions.

Table 7A.51: Plume Visibility Assessment Results per stack

MET DATA YEAR	PERCENTAGE TIME PLUME IS VISIBLE	LONGEST VISIBLE PLUME LENGTH (m)	AVERAGE VISIBLE PLUME LENGTH (m)	PERCENTAGE OF TIME THERE IS A VISIBLE PLUME OVER 100 M
2013	76	886	93	37
2014	77	752	91	36
2015	82	861	91	36
2016	74	816	88	33
2017	74	960	88	33

7.0 ASSESSMENT OF LIMITATIONS AND ASSUMPTIONS

7.1 This section outlines the potential limitations associated with the dispersion modelling assessment. Where assumptions have been made, this is also detailed here.

7.2 The greatest uncertainty associated with any dispersion modelling assessment arises through the inherent uncertainty of the dispersion modelling process itself. Despite this, the use of dispersion modelling is a widely applied and accepted approach for the prediction of impacts from a development such as this.

7.3 In order to minimise the likelihood of under-estimating the PC to ground level concentrations from the main stacks, the following assumptions have been made within the assessment:

- the Proposed Development has been assumed to operate on a continuous basis i.e. for 8,760 hour per year, although in practice the plant will require routine maintenance periods;
- the modelling predictions are based on the use of five full years of meteorological data from Humberside Airport, for the years 2013 to 2017 inclusive. The use of five years data can be considered to represent the majority of meteorological conditions that would be experienced during the future operation of the Proposed Development; and
- emission concentrations for the process are calculated based on the use of IED limits, BAT-AEL concentrations, or maximum measured emission rates at comparable facilities.

7.4 The following assumptions have been made in the preparation of the assessment:

- a 70% NO_X to NO_2 conversion rate has been assumed in predicting the long-term PC, and 35% for the short-term PC;
- in the assessment of emissions of $PM_{2.5}$, the total particulate emissions have been assumed to be $PM_{2.5}$;
- with the exception of As, Ni and Cr, the emission concentrations for individual metals have been modelled as being emitted at the emission limit value for the whole group. Actual heavy metal emission rates at comparable facilities are normally well below WID limits, and as such the values used are conservative;
- emissions of As and Cr (VI) have been considered separately, and have been evaluated using guidance issued by the EA's Air Quality Modelling and Assessment Unit. The maximum reported measured concentrations for As and Cr (VI) at operational facilities in the UK has been used to calculate the emission rate for the Proposed Development

7.5 In particular, the use of IED or BAT-AEL emission limits for most of the pollutants in the study is likely to result in an over-prediction of impacts from the Proposed Development. Emissions tests on other facilities of comparable design within the UK have shown that actual emissions associated with this facility actually represent only a fraction of their respective ELVs for most pollutants.

8.0 CONCLUSIONS

8.1 This report has assessed the impact on local air quality of the operation of the Proposed Development. The assessment has used the dispersion models ADMS and ADMS Roads.

8.2 The assessment of emissions from the main stacks has focused on the impact on ground-level concentrations of the pollutants specified in the IED. Particular attention has been given to the impact on concentrations of NO_2 and particulate matter in the vicinity of residential properties in close proximity to the Proposed Development and near to major traffic routes.

8.3 An evaluation of release height for the main stacks has shown that a release height of 100 metres or greater is capable of mitigating the short-term and long-term impacts of emissions to an acceptable level, with regard to existing air quality and ambient air quality standards. The design of the Proposed Development includes stacks with a release height of 100 m above ground level.

8.4 Emissions from the main stacks and road traffic would result in small increases in ground-level concentrations of the modelled pollutants. Taking into account available information on background concentrations within the modelled domain, predicted operational concentrations of the modelled pollutants would be within current Environmental Standards for the protection of human health.

8.5 The results from modelling of emissions from the stacks predicted an impact on annual mean NO_2 concentrations of 0.4 $\mu g/m^3$ or more is restricted to an area within a maximum distance of 2 km. There would not be a measurable change in annual mean NO_2 concentrations within any nearby AQMA, due to the operation of the Proposed Development.

8.6 The modelling of impacts at designated ecological sites (Humber Estuary, Ramsar site, SAC and SPA) has predicted that stack emissions would give rise to no significant impacts with regard to increases in atmospheric concentrations of NO_X, SO_2, NH_3 and HF, or through deposition of nutrient nitrogen and acid.

8.7 Modelling of the combined impact of emissions from the proposed Development and other consented facilities has shown that the combined impact on local pollutant concentrations would not result in significant effects. At the dune habitat in Cleethorpes, the cumulative impact on acid deposition is slightly above the screening criteria for insignificance. The cumulative effect of acid deposition on the dune habitat has been considered in detail in the report to inform the HRA Signposting (see Appendix 10G in ES Volume III).

8.8 The use of emission concentrations at the BAT-AEL emission limit values is likely to have resulted in an over-prediction of impacts from the Proposed Development. Therefore the reported impacts are considered to represent a robust assessment of likely impacts at all sensitive receptors locations.

9.0 REFERENCES

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