EP UK Investments

South Humber Bank Energy Centre Development Consent Order

South Marsh Road, Stallingborough, DN41 8BZ

Appendix 7A: Air Quality Dispersion Modelling Assessment

Applicant: EP Waste Management Limited
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DOCUMENT HISTORY

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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
Tl	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 (the Proposed Development) 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 stacks of the Proposed Development. The impact of emissions on sensitive ecological receptors is considered in the context of relevant Critical Loads (deposition to ground) or Critical Levels (atmospheric pollutant concentrations) for designated nature sites.

1.4 In addition to the topics listed above, the dispersion modelling exercise will provide 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. This will be prepared and will accompany the Environmental Statement (ES) to be prepared as part of the suite of DCO application documents.

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 stacks serving the combustion process. The assessment considers impacts in the year in which the Proposed Development is due to commence operation, 2023.

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 In air quality terms the emissions to air from the Proposed Development stacks are equivalent to those for the Consented Development. The assessment presented in this PEI Report is therefore based on modelling undertaken for the Consented Development. Where updates are required for the final ES for the Proposed Development, this will be stated throughout this Appendix.

2.4 Emissions to air from Energy from Waste (EfW) 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).

2.5 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.

2.6 The Proposed Development would be regulated under the Industrial Emissions Directive (IED) and in accordance with the waste incineration BREF. The final draft of the waste incineration BREF (version D1) was published in December 2018. 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. 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).

2.7 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 Proposed Development plant will be designed to meet will be based on BAT. BAT-AELs are included in the waste incineration BREF that is currently under review and these have been applied in the air impact assessment accordingly.

2.8 The pollutants considered within this assessment from the Proposed Development stacks are:

- pxides 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.

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

2.10 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).

2.11 The air quality assessment also includes a consideration of visible plume generation, using worst case assumptions regarding the water content of the fuel, as reported in Section 6.

Cumulative Impacts

2.12 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 (or for which consent applications have been made).

2.13 The other developments included in the cumulative impact assessment for the Consented Development and also considered still relevant to the Proposed Development are Great Coates Renewable Energy Centre (DM/0329/18/FUL), North Beck Energy Centre (DM/0026/18/FUL), Waste Tyre Pyrolysis – Immingham Railfreight (DM/0333/17/FUL) and VPI Immingham Energy Park A (PA/SCO/2017/3). The full list of other developments considered as part of the cumulative effects assessment is provided in Chapter 17: Cumulative and Combined Effects in PEI Report Volume I.

2.14 The assessment of cumulative impacts is contained in Annex D of this Report. The assessment of cumulative air quality impacts for the PEI Report has not included a consideration of the emissions to air from the proposed Sustainable Transport Fuels Facility adjacent to the Site or the VPI Immingham OCGT DCO which have been reported on since the assessment of the Consented Development was undertaken. However these will be included in the final ES for the Proposed Development.

Sources of Information

2.15 The information used within this air quality assessment includes:

- data on emission concentrations to atmosphere from the process, taken from limit values in the IED and BAT-AEL values, or in the case of stack flow parameters, data provided by EP Waste Management Ltd.;
- details on the development layout provided by EP Waste Management 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

2.16 The remainder of this PEI 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 Standards contained within EA's air emissions risk assessment guidance (EA, 2018).

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 (μg/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

POLLUTANT	SOURCE	CONCENTRATION (µg/m³)	MEASURED AS
			than 24 times a year
	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

POLLUTANT	SOURCE	CONCENTRATION ($\mu g/m^3$)	MEASURED AS
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 Standards	0.2	Annual mean
		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)

POLLU-TANT	SOURCE	CONCENTRATION (µg/m³)	MEASURED AS	NOTES
NH_3	Environmental Agency Environmental Permit Guidance	1	Annual mean	For sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's 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 and 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), 2019).

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 four sub-sections.

- Qualitative assessment of construction dust;
- Modelling of combustion emissions from the 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 –Construction Dust Assessment

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

- 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).

Magnitude Definitions

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 construction activities

MAGNITUDE	EARTHWORKS	CONSTRUCTION	TRACKOUT
Large	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 Heavy Duty Vehicle (HDV) (>3.5 tonne) peak outward movements per day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
Medium	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 peak outward movements per day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 – 100 metres

MAGNITUDE	EARTHWORKS	CONSTRUCTION	TRACKOUT
Small	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 peak outward movements per day, surface material low dust potential, unpaved road length <50 metres

Receptor Sensitivity Definitions

4.5 The assessment of 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 construction dust effects

POTENTIAL DUST EFFECT	HUMAN PERCEPTION OF DUST DEPOSITION EFFECTS	PM_{10} HEALTH EFFECTS	ECOLOGICAL EFFECTS
High sensitivity	Enjoy a high level of amenity; appearance/ aesthetics/ value of property would be diminished by soiling; receptor expected to be present continuously	Public present for 8 hours per day or more, e.g. residential, schools, care homes	Locations with an international or national designation and the designated features may be affected by dust deposition
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	Transient human exposure, e.g. footpaths, playing fields, parks	Locations with a local designation which may be affected by dust deposition

POTENTIAL DUST EFFECT	HUMAN PERCEPTION OF DUST DEPOSITION EFFECTS	PM_{10} HEALTH EFFECTS	ECOLOGICAL EFFECTS
	soiling; receptors are transient / present for limited period of time; e.g. playing fields, farmland, footpaths, short term car parks		

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 ecological impacts the distance bands are as set out in Table 7A.7.

Table 7A.5: Sensitivity of the area to dust deposition 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 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
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
Medium	Medium risk	Low risk	Negligible
Low	Low risk	Low risk	Negligible

Assessment of 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	-

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
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	-
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

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
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	-
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 deposition 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 deposition and PM_{10} (human health), based on the area sensitivity for each activity listed in Table 7A.10 below, is considered to be ‘low’.

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

ACTIVITY	POTENTIAL IMPACT	RECEPTOR SENSITIVITY AND DISTANCE TO ACTIVITY	AREA SENSITIVITY
Earthworks	Dust deposition	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 deposition	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 deposition	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 a 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		EARTHWORKS	CONSTRUCTION	TRACKOUT
Dust Emission Magnitude		Large	Large	Medium
Risk of impacts from unmitigated activities				

ACTIVITY		EARTHWORKS	CONSTRUCTION	TRACKOUT
Dust soiling (low sensitivity)		Low Risk	Low Risk	Low Risk
Health PM_{10} (low sensitivity)		Low Risk	Low Risk	Low Risk
Ecology		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 deposition from unmitigated earthworks, construction and trackout activities. These risk classifications are solely used to select the appropriate schedule of mitigation measures from IAQM guidance.

4.12 Mitigation measures to be embedded within the Proposed Development 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. Additional site-specific measures will be identified in the CEMP if necessary.

Modelling of Combustion Emissions from the Stacks

Dispersion Model Selection

4.13 The assessment of emissions from the Proposed Development stacks has been undertaken using the latest version of ADMS 5 (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 undertaken in the assessment of emissions from the stacks are:

- modelling of maximum ground-level impacts at a range of release heights, between 60 m and 140 m above ground level, 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.

Model Inputs

4.16 The general model conditions used in the assessment are summarised 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

VARIABLE	INPUT
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 Waste Management 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	Proposed Development buildings (Boiler Hall, RDF Reception, Control Room, Turbine Hall and Air Cooled Condenser as shown on Plot 7A.1 below), SHBPS buildings (Buildings 1 and 2 as shown on Plot 7A.2 below) and NEWLINCS buildings (IWMF 1 as shown on Plot 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, and the height considered to represent BAT for the Proposed Development stacks based on the range of stack heights assessed is 100 metres above ground level, with an internal diameter of 2.75 metres.

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

4.19 The position of the two 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
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 associated with the Proposed Development (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 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 are based on the BAT-AEL value set out in the draft BREF.

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 (see Table 7A.1).

4.27 The BAT-associated energy efficiency levels (BAT-AELs) (Official Journal of the European Union, 2018) 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 (mg/m^3)	EMISSION LIMIT (mg/m^3)	
	HALF-HOUR AVERAGE (BASED ON IED)	DAILY AVERAGE (BASED ON BAT-AEL)
NO_X (as NO_2)	400	120
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

EMISSION LIMIT (mg/m^3)	EMISSION LIMIT (mg/m^3)	
	HALF-HOUR AVERAGE (BASED ON IED)	DAILY AVERAGE (BASED ON BAT-AEL)
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	-

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 and more stringent than earlier Environmental Standards. In particular, the new guidelines include more conservative assumptions for the assessment of Group 3 metal emissions, which make it possible for an assessment to 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) as set out in paragraphs 4.29 and 4.30 below.

[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 current IED. A value of 10 mg/Nm^3 was used, as set out in the draft BREF.
[4] Emissions of the listed group 1 and 3 metals are taken as 100% the respective limit value for each metal group

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 sensitive human receptors are also shown in Figure 7A.1 of Annex A to this PEI Report. The residential receptors have been selected to be representative of residential dwellings in the area around the Proposed Development.

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

4.33 The flagpole height of the all sensitive human 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 ID	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

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

<u>Sensitive Ecological Receptors</u>

4.34 In accordance with the EA'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 PEI 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 ID	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
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				

[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 ID	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
E4_1	Acid Fixed Dunes	531237	408287		22.75 34.13		2.73		0.89		
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								

RECEPTOR ID	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_8	Atlantic Salt Meadows	532324	407415								
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						

RECEPTOR ID	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
E9_2	Sweedale Croft Drain LWS	523599	411714								
E9_3	Sweedale Croft Drain LWS	523710	411805								

Modelled Domain – Receptor Grid

4.37 Emissions from the 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

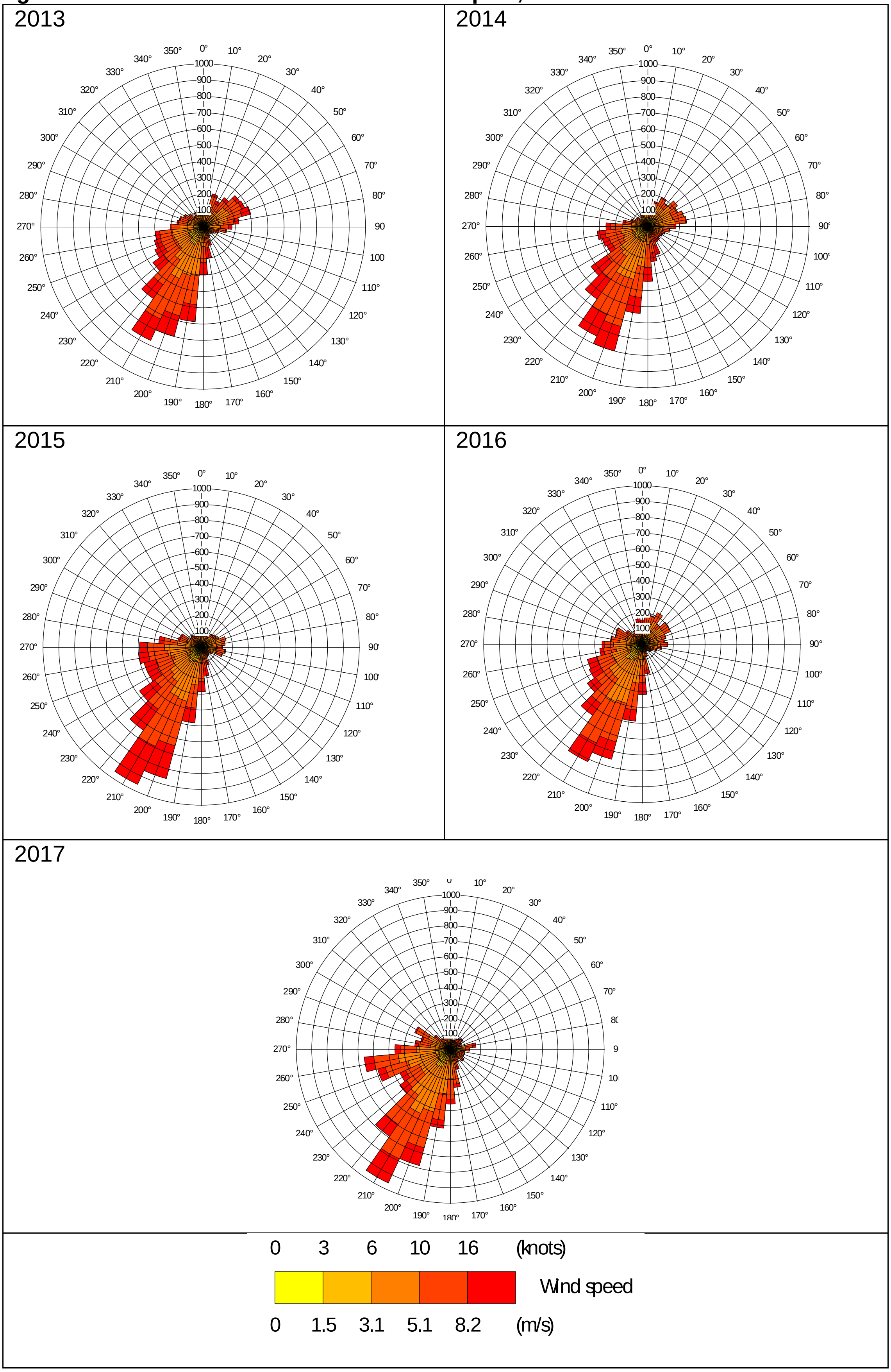
Meteorological Data

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 stacks. The ADMS buildings effect module has therefore been used to incorporate building downwash effects as part of the modelling. 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, administration block, turbine hall and air cooled condenser. The heights for these buildings were calculated from cross sections and a 3-D model produced by Fichtner on behalf of EP Waste Management Limited.

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 Proposed Development building 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.

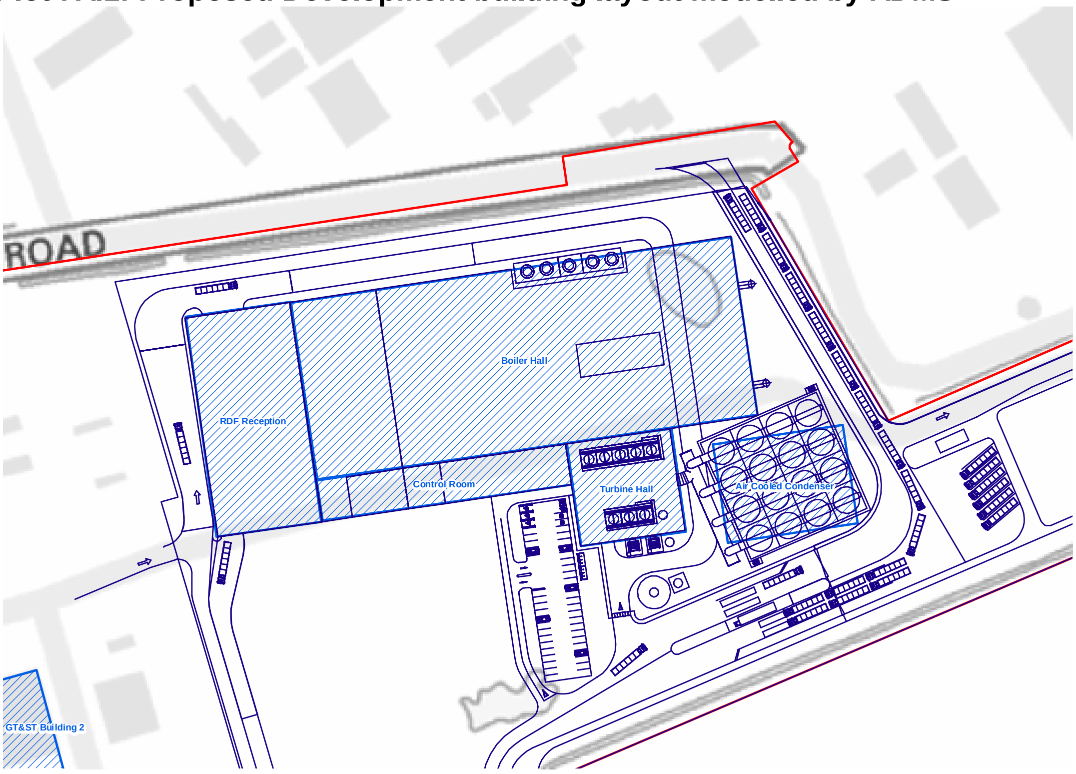
4.46 The design for the Proposed Development includes an additional row of Air Cooled Condensers (ACCs) compared to the Consented Development so the ACC enclosure is therefore narrower. The ACC structure as modelled is 26 m in height, and as such may slightly affect the building downwash effects predicted in the range of stack heights evaluated below about 75 m. The model results for the selected stack height of 100 m would not be affected as the ACC structure is less than one third of the height of the stacks. The dimensions of the ACC structure within the model will be updated in the final assessment for the Proposed Development.

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

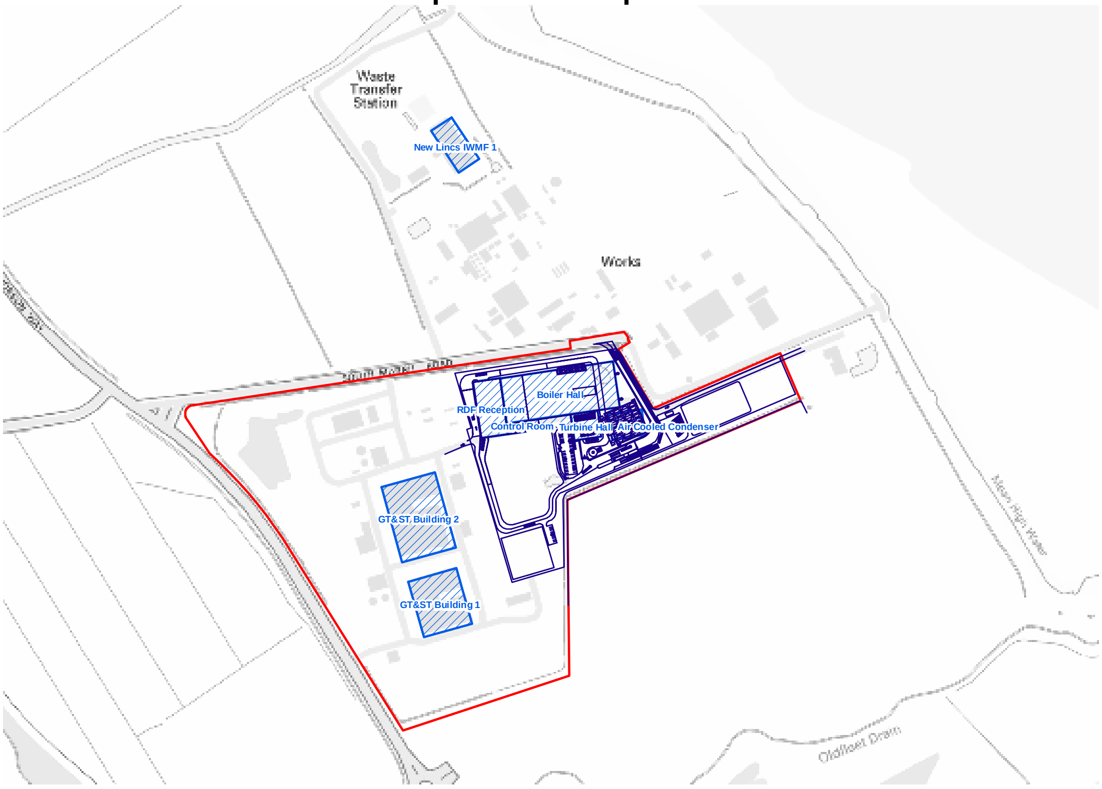
BUILDING	BUILDING CENTRE GRID REFERENCE (X, Y)	HEIGHT (m)	LENGTH (m)	WIDTH (m)	ANGLE (°)
Proposed Development Buildings (as shown on Plot 7A.1)					
Boiler Hall	523083, 413456	55	169	68	82
RDF Reception	522980, 413433	30	40	84	82
Control Room	523053, 413410	30	96	16	82
Turbine Hall	523122, 413408	28	41	39	82
Air Cooled Condenser	523182, 413409	26	50	38	82
Nearby Development Buildings (as shown on Plot 7A.2)					

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 modelled in ADMS 5



4.47 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.

4.48 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

4.49 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.

4.50 For the purposes of detailed modelling, and in accordance with EA technical guidance it is assumed that 70% of nitric oxide emitted from 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

4.51 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.

4.52 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/m³/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/m³/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

4.53 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.

Specialised Model Treatments

4.54 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

4.55 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.

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

Model Inputs

4.57 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 9.0.1 for 2017 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

4.58 The traffic data used in this assessment have been provided from the Transport Assessment for the Proposed Development (see Chapter 9: Traffic and Transport in PEI Report Volume I).

4.59 The data used in the road traffic dispersion modelling has been provided for the following scenarios, with other proposed developments' traffic forecasts (referred to as 'committed development' traffic) included in the future scenarios as per the transport assessment:

- 2017 baseline traffic (for model verification process);
- 2021 baseline traffic + committed development traffic (the total future baseline traffic flows for the Construction assessment);
- 2021 baseline traffic + committed development traffic + peak construction traffic from the Proposed Development (the total traffic flows with the Proposed Development for the Construction assessment);
- 2023 baseline traffic + committed development traffic (the total future baseline traffic flows for the Operation assessment); and
- 2023 baseline traffic + committed development traffic + operational traffic from the Proposed Development (the total traffic flows with the Proposed Development for the Operation assessment).

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

Emissions Data

4.61 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 9.0.1 (Defra, 2019). 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

4.62 The receptors for which the impacts 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

4.63 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

4.64 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

4.65 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 7.1 (April 2019) (Defra, 2019b) 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 $PM_{2.5}$

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

4.67 In order to inform model verification, a six-month NO_2 diffusion tube monitoring survey was undertaken in the study area, for the period 29th June 2018 to 14th December 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
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

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

4.68 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.

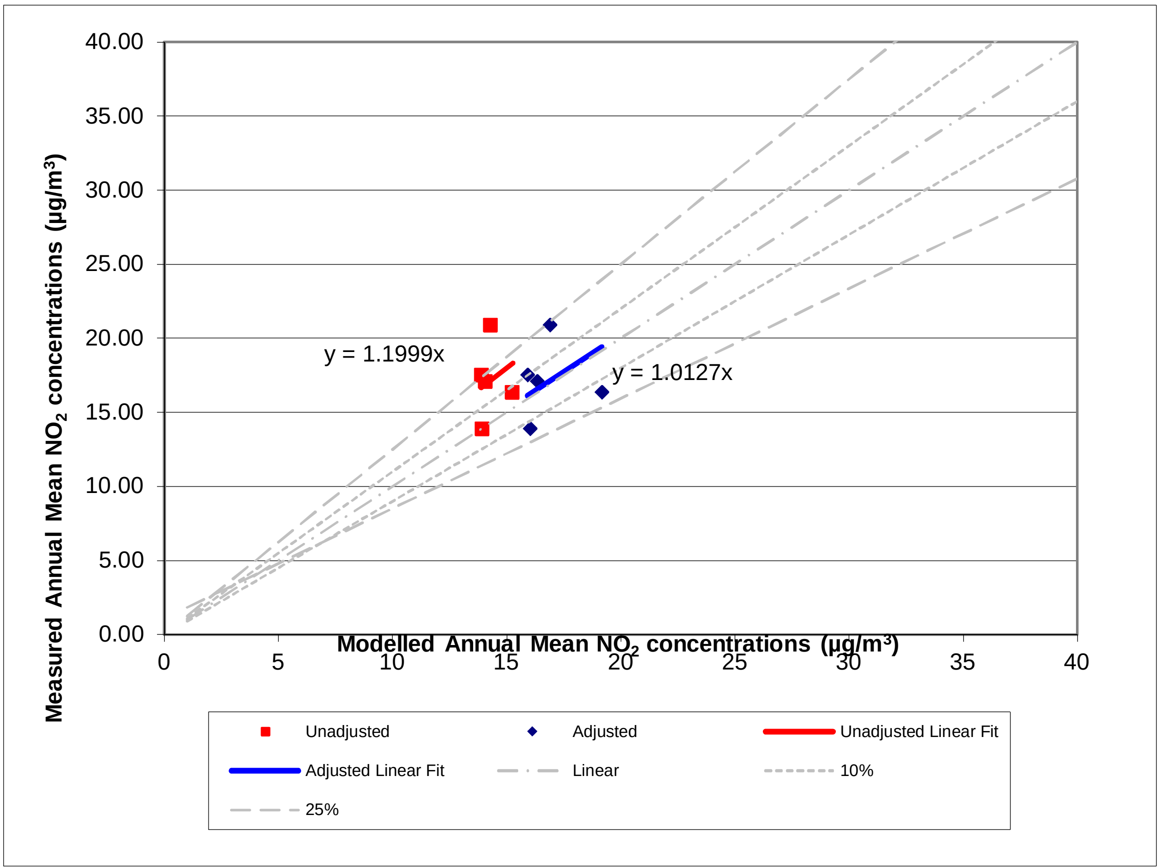
Table 7A.24: Summary of bias adjustment process

TUBE ID	2017 ANNUALISED MONITORED ROAD NO_X	2017 ANNUAL MEAN MODELLED ROAD NO_X ($\mu g/m^3$) *BEFORE ADJUSTMENT*	2017 ANNUAL MEAN MODELLED ROAD NO_X ($\mu g/m^3$) *AFTER ADJUSTMENT*	VERIFICATION FACTOR FOR ROAD NO_X ADJUSTMENT
KOA T2	8.9	3.0	7.4	2.44
KOA T3	7.4	5.3	12.9	
KOA T4	2.7	2.8	6.8	
KOA T5	16.4	3.5	8.5	
KOA T6	9.7	2.7	6.5	

4.69 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 2.44 was applied to the modelled road NO_X.

4.70 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 $\mu g/m^3$. A RMSE value for the whole study area of 2.5 $\mu g/m^3$ was obtained for the adjusted model predictions, which being below 4 $\mu g/m^3$, is evidence of a robust level of performance from the model.

Graph 7A.1: Modelled NO_2 versus monitored NO_2 for the whole road traffic study area



4.71 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).

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

4.72 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.

4.73 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.

4.74 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.

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

4.75 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:

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

4.76 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

4.77 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 $\mu g/m^3$.

4.78 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 $\mu g/m^3$ and above."

4.79 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 $\mu g/m^3$ NO_2 as the trigger for considering a likely exceedance of the hourly mean nitrogen dioxide objective."

4.80 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 $\mu g/m^3$ nitrogen dioxide. Where predicted concentrations are below this value, it can be concluded that the hourly mean nitrogen dioxide objective (200 $\mu g/m^3$ NO_2 not to be exceeded more than 18 times per year) will be achieved.

Specialised Model Treatments

4.81 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 Site (see Figures 7A.1 and 7A.2 in Annex A). 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 5.5 km south-east of the Proposed Development emission stacks.

Local Authority Ambient Monitoring Data

<u>North East Lincolnshire District Council</u>

5.3 NELDC currently undertake monitoring within Immingham and Grimsby (NELDC, 2019). NELDC report 32 locations for NO_2 diffusion tube monitoring, and one continuous monitor for NO_2, operated as part of Defra's AURN. 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 for 2018.

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

SITE NAME	SITE LOCATION	NATIONAL GRID REFERENCE	DISTANCE TO FACILITY	ANNUAL MEAN CONCENTRATION (µg/m^3)		
				2016	2017	2018
DIF14	113 Cleethorpe Road, Grimsby	527761, 410446	5.3 km south-east	37.3	34.7	33.3
DIF15	123 Cleethorpe Road, Grimsby	527802, 410436	5.3 km south-east	357	37.3	32.9

SITE NAME	SITE LOCATION	NATIONAL GRID REFERENCE	DISTANCE TO FACILITY	ANNUAL MEAN CONCENTRATION (µg/m^3)		
				2016	2017	2018
DIF16	6 Freeman Street, Grimsby	527693, 410423	5.3 km south-east	33.1	35.2	30.9
DIF21	9 Pyewipe Road, Grimsby	526074, 410112	4.2 km south-east	33.2	30.6	26.9
DIF22	Great Coates/ Yarborough Road, Grimsby	524593, 408863	4.4 km south-east	28.6	27.0	24.3
DIF23/24/25	Kings Road, Immingham	519193, 415279	3.8 km north-west	33.3	28.5	26.6
CM2	Woodlands Avenue, Immingham	518277, 415116	3.8 km north-west	-	16.9a	13.9

Defra Background Data

5.6 Defra's 2017-based background maps (Defra, 2019) 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 2017-based background maps are presented for the year 2017 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	22.1
NO_2	15.3
PM_{10}	14.1
$PM_{2.5}$	8.2
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 14th December 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 6 (29/06/18 TO 14/12/18) (µg/m^3)	BIAS ADJUSTED TO 2017 ANNUAL MEAN NO_2 CONCENTRATION (µg/m^3)
KOA T1	13.4	12.5
KOA T2	18.4	17.1
KOA T3	17.6	16.4
KOA T4	15.0	13.9
KOA T5	21.6	20.9
KOA T6	18.8	17.5

5.9 All 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 1.43. This conversion was then applied the KOA T1 NO_2 value of 12.5 µg/m^3, to give a NO_X concentration of 17.9 µg/m^3.

5.11 For the background 24-hour mean NO_X concentration, the annual mean value of 17.9 µg/m^3 was multiplied by 1.5, to give a concentration of 26.9 µg/m^3.

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

5.13 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 2023.

5.14 The background NO_2, PM_{10} and $PM_{2.5}$ concentrations have been sourced from Defra's 2017 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.

5.15 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 as part of the project specific monitoring survey.

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

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

5.18 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).

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

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

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

5.22 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).

5.23 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.

5.24 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 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	12.5	25.0	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	33.3	-	North-east Leicestershire Council diffusion tube 14 located within Grimsby AQMA. Used as the background NO_2 concentration for R21.
NO_X	29.19 17.90	43.79 26.90	E1 from APIS E1 from project specific monitoring
	27.34	41.01	E2_1 from APIS

POLLUTANT	BACKGROUND CONCENTRATION (µg/m^3)		SOURCE
	LONG-TERM	SHORT-TERM	
	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}	14.1	21.2	Defra background value for 2017. 24-hour concentration is 1.5 times long-term concentration
$PM_{2.5}$	8.2	-	Defra background value for 2017.
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 Scunthorpe Low Stanton for 2017

POLLUTANT	BACKGROUND CONCENTRATION (μg/m^3)		SOURCE
	LONG-TERM	SHORT-TERM	
Cd	4.72 x 10^{-4}	-	Measured concentration from Scunthorpe Low Stanton for 2017
Hg	2.0 x 10^{-3}	4.0 x 10^{-3}	Maximum monitored concentration at all urban industrial sites across the UK 2012 to 2016
Sb	7.8 x 10^{-4}	1.56 x 10^{-3}	Maximum monitored concentration at all urban industrial sites across the UK 2012 to 2016
As	1.01 x 10^{-3}	-	Measured concentration from Scunthorpe Low Stanton for 2017
Cr, as Cr (II) compounds and Cr (III) compounds	4.02 x 10^{-3}	8.04 x 10^{-3}	Measured concentration from Scunthorpe Low Stanton for 2017
Cu	5.72 x 10^{-3}	1.14 x 10^{-2}	Measured concentration from Scunthorpe Low Stanton for 2017
Mn	1.06 x 10^{-1}	2.12 x10^{-1}	Measured concentration from Scunthorpe Low Stanton for 2017
Ni	1.22 x 10^{-3}	-	Measured concentration from Scunthorpe Low Stanton for 2017
V	1.17 x 10^{-2}	2.34 x 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 x 10^{-5}	2.10 x 10^{-5}	Measured concentration from Manchester Law Courts for 2016 to 2017.
Dioxins and furans	1.2 x 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

5.25 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 4.59 are presented in Table 7A.29, Table 7A.30, Table 7A.31.

5.26 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 33.5 µg/m^3 or 84% 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	2021 BASE + COMMITTED DEVELOPMENT	2023 BASE + COMMITTED DEVELOPMENT
R1	12.5	17.1	17.7	18.0
R2	12.5	15.4	15.7	15.9
R3	12.5	15.6	15.9	16.0
R4	12.5	16.9	17.3	17.5
R5	12.5	17.4	17.8	18.0
R6	12.5	19.1	19.6	19.8
R7	12.5	21.2	21.9	22.2
R8	12.5	23.5	24.4	24.7
R9	12.5	17.6	18.1	18.2
R10	12.5	15.9	16.2	16.3
R11	12.5	15.5	15.8	15.9
R12	12.5	15.9	16.2	16.3
R13	12.5	17.1	17.5	17.6
R14	12.5	14.2	14.4	14.6
R15	12.5	14.4	14.6	14.7
R16	12.5	15.1	15.4	15.6
R17	12.5	15.8	16.2	16.4
R18	12.5	17.3	17.9	18.2
R19	12.5	16.3	16.7	16.9
R20	12.5	24.4	25.7	26.4
R21	33.3	33.5	33.5	33.5

Table 7A.30: Predicted annual mean PM_{10} concentrations at discrete receptors, baseline scenarios

RECEPTOR	BKG	2017 BASELINE		2021 BASE + COMMITTED DEVELOPMENT		2023 BASE + COMMITTED DEVELOPMENT	
		ANNUAL MEAN PM_{10} CONC (μg/m³)	NUMBER OF DAYS 24 HOUR MEAN PM_{10} CONC OF MORE THAN 50 μg/m³	ANNUAL MEAN PM_{10} CONC (μg/m³)	NUMBER OF DAYS 24 HOUR MEAN PM_{10} CONC ENTRATIONS OF MORE THAN 50 μg/m³	ANNUAL MEAN PM_{10} CONC (μg/m³)	NUMBER OF DAYS 24 HOUR MEAN PM_{10} CONC OF MORE THAN 50 μg/m³
R1	14.1	14.9	1	15.0	1	15.0	1
R2	14.1	14.6	1	14.7	1	14.7	1
R3	14.1	14.6	1	14.7	1	14.7	1
R4	14.1	14.9	1	14.9	1	15.0	1
R5	14.1	15.0	1	15.0	1	15.1	1
R6	14.1	15.3	1	15.4	1	15.4	1
R7	14.1	15.7	1	15.8	1	15.9	1
R8	14.1	16.1	1	16.3	1	16.4	1
R9	14.1	15.0	1	15.1	1	15.1	1
R10	14.1	14.7	1	14.8	1	14.8	1
R11	14.1	14.6	1	14.7	1	14.7	1
R12	14.1	14.7	1	14.7	1	14.8	1
R13	14.1	14.9	1	15.0	1	15.0	1
R14	14.1	14.4	1	14.4	1	14.5	1
R15	14.1	14.4	1	14.5	1	14.5	1
R16	14.1	14.6	1	14.6	1	14.6	1
R17	14.1	14.7	1	14.8	1	14.8	1
R18	14.1	15.0	1	15.1	1	15.1	1
R19	14.1	14.8	1	14.9	1	14.9	1
R20	14.1	16.3	1	16.6	1	16.7	1
R21	14.1	14.1	1	14.1	1	14.1	1

Table 7A.31: Predicted annual mean $PM_{2.5}$ concentrations at discrete receptors, baseline scenarios

RECEPTOR	BACKGROUND	ANNUAL MEAN CONCENTRATION (BACKGROUND + ROAD TRAFFIC) (μg/m³)		
		2017 BASELINE	2021 BASE + COMMITTED	2023 BASE+ COMMITTED
R1	8.2	8.7	8.7	8.8
R2	8.2	8.5	8.5	8.6
R3	8.2	8.5	8.6	8.6

RECEPTOR	BACKGROUND	ANNUAL MEAN CONCENTRATION (BACKGROUND + ROAD TRAFFIC) ($\mu g/m^3$)		
		2017 BASELINE	2021 BASE + COMMITTED	2023 BASE+ COMMITTED
R4	8.2	8.7	8.7	8.7
R5	8.2	8.7	8.8	8.8
R6	8.2	8.9	9.0	9.0
R7	8.2	9.2	9.2	9.3
R8	8.2	9.4	9.5	9.6
R9	8.2	8.8	8.8	8.8
R10	8.2	8.6	8.6	8.6
R11	8.2	8.5	8.5	8.6
R12	8.2	8.6	8.6	8.6
R13	8.2	8.7	8.7	8.8
R14	8.2	8.4	8.4	8.4
R15	8.2	8.4	8.4	8.4
R16	8.2	8.5	8.5	8.5
R17	8.2	8.6	8.6	8.6
R18	8.2	8.7	8.8	8.8
R19	8.2	8.6	8.7	8.7
R20	8.2	9.5	9.7	9.8
R21	8.2	8.2	8.2	8.2

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 height 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.

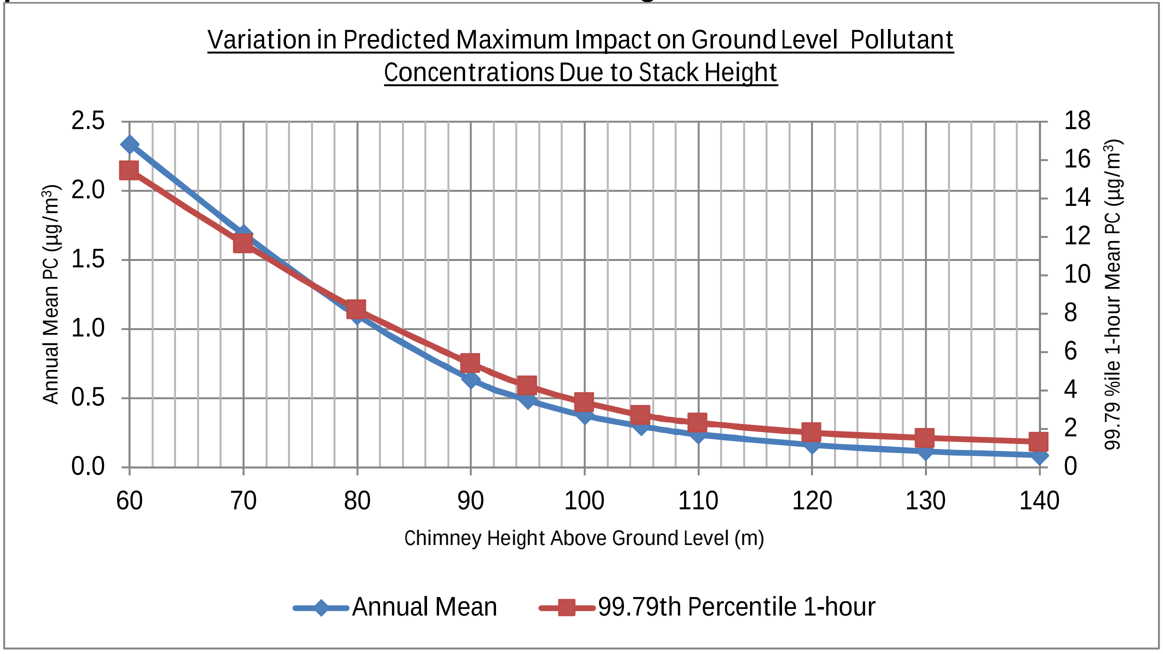
6.2 Emissions from the stacks have been modelled at heights between 60 m and 140 m, at 10 m increments except for between 90 and 105 where a 5 m increment was used. A graph, showing the PC to annual mean and maximum 1-hour pollutant concentrations for a modelled unit emission rate is presented in Figure 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 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 plant 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 from the stacks and fuel delivery vehicles. 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 from the point of maximum impact approximately 370 m to the north-east of the Proposed Development further into the Humber Estuary (see Figure 7A.3). 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 for the Proposed Development, at the selected sensitive receptors (being the residential receptors R1 to R21), 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 the selected sensitive 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 PEI Report Volume I.

Table 7A.33: Predicted change in annual mean NO_2 concentrations at discrete receptors (µg/m^3) due to construction road traffic emissions, with comparison against Environmental Standard criteria

RECEPTOR	2021 BASELINE	CHANGE DUE TO ROAD	PC % ENV STD	PEC	PEC % ENV STD
R1	17.7	+0.1	0.3	17.8	44.4
R2	15.7	<0.1	0.1	15.8	39.4
R3	15.9	<0.1	0.2	15.9	39.8
R4	17.3	<0.1	0.2	17.4	43.5
R5	17.8	<0.1	0.2	17.9	44.7
R6	19.6	<0.1	0.2	19.7	49.2
R7	21.9	<0.1	<0.1	21.9	54.8
R8	24.4	<0.1	<0.1	24.4	60.9
R9	18.1	<0.1	<0.1	18.1	45.2
R10	16.2	<0.1	<0.1	16.2	40.5
R11	15.8	<0.1	<0.1	15.8	39.4
R12	16.2	<0.1	0.2	16.3	40.7
R13	17.5	<0.1	<0.1	17.5	43.7
R14	14.4	<0.1	0.1	14.5	36.2
R15	14.6	<0.1	0.1	14.6	36.6
R16	15.4	<0.1	0.2	15.5	38.6
R17	16.2	<0.1	0.2	16.3	40.7
R18	17.9	+0.1	0.3	18.0	44.9
R19	16.7	<0.1	0.2	16.8	42.0
R20	25.7	+0.3	0.6	26.0	64.9
R21	33.5	<0.1	<0.1	33.5	83.7

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 stacks and the results showing the combined impact of the 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 +0.6 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 +0.4 µg/m^3 from road traffic and +0.2 µg/m^3 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 33.6 µg/m^3. At this receptor, a change in annual mean concentrations of +0.1 µg/m^3 is predicted (+<0.1 µg/m^3 from road traffic and +0.1 µg/m^3 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 0.6 µg/m^3 with 0.4 µg/m^3 of annual mean NO_2 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/m^3 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 PEI Report Volume I.

Table 7A.34: Predicted change in annual mean NO_2 concentrations at discrete receptors (µg/m^3) due to emissions from the Proposed Development and operational road traffic emissions, with comparison against Environmental Standard criteria

RECEPTOR	2023 BASELINE SCENARIO	CHANGE DUE TO ROAD	PC STACKS	TOT PC % ENV STD	PEC	PEC % ENV STD
R1	18.0	+0.2	+0.1	0.8	18.3	45.8
R2	15.9	+0.2	+0.2	1.0	16.3	40.7
R3	16.0	+0.2	+0.3	1.3	16.5	41.2
R4	17.5	+0.2	+0.3	1.2	18.0	44.9
R5	18.0	+0.2	+0.3	1.2	18.5	46.2
R6	19.8	+0.3	+0.3	1.3	20.4	50.9
R7	22.2	+0.3	+0.3	1.4	22.7	56.9
R8	24.7	+0.4	+0.2	1.4	25.3	63.2
R9	18.2	+0.2	+0.2	0.9	18.6	46.4
R10	16.3	+0.1	+0.2	0.8	16.6	41.5
R11	15.9	+0.1	+0.2	0.7	16.1	40.4
R12	16.3	+0.2	+0.2	0.9	16.7	41.7
R13	17.6	+0.1	+0.1	0.5	17.8	44.6
R14	14.6	+<0.1	+0.1	0.4	14.7	36.8
R15	14.7	+<0.1	+0.1	0.3	14.8	37.1
R16	15.6	+<0.1	+0.1	0.4	15.7	39.3
R17	16.4	+0.1	0.1	0.4	16.6	41.5
R18	18.2	+0.1	0.1	0.4	18.3	45.8
R19	16.9	+<0.1	+<0.1	0.3	17.1	42.6
R20	26.4	+0.2	+<0.1	0.7	26.7	66.7
R21	33.5	+<0.1	0.1	0.2	33.6	83.9

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

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 sensitive 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 construction road traffic emissions, with comparison against Environmental Standard criteria

RECEPTOR	2021 BASELINE	CHANGE DUE TO ROAD	PC % ENV STD	PEC	PEC % ENV STD
R1	15.0	+<0.1	0.1	15.0	37.5
R2	14.7	+<0.1	<0.1	14.7	36.7
R3	14.7	+<0.1	<0.1	14.7	36.7
R4	14.9	+<0.1	<0.1	15.0	37.4
R5	15.0	+<0.1	<0.1	15.1	37.6
R6	15.4	+<0.1	<0.1	15.4	38.5
R7	15.8	+<0.1	<0.1	15.8	39.6
R8	16.3	+<0.1	<0.1	16.3	40.7
R9	15.1	+<0.1	<0.1	15.1	37.8
R10	14.8	+<0.1	<0.1	14.8	36.9
R11	14.7	+<0.1	<0.1	14.7	36.7
R12	14.7	+<0.1	<0.1	14.8	36.9
R13	15.0	+<0.1	<0.1	15.0	37.5
R14	14.4	+<0.1	<0.1	14.4	36.1
R15	14.5	+<0.1	<0.1	14.5	36.2
R16	14.6	+<0.1	<0.1	14.6	36.6
R17	14.8	+<0.1	<0.1	14.8	36.9
R18	15.1	+<0.1	0.1	15.1	37.7
R19	14.9	+<0.1	<0.1	14.9	37.2
R20	16.6	+<0.1	0.1	16.6	41.6
R21	14.1	+<0.1	<0.1	14.1	35.3

Table 7A.36: Predicted change in annual mean $PM_{2.5}$ concentrations at discrete receptors (µg/m^3) due to construction road traffic emissions with comparison against Environmental Standard criteria

RECEPTOR	2021 BASELINE	CHANGE DUE TO ROAD	PC % ENV STD	PEC	PEC % ENV STD
R1	8.7	+<0.1	<0.1	8.7	35.0
R2	8.5	+<0.1	<0.1	8.5	34.2
R3	8.6	+<0.1	<0.1	8.6	34.2

RECEPTOR	2021 BASELINE	CHANGE DUE TO ROAD	PC % ENV STD	PEC	PEC % ENV STD
R4	8.7	+<0.1	<0.1	8.7	34.9
R5	8.8	+<0.1	<0.1	8.8	35.1
R6	9.0	+<0.1	<0.1	9.0	35.9
R7	9.2	+<0.1	<0.1	9.2	36.9
R8	9.5	+<0.1	<0.1	9.5	38.1
R9	8.8	+<0.1	<0.1	8.8	35.2
R10	8.6	+<0.1	<0.1	8.6	34.4
R11	8.5	+<0.1	<0.1	8.6	34.2
R12	8.6	+<0.1	<0.1	8.6	34.4
R13	8.7	+<0.1	<0.1	8.7	35.0
R14	8.4	+<0.1	<0.1	8.4	33.6
R15	8.4	+<0.1	<0.1	8.4	33.7
R16	8.5	+<0.1	<0.1	8.5	34.1
R17	8.6	+<0.1	<0.1	8.6	34.4
R18	8.8	+<0.1	<0.1	8.8	35.2
R19	8.7	+<0.1	<0.1	8.7	34.7
R20	9.7	+<0.1	0.1	9.7	38.9
R21	8.2	+<0.1	<0.1	8.2	32.9

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 sensitive 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.

6.29 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 (µg/m^3) due to stack emissions and operational road traffic emissions, with comparison against Environmental Standard criteria

RECEPTOR	2023 BASELINE	CHANGE DUE TO ROAD	PC STACKS	PC % ENV STD	PEC	PEC % ENV STD
R1	15.0	+<0.1	+<0.1	0.1	15.1	37.7
R2	14.7	+<0.1	+<0.1	0.1	14.7	36.8
R3	14.7	+<0.1	+<0.1	0.1	14.8	36.9
R4	15.0	+<0.1	+<0.1	0.1	15.0	37.6
R5	15.1	+<0.1	+<0.1	0.1	15.1	37.8
R6	15.4	+<0.1	+<0.1	0.1	15.5	38.7
R7	15.9	+<0.1	+<0.1	0.2	15.9	39.9
R8	16.4	+<0.1	+<0.1	0.2	16.4	41.1
R9	15.1	+<0.1	+<0.1	0.1	15.2	37.9
R10	14.8	+<0.1	+<0.1	0.1	14.8	37.0
R11	14.7	+<0.1	+<0.1	0.1	14.7	36.8

RECEPTOR	2023 BASELINE	CHANGE DUE TO ROAD	PC STACKS	PC % ENV STD	PEC	PEC % ENV STD
R12	14.8	+<0.1	+<0.1	0.1	14.8	37.0
R13	15.0	+<0.1	+<0.1	0.1	15.1	37.6
R14	14.5	+<0.1	+<0.1	<0.1	14.5	36.2
R15	14.5	+<0.1	+<0.1	<0.1	14.5	36.3
R16	14.6	+<0.1	+<0.1	<0.1	14.7	36.7
R17	14.8	+<0.1	+<0.1	0.1	14.8	37.1
R18	15.1	+<0.1	+<0.1	0.1	15.2	37.9
R19	14.9	+<0.1	+<0.1	<0.1	14.9	37.3
R20	16.7	+<0.1	+<0.1	0.1	16.8	42.0
R21	14.1	+<0.1	+<0.1	<0.1	14.1	35.4

Table 7A.38: Predicted change in annual mean $PM_{2.5}$ concentrations at discrete receptors ($\mu g/m^3$) due to stack emissions and operational road traffic emissions, with comparison against Environmental Standard criteria

RECEPTOR	2023 BASELINE	CHANGE DUE TO ROAD	PC STACKS	PC % ENV STD	PEC	PEC % ENV STD
R1	8.8	+<0.1	+<0.1	0.1	8.8	35.2
R2	8.6	+<0.1	+<0.1	0.1	8.6	34.3
R3	8.6	+<0.1	+<0.1	0.1	8.6	34.4
R4	8.7	+<0.1	+<0.1	0.1	8.8	35.1
R5	8.8	+<0.1	+<0.1	0.1	8.8	35.3
R6	9.0	+<0.1	+<0.1	0.1	9.0	36.1
R7	9.3	+<0.1	+<0.1	0.1	9.3	37.3
R8	9.6	+<0.1	+<0.1	0.1	9.6	38.4
R9	8.8	+<0.1	+<0.1	0.1	8.8	35.4
R10	8.6	+<0.1	+<0.1	0.1	8.6	34.5
R11	8.6	+<0.1	+<0.1	0.1	8.6	34.3
R12	8.6	+<0.1	+<0.1	0.1	8.6	34.5
R13	8.8	+<0.1	+<0.1	0.1	8.8	35.1
R14	8.4	+<0.1	+<0.1	<0.1	8.4	33.7
R15	8.4	+<0.1	+<0.1	<0.1	8.4	33.8
R16	8.5	+<0.1	+<0.1	<0.1	8.5	34.2
R17	8.6	+<0.1	+<0.1	<0.1	8.6	34.5
R18	8.8	+<0.1	+<0.1	<0.1	8.8	35.3
R19	8.7	+<0.1	+<0.1	<0.1	8.7	34.8
R20	9.8	+<0.1	+<0.1	0.1	9.8	39.3
R21	8.2	+<0.1	+<0.1	<0.1	8.2	32.9

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 high stacks above ground level. 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 are:

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

6.33 Therefore, the impact on concentrations of these substances have undergone additional assessment, 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 assessment as set out in the following sections of this PEI Report.

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	14.6	36
	99.79th %ile of 1-hour means	200	9.42	4.7	34.4	17
PM_{10}	Annual Mean	40	0.12	0.3	14.2	36
	90.41st %ile of 24-hour means	50	0.38	0.8	21.6	43
$PM_{2.5}$	Annual Mean	25	0.12	0.5	8.3	33
SO_2	Annual Mean	50	0.75	1.5	17.4	35
	99.9th %le of 15-min means	266	7.25	2.7	40.7	15
	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

POLLUTANT	AVERAGING PERIOD	ENV STD (µg/m³)	PC	PC % ENV STD	PEC	PEC % ENV STD
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
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 the EA guidance outlined below).

6.35 As set out above, in the first instance and as a first step, a worst case screening step was carried out. 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/m^3)	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/Nm^3. 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/m³)	PC (µg/m³)	PC % ENV STD	PEC (µg/m³)	PEC % ENV STD
NO_2	99.79th %ile of 1-hour means	200	31.4	15.7	56.4	28
PM_{10}	90.41st %ile of 24-hour means	50	2.3	4.5	23.5	47
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

POLLUTANT	AVERAGING PERIOD	ENV STD (µg/m^3)	PC (µg/m^3)	PC % ENV STD	PEC (µg/m^3)	PEC % ENV STD
HF	Max 1-hour mean	160	1.9	1.2	1.9	1

Modelling Results: Impact on Designated Nature Sites

The results of the dispersion modelling of predicted impacts on sensitive ecological receptors are presented in Table 7A.43 to

6.44 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; and
- 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

6.49 Table 7A.50.

6.50 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 1.43. This conversion was then applied the KOA T1 NO_2 value of 12.5 µg/m^3, to give an NO_X concentration of 17.9 µg/m^3.

6.51 Using site-specific monitoring, the annual mean NOx PC is 2.4% of the Critical Level, however the PEC is 62% of the Critical Level. This can be screened out as insignificant.

6.52 For the 24 hour mean, the PC is 15.7% of the Critical Level at the closest affected receptor, the PEC at E1_1 to E1_3 is 52% of the Critical Level. This can be screened out as insignificant.

6.53 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 PEI Report Volume III). Please refer to the Chapter 10: Ecology in PEI Report 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

REC ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKG µg/m³	CLe	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m³	CLe	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	28.7	30	0.1	0.4	28.8	96	43.1	75	2.3	3.1	45.4	61

REC ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKG µg/m³	CLe	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m³	CLe	PC	PC/ CL	PEC	PEC/ CL
	Salt Meadows)												
E2_4	Humber Estuary (Atlantic Salt Meadows)	28.7	30	0.1	0.4	28.8	96	43.1	75	2.3	3.0	45.3	60
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	22.8	30	0.05	0.2	22.8	76	34.1	75	0.6	0.8	34.8	46

REC ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)						24 HOUR MEAN (µg/m^3)					
		BKG µg/m^3	CLe	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m^3	CLe	PC	PC/ CL	PEC	PEC/ CL
	(Acid Fixed Dunes)												
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 Meadows)	21.2	30	0.05	0.2	21.3	71	31.8	75	0.6	0.8	32.4	43
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

REC ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)						24 HOUR MEAN (µg/m^3)					
		BKG µg/m^3	CLe	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m^3	CLe	PC	PC/ CL	PEC	PEC/ CL
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	19.6	30	0.04	0.1	19.6	65	29.3	75	0.6	0.7	29.9	40

REC ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)						24 HOUR MEAN (µg/m^3)					
		BKG µg/m^3	CLe	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m^3	CLe	PC	PC/ CL	PEC	PEC/ CL
	Salt Meadows)												
E5_10	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
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	25	30	0.4	1.3	25.4	85	37.50	75	5.5	7.3	43.0	57

REC ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKG µg/m³	CLe	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m³	CLe	PC	PC/ CL	PEC	PEC/ CL
	yew woodland)												
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 Croft Drain (Fen, Marsh and Swamp)	31.17	30	0.2	0.6	31.3	104	46.76	75	5.0	6.7	51.8	69
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

REC ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)						24 HOUR MEAN (µg/m^3)					
		BKG µg/m^3	CLe	PC	PC/ CL	PEC	PEC/ CL	BKG µg/m^3	CLe	PC	PC/ CL	PEC	PEC/ CL
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/m^3)					
		BKGD (µg/m^3)	CRITICAL LEVEL (CLe)	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

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)					
		BKGD (µg/m^3)	CRITICAL LEVEL (CLe)	PC	PC/CL	PEC	PEC/CL
E4_3	Humber Estuary (Acid Fixed Dunes)	2.7	20	0.01	0.1	2.7	14
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

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)					
		BKGD (µg/m³)	CRITICAL LEVEL (CLe)	PC	PC/CL	PEC	PEC/CL
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

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)					
		BKGD (µg/m^3)	CRITICAL LEVEL (CLe)	PC	PC/CL	PEC	PEC/CL
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 (CLe)	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

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)					
		BKGD (µg/m^3)	CRITICAL LEVEL (CLe)	PC	PC/CL	PEC	PEC/CL
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

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)					
		BKGD (µg/m^3)	CRITICAL LEVEL (CLe)	PC	PC/CL	PEC	PEC/CL
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
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

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)					
		BKGD (µg/m^3)	CRITICAL LEVEL (CLe)	PC	PC/CL	PEC	PEC/CL
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/m^3)						168 HOUR MEAN (µg/m^3)					
		BKGD (µg/m^3)	CL	PC	PC/ CL	PEC	PEC/ CL	BKGD (µg/m^3)	CLe	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
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

RECEPTOR ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m³)						168 HOUR MEAN (µg/m³)					
		BKGD (µg/m³)	CL	PC	PC/ CL	PEC	PEC/ CL	BKGD (µg/m³)	CLe	PC	PC/ CL	PEC	PEC/ CL
E4_2	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_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
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

RECEPTOR ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m^3)						168 HOUR MEAN (µg/m^3)					
		BKGD (µg/m^3)	CL	PC	PC/ CL	PEC	PEC/ CL	BKGD (µg/m^3)	CLe	PC	PC/ CL	PEC	PEC/ CL
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 grassland)	0.006	5	0.03	0.6	0.04	1	0.006	5	0.01	1.6	0.01	3
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,	0.006	5	0.05	0.9	0.05	1	0.006	5	0.02	4.2	0.03	5

RECEPTOR ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m³)						168 HOUR MEAN (µg/m³)					
		BKGD (µg/m³)	CL	PC	PC/ CL	PEC	PEC/ CL	BKGD (µg/m³)	CLe	PC	PC/ CL	PEC	PEC/ CL
	mixed and yew woodland)												
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
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
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

RECEPTOR ID	SITE NAME & LAND USE TYPE	BACKGROUND NITROGEN DEPOSITION (KG N/HA/YR)	CRITICAL LOAD	PC	PC % CRITICAL LOAD	PEC	PEC % CRITICAL LOAD
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

RECEPTOR ID	SITE NAME & LAND USE TYPE	BACKGROUND NITROGEN DEPOSITION (KG N/HA/YR)	CRITICAL LOAD	PC	PC % CRITICAL LOAD	PEC	PEC % CRITICAL LOAD
E5_7	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.02	0.1	12.5	62
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,	24.5	10	0.29	2.9	24.8	248

RECEPTOR ID	SITE NAME & LAND USE TYPE	BACKGROUND NITROGEN DEPOSITION (KG N/HA/YR)	CRITICAL LOAD	PC	PC % CRITICAL LOAD	PEC	PEC % CRITICAL LOAD
	mixed and yew woodland)						
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							

[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
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 0.223 Min CL Max N 0.643 Min CL Max S 0.42	N: 0.89 S: 0.26	1.15	178.8	0.004	0.6	1.15	179.4
E4_2	Humber Estuary (Acid Fixed Dunes)			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							

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
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 (Atlantic Salt Meadows)	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
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,	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
	Marsh and 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/m³)	NO_X 24 HR MEAN PC (µg/m³)	SO_2 ANNUAL MEAN PC (µg/m³)	NH_3 ANNUAL MEAN PC (µg/m³)	HF 24 HR MEAN PC (µg/m³)	HF WEEKLY MEAN PC (µg/m³)
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 Meadows)		0.08	0.1	2.6	0.03	0.01	0.02	0.01
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

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)
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
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

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_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 Bonds (Broadleaved, mixed and yew woodland)	0.029	0.28	0.4	5.4	0.1	0.03	0.04	0.02
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

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)
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

ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)						24 HOUR MEAN (µg/m³)					
		BKGD	CLe	PC	PC/CLe	PEC	PEC/CLe	BKGD	CLe	PC	PC/CLe	PEC	PEC/ CLe
E1_1	Humber Estuary (Atlantic Salt Meadows)	17.9	30	0.7	2.4	18.6	62	26.9	75	11.8	15.7	38.7	51
E1_2	Humber Estuary (Atlantic Salt Meadows)	17.9	30	0.7	2.4	18.6	62	26.9	75	11.6	15.5	38.5	51
E1_3	Humber Estuary (Atlantic Salt Meadows)	17.9	30	0.7	2.5	18.7	62	26.9	75	12.2	16.3	39.1	52

Modelling Results: Plume Visibility

6.54 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).

6.55 The model setup is identical to that used for the assessment of pollutant emissions, 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.

6.56 The results from the model 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.

6.57 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, these are 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 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 type of facility actually represent only a fraction of their respective ELVs for most pollutants.

7.6 The design for the Proposed Development differs from the Consented Development in that an additional row of Air Cooled Condensers (ACCs) would be installed. The ACC structure as modelled is 26 m in height, and as such may slightly affect the building downwash effects predicted in the range of stack heights evaluated below about 75m. The model results for the selected stack height of 100 m would not be affected as the ACC structure is less than one third of the height of the stacks. The dimensions of the

ACC structure within the model will be updated in the final assessment for the Proposed Development

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 Proposed Development 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 Proposed Development stacks has shown that a release height of 100 metres above ground level or greater is capable of mitigating the short-term and long-term impacts of emissions to an level which is not significant, 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 Proposed Development 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 Proposed Development 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 Proposed Development stack emissions would give rise to no significant effects 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 developments has shown that the combined impact on local pollutant concentrations would result in no 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 PEI Report Volume III), which concluded the effect was not significant.

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 worst case robust assessment of likely significance effects at all sensitive receptor locations.

9.0 REFERENCES

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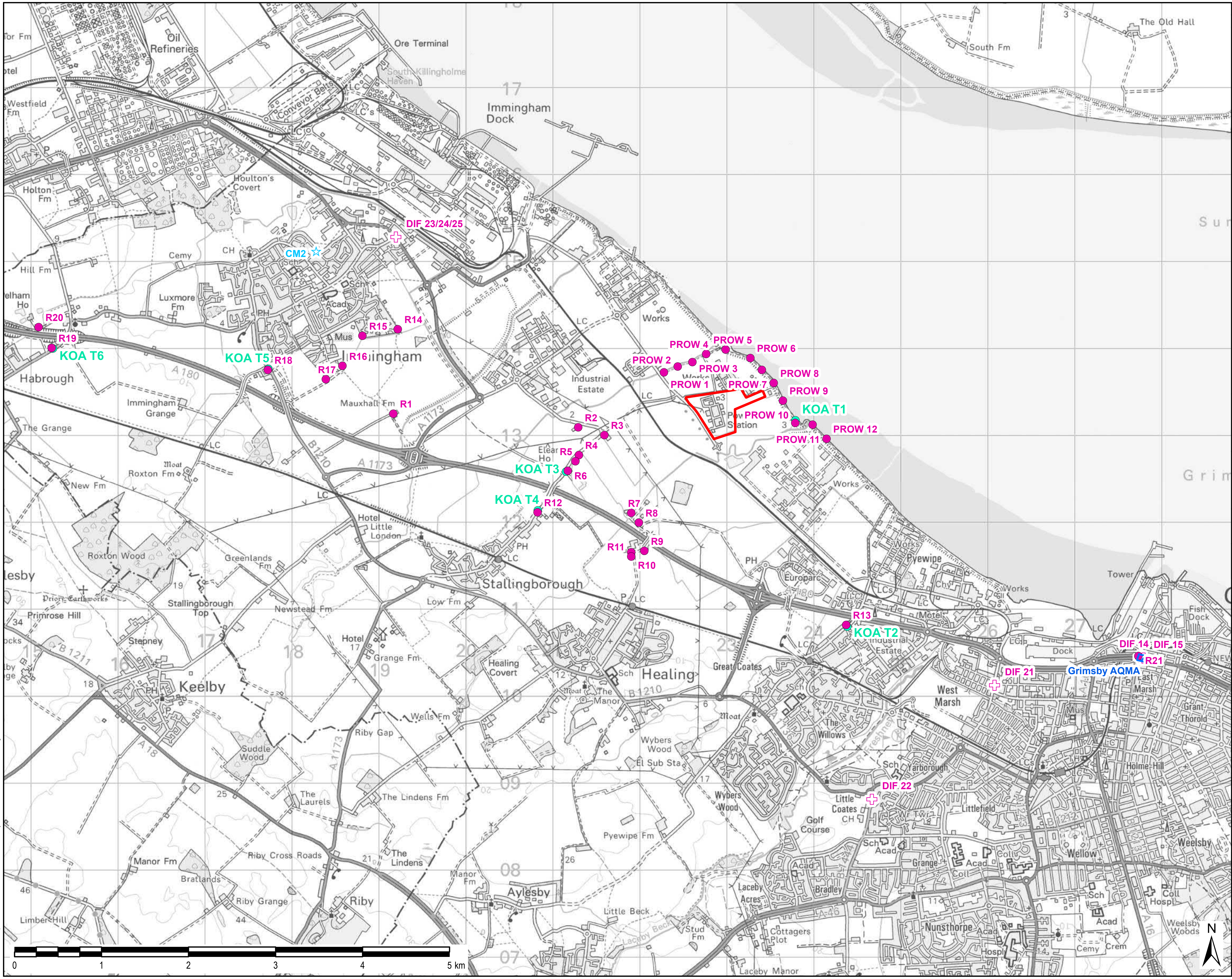
ANNEX A: FIGURES

Figure 7A-1: Air quality receptors and diffusion tube monitoring locations



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LEGEND

- Application Boundary
- Grimsby AQMA
- Human Receptors
- AECOM NO_2 Diffusion Tubes
- North East Lincolnshire Council NO_2 Diffusion Tubes
- North East Lincolnshire Continuous Monitoring Location

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue
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Client
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Drawing Title
AIR QUALITY RECEPTORS AND DIFFUSION TUBE MONITORING LOCATIONS

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FIGURE 7.1

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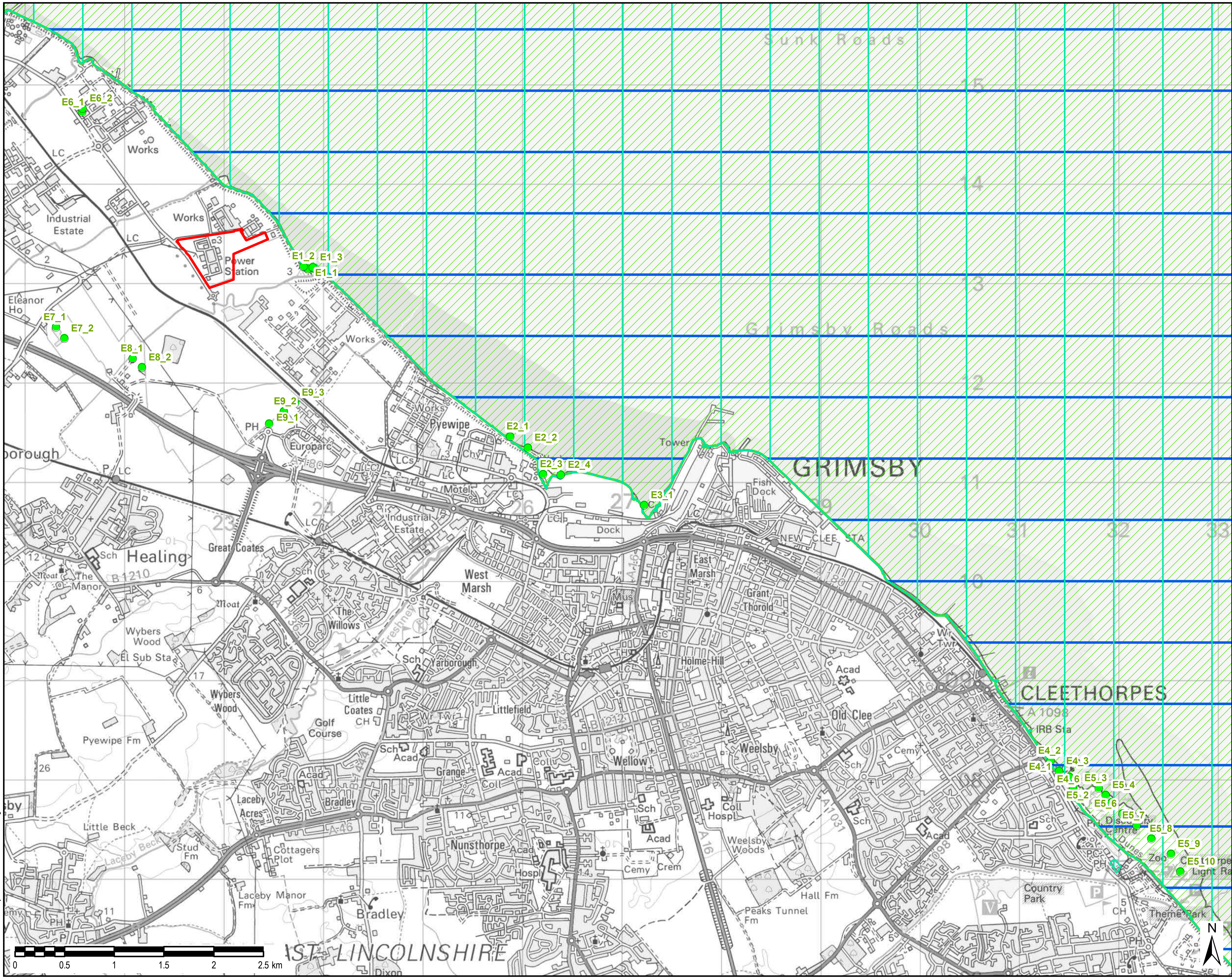
Figure 7A.2: Ecological receptors and Air Quality Management Areas



LEGEND

- Ecological Receptors
- Humber Estuary Site of Special Scientific Interest
- Humber Estuary Special Protection Area
- Humber Estuary Special Area of Conservation
- Application Boundary

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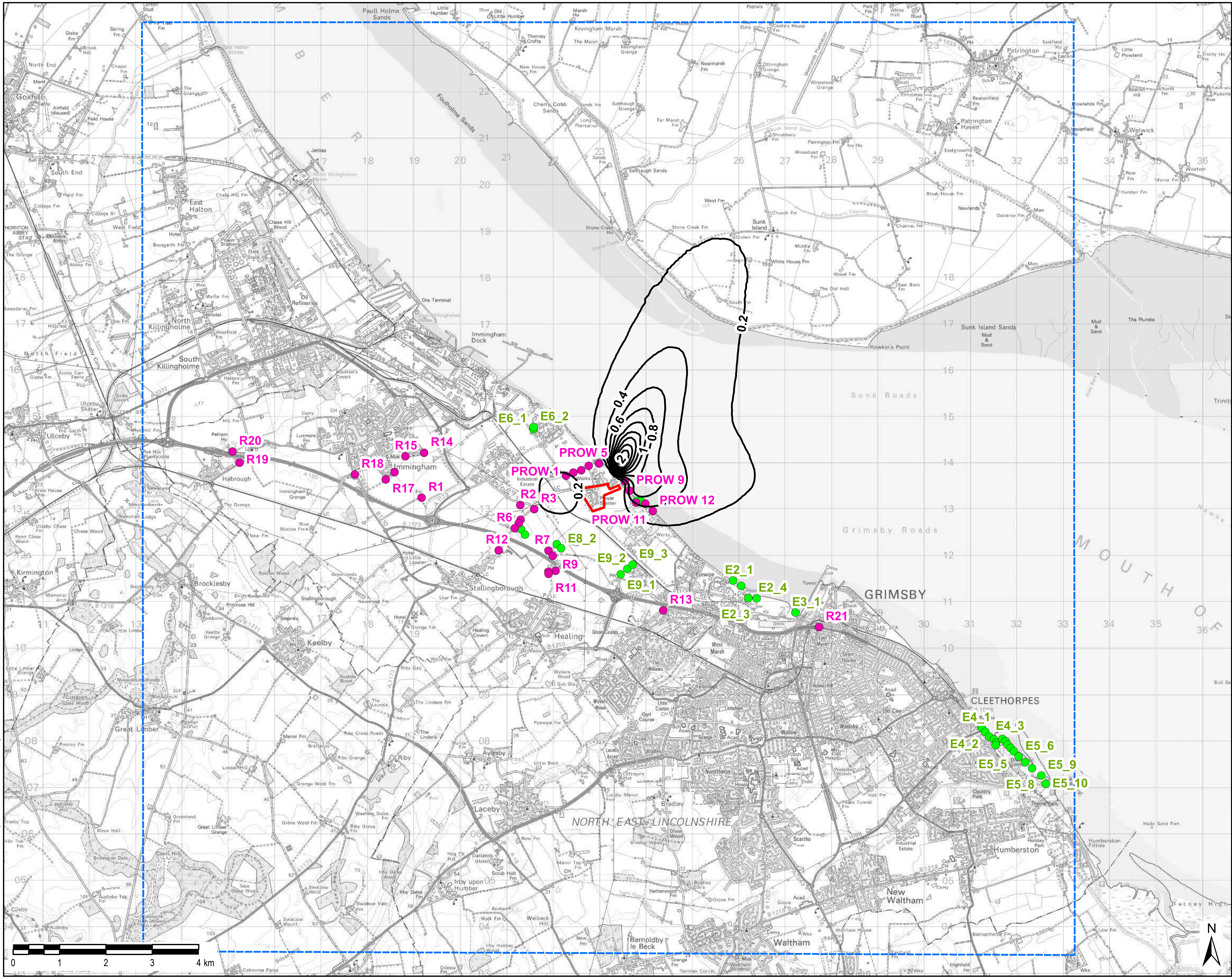
Figure 7A.3: Process Contribution to annual mean NO_2 concentrations



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LEGEND

- Application Boundary
- Annual Mean NO_2 Process Contribution ($\mu g/m^3$)
- Modelled Domain
- Human Receptors
- Ecological Receptors

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ANNUAL MEAN MAXIMUM NO_2 PROCESS CONTRIBUTION 2015 METEOROLOGICAL YEAR

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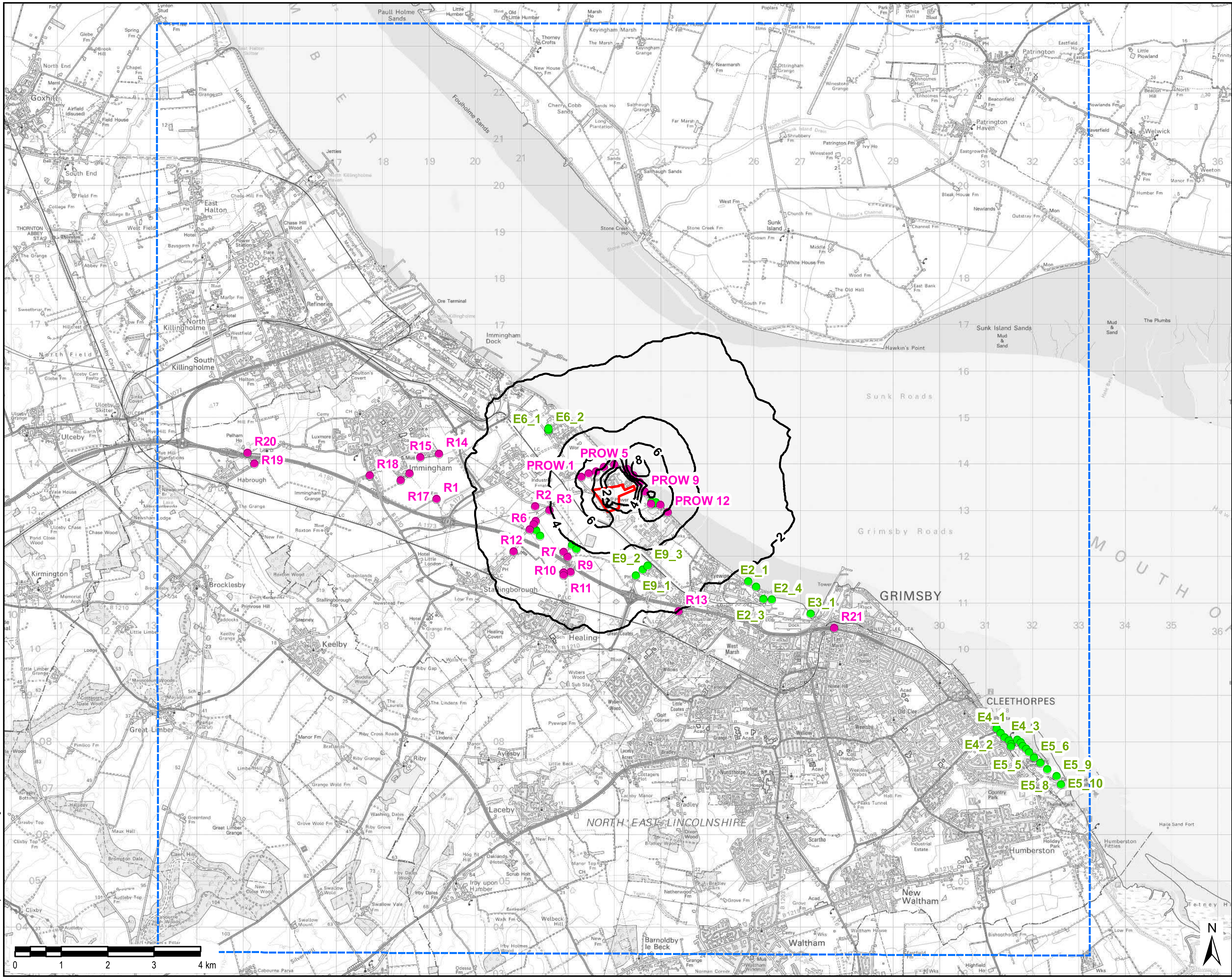
Figure 7A.4: Process Contribution to maximum hourly mean NO_2 concentrations



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SHORT TERM MAXIMUM NO_2 PROCESS CONTRIBUTION 2014 METEOROLOGICAL YEAR

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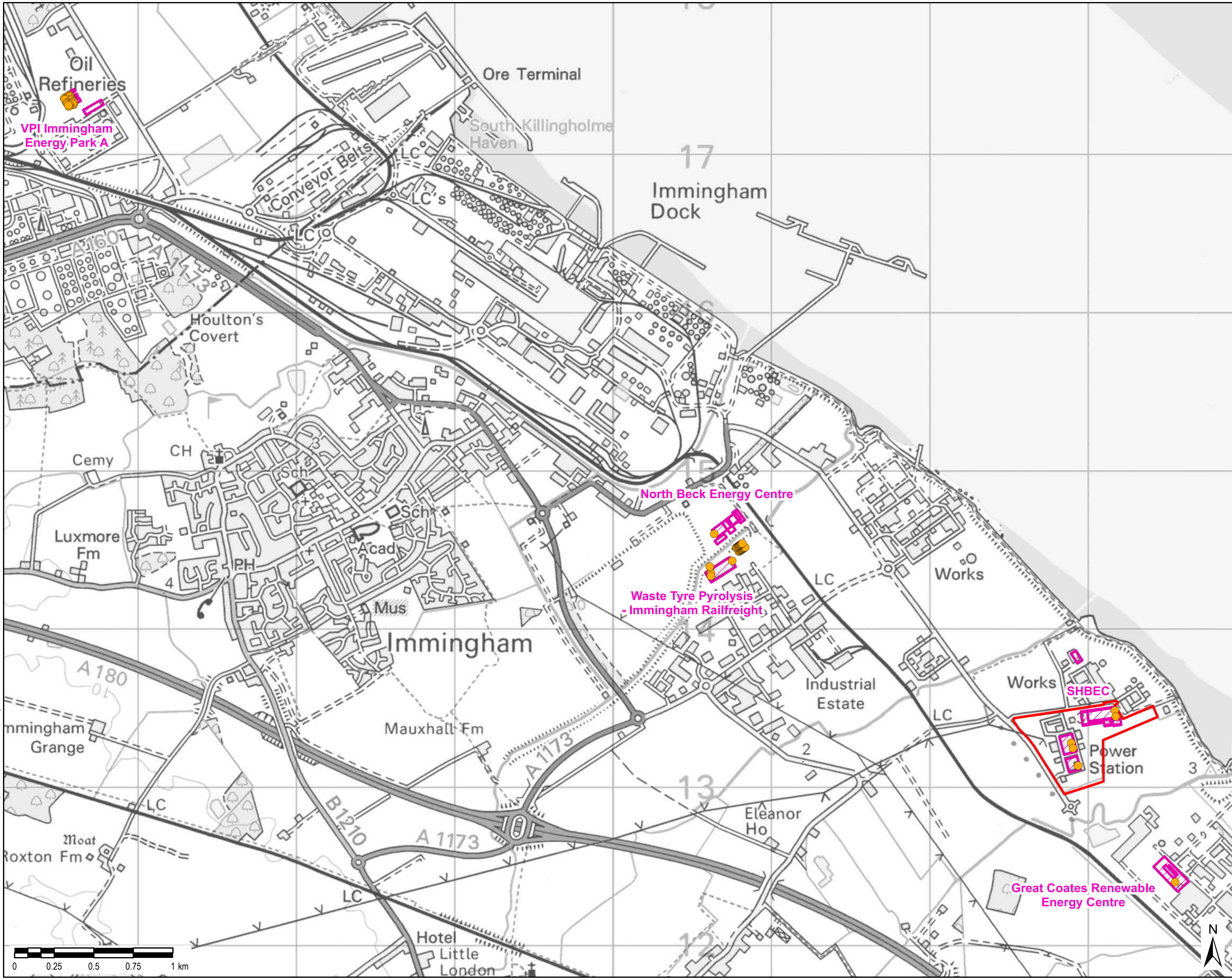
Figure 7A.5: Cumulative Developments modelled



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- Modelled Point Sources
- Application Boundary
- Modelled Buildings

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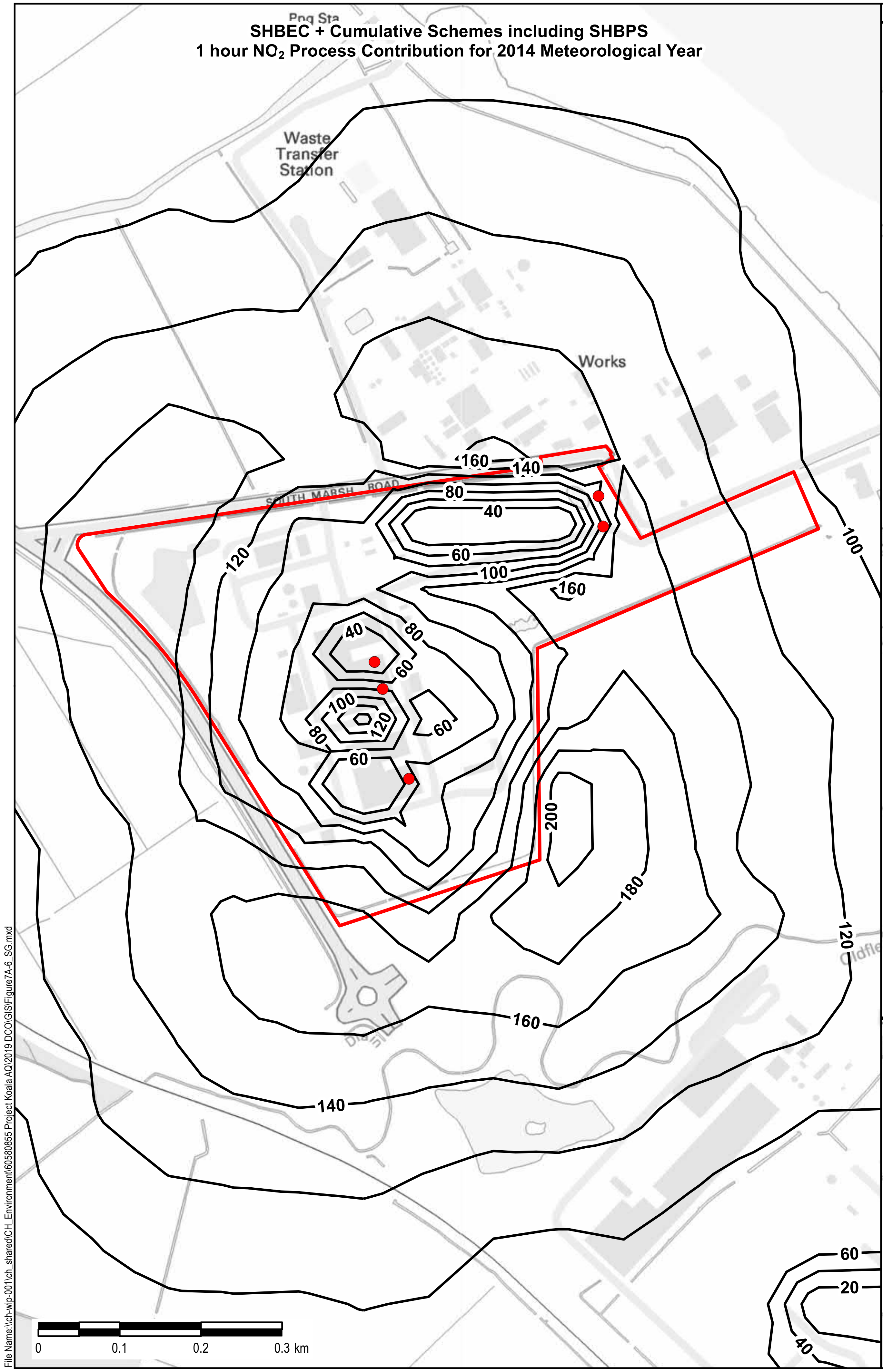
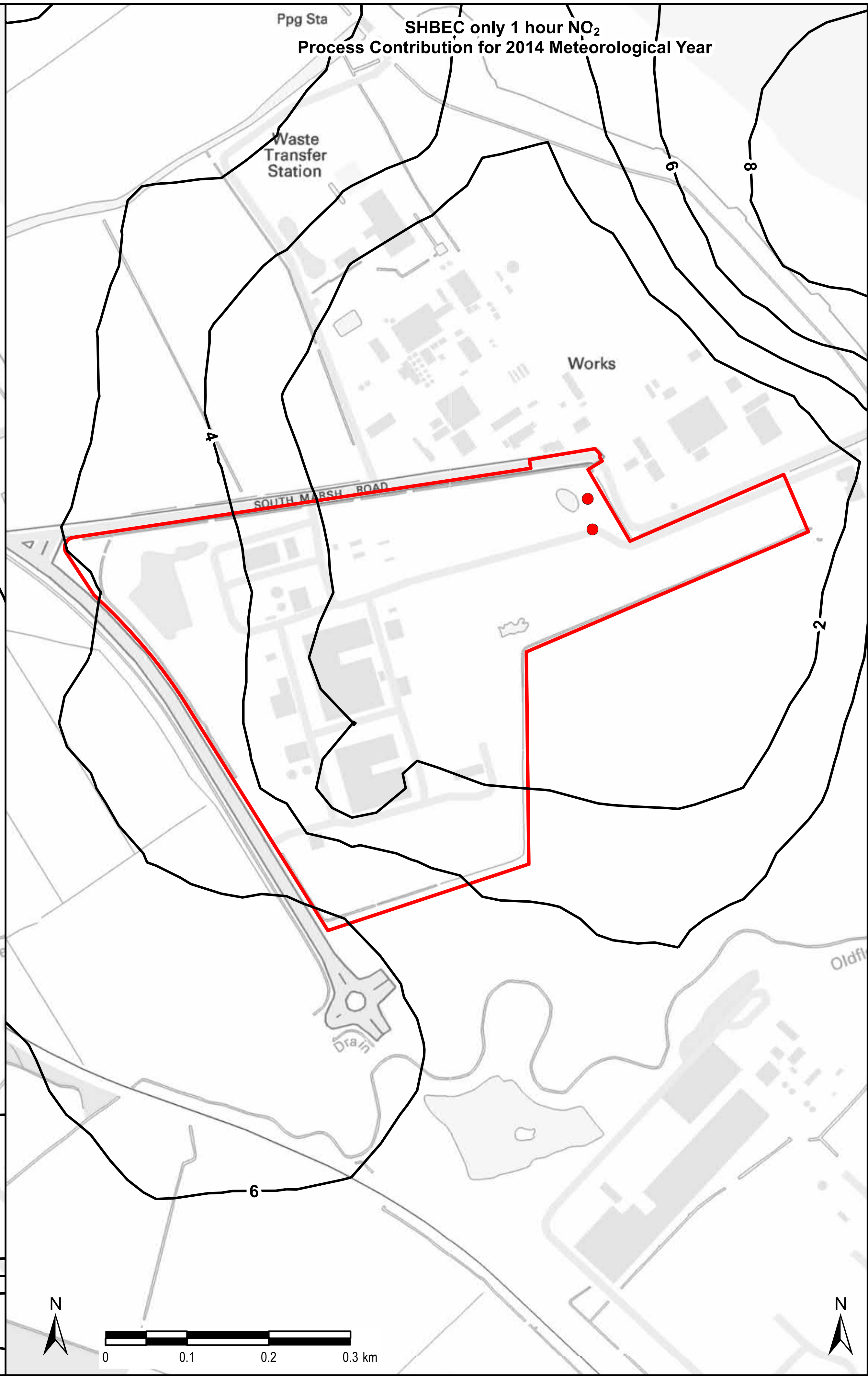
Figure 7A.6: Short term maximum NO_2 Process Contribution 2014 meteorological year for Proposed Development and for cumulative Developments





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- Modelled Point Sources
- Application Boundary
- NO_2 1 hour Mean Process Contribution ($\mu g/m^3$)

Revision Details	By / Check	Check Date	Suffix

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Project Title
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Drawing Title
SHORT TERM MAXIMUM NO_2 PROCESS CONTRIBUTION 2014 METEOROLOGICAL YEAR FOR SHBEC ONLY AND FOR CUMULATIVE DEVELOPMENTS

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FIGURE 7A-6

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ANNEX B: ROAD TRAFFIC FLOW DATA

Traffic Data used in Modelling of Road Emissions

Table B.1: 2017 baseline traffic data

LINK	AADT (VEH/DAY)	%HDV	SPEED (MPH)
South Marsh Road (East of Hobson Way)[12]	780	26	30
South Marsh Road (West of Hobson Way)[12]	771	7	30
Hobson Way[12]	1,203	21	40
Kiln Lane[12]	2,815	35	40
A1173 (West of North Moss Lane)[12]	8,875	28	40
A1173 (North of A180)[12]	14,004	19	50
A180 North of A1173 (Eastbound)	11,786	21	60
A180 North of A1173 (Westbound)	13,884	20	60
A180 South of A1173 (Eastbound)	16,665	16	60
A180 South of A1173 (Westbound)	17,022	16	60

[12] These links have also been modelled as queues with a speed of 15 mph.

Table B.2: 2021 baseline traffic + committed development traffic data

LINK	AADT (VEH/DAY)	%HDV	SPEED (KPH)
South Marsh Road (East of Hobson Way)[12]	822	26	30
South Marsh Road (West of Hobson Way)[12]	813	7	30
Hobson Way[12]	1,845	29	40
Kiln Lane[12]	4,282	33	40
A1173 (West of North Moss Lane)[12]	10,403	30	40
A1173 (North of A180)[12]	16,976	19	50
A180 North of A1173 (Eastbound)	12,995	22	60
A180 North of A1173 (Westbound)	15,207	21	60
A180 South of A1173 (Eastbound)	18,059	16	60
A180 South of A1173 (Westbound)	18,435	16	60

Table B.3: 2021 baseline traffic + committed development traffic + Proposed Development peak construction traffic data

LINK	AADT (VEH/DAY)	%HDV	SPEED (KPH)
South Marsh Road (East of Hobson Way)[12]	1,688	20	30
South Marsh Road (West of Hobson Way)[12]	888	7	30
Hobson Way[12]	2,636	25	40
Kiln Lane[12]	5,073	30	40
A1173 (West of North Moss Lane)[12]	11,194	29	40
A1173 (North of A180)[12]	17,760	19	50
A180 North of A1173 (Eastbound)	13,313	22	60
A180 North of A1173 (Westbound)	15,525	21	60
A180 South of A1173 (Eastbound)	18,133	16	60
A180 South of A1173 (Westbound)	18,509	16	60

Table B.4: 2023 Baseline traffic + committed development traffic data

LINK	AADT (VEH/DAY)	%HDV	SPEED (KPH)
South Marsh Road (East of Hobson Way)[12]	844	26	30
South Marsh Road (West of Hobson Way)[12]	834	7	30
Hobson Way	1,953	28	40
Kiln Lane	4,607	35	40
A1173 (West of North Moss Lane)[12]	10,988	31	40
A1173 (North of A180)[12]	18,150	21	50
A180 North of A1173 (Eastbound)	13,553	23	60
A180 North of A1173 (Westbound)	15,824	22	60
A180 South of A1173 (Eastbound)	18,655	16	60
A180 South of A1173 (Westbound)	19,042	16	60

Table B.5: 2023 Baseline traffic + committed development traffic + Proposed Development operational traffic

LINK	AADT (VEH/DAY)	%HDV	SPEED (KPH)
South Marsh Road (East of Hobson Way)[12]	1,580	54	30
South Marsh Road (West of Hobson Way)[12]	886	7	30
Hobson Way[12]	2,638	45	40
Kiln Lane[12]	5,292	42	40
A1173 (West of North Moss Lane)[12]	11,673	34	40
A1173 (North of A180)[12]	18,832	24	50
A180 North of A1173 (Eastbound)	13,717	24	60
A180 North of A1173 (Westbound)	15,988	22	60
A180 South of A1173 (Eastbound)	18,831	17	60
A180 South of A1173 (Westbound)	19,218	17	60

ANNEX C: NITROGEN DIOXIDE DIFFUSION TUBE MONITORING RESULTS

Month 1: 29th June 2018 to 27th June 2018

To:

AECOM Infrastructure &
Environment UK Ltd
Scott House
Alencon Link
BASINGSTOKE
Hampshire
RG21 7PP

REPORT

For the attention of: Joanna Morgan

Date : 14 August 2018

Site : Project Koala

NO2 - Batch 1

Method : E/5049

Issue No. : 1

Lab Ref	Sample Details	Exposure Time Hours	*Nitrogen Dioxide (20°C) µg/m^3	Comments
10447852	KOA T1	671	9.0	-
10447853	KOA T2	671	16.8	-
10447854	KOA T3	670	13.2	-
10447855	KOA T4	670	14.2	-
10447856	KOA T5	670	22.0	-
10447857	KOA T6	670	17.4	-
10447858	KOA TB	672	< 1.0	-

Comments

The limit of detection for the laboratory method E/5049 is 0.050µg NO2.

Mark Chapman
Testing Manager

Tests marked * are included in the UKAS accreditation schedule for this laboratory. Further information on accredited tests can be obtained on request. Opinions and Interpretations expressed herein are outside the scope of UKAS accreditation. Tests marked ' have been subcontracted. The laboratory does not accept any liability for data supplied in the form of air volumes and exposure dates.

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Month 2: 27th July 2018 to 24th August 2018

Staffordshire County Council

the knot unites

UKAS TESTING 0719

To:

AECOM Infrastructure &
Environment UK Ltd
Scott House
Alencon Link
BASINGSTOKE
Hampshire
RG21 7PP

REPORT

For the attention of: Joanna Morgan

Date : 5 September 2018

Site : Project Koala

NO2 - Batch 2

Method : E/5049

Issue No. : 1

Lab Ref	Sample Details	Exposure Time Hours	*Nitrogen Dioxide (20℃) µg/m^3	Comments
10449553	KOA T1	672	8.8	-
10449554	KOA T2	672	13.8	-
10449555	KOA T3	672	14.1	-
10449556	KOA T4	672	12.3	-
10449557	KOA T5	672	18.6	-
10449558	KOA T6	I/S	I/S	Tube missing
10449559	KOA TB	673	< 1.0	-

Comments

The limit of detection for the laboratory method E/5049 is 0.050µg NO2.

Emma Loach
Lab Manager

E Loach

Emma Loach
Laboratory Manager

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Month 3: 24th August 2018 to 20th September 2018

Staffordshire County Council

the knot unites

0719

To:

AECOM Infrastructure &
Environment UK Ltd
Scott House
Alencon Link
BASINGSTOKE
Hampshire
RG21 7PP

REPORT

For the attention of: Joanna Morgan

Date : 4 October 2018

Site : Project Koala

NO_2 - Batch 3

Method : E/5049

Issue No. : 1

Lab Ref	Sample Details	Exposure Time Hours	*Nitrogen Dioxide (20℃) µg/m^3	Comments
10451034	KOA T1	648	11.5	cobweb
10451035	KOA T2	648	14.9	cobweb
10451036	KOA T3	648	15.2	cobweb
10451037	KOA T4	648	13.6	Spider
10451038	KOA T5	648	19.5	-
10451039	KOA T6	648	15.5	-
10451040	KOA TB	648	< 1.0	-

Comments

The limit of detection for the laboratory method E/5049 is 0.050µg NO2.

Emma Loach
Lab Manager

E Loach

Tests marked * are included in the UKAS accreditation schedule for this laboratory. Further information on accredited tests can be obtained on request. Opinions and Interpretations expressed herein are outside the scope of UKAS accreditation. Tests marked ' have been subcontracted. The laboratory does not accept any liability for data supplied in the form of air volumes and exposure dates.

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Month 4: 20th September 2018 to 18th October 2018

Staffordshire County Council

the knot unites

0719

To:

AECOM Infrastructure &
Environment UK Ltd
Scott House
Alencon Link
BASINGSTOKE
Hampshire
RG21 7PP

REPORT

For the attention of: Joanna Morgan

Date : 6 November 2018

Site : Project Koala

NO2 - Batch 4

Method : E/5049

Issue No. : 1

Lab Ref	Sample Details	Exposure Time Hours	*Nitrogen Dioxide (20℃) µg/m^3	Comments
10453679	KOA T1	672	13.0	-
10453680	KOA T2	672	19.8	-
10453681	KOA T3	672	17.8	-
10453682	KOA T4	672	15.8	-
10453683	KOA T5	672	21.8	-
10453684	KOA T6	I/S	I/S	Tube Missing
10453685	KOA TB	672	< 1.0	-

Comments

The limit of detection for the laboratory method E/5049 is 0.050µg NO2.

Emma Loach
Lab Manager

E Loach

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Month 5: 18th October 2018 to 16th November 2018

Staffordshire County Council

the knot unites

0719

To:

AECOM Infrastructure &
Environment UK Ltd
Scott House
Alencon Link
BASINGSTOKE
Hampshire
RG21 7PP

REPORT

For the attention of: Joanna Morgan

Date : 5 December 2018

Site : Project Koala

NO2 - Batch 5

Method : E/5049

Issue No. : 1

Lab Ref	Sample Details	Exposure Time Hours	*Nitrogen Dioxide (20℃) µg/m^3	Comments
10456283	KOA T1	697	19.0	-
10456284	KOA T2	697	19.5	-
10456285	KOA T3	697	21.2	-
10456286	KOA T4	697	15.1	-
10456287	KOA T5	I/S	I/S	Tube missing
10456288	KOA T6	I/S	I/S	Tube missing
10456289	KOA TB	698	< 1.0	-

Comments

The limit of detection for the laboratory method E/5049 is 0.050µg NO2.

The hours of exposure account for the change from BST to GMT.

Emma Loach
Lab Manager

EJLoach

Emma Loach
Laboratory Manager

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Month 6: 16th November 2018 to 14th December 2018

Staffordshire County Council

the knot unites

0719

To:

AECOM Infrastructure &
Environment UK Ltd
Scott House
Alencon Link
BASINGSTOKE
Hampshire
RG21 7PP

REPORT

For the attention of: Joanna Morgan

Date : 21 December 2018

Site : Project Koala

NO2 - Batch 6

Method : E/5049

Issue No. : 1

Lab Ref	Sample Details	Exposure Time Hours	*Nitrogen Dioxide (20℃) µg/m^3	Comments
10457315	KOA T1	672	19.2	-
10457316	KOA T2	672	25.8	-
10457317	KOA T3	672	24.2	-
10457318	KOA T4	672	18.9	-
10457319	KOA T5	672	26.2	-
10457320	KOA T6	672	23.5	-
10457321	KOA TB	672	< 1.0	-

Comments

The limit of detection for the laboratory method E/5049 is 0.050µg NO2.

Emma Loach
Lab Manager

Emma Loach
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ANNEX D: ASSESSMENT OF CUMULATIVE IMPACTS

Introduction

This Annex reports the results of an assessment of cumulative impacts from the Proposed Development and other industrial emission sources in the vicinity of the Site. While the baseline data used in the assessment has captured the effect of existing emissions on local air quality concentrations, the measurements taken have not captured the process contribution made by consented but not yet operational developments in the local area, in particular the Great Coates Renewable Energy Centre (DM/0329/18/FUL), North Beck Energy Centre (DM/0026/18/FUL), Waste Tyre Pyrolysis – Immingham Railfreight (DM/0333/17/FUL), and VPI Immingham Energy Park A (PA/2018/918).

The South Humber Bank Power Station (SHBPS) adjacent to the Main Development Area is operational and the emissions of which will be captured within the baseline values from APIS, Defra and the measured nitrogen dioxide diffusion tube concentrations. Therefore inclusion of SHBPS in the cumulative modelling was not needed. However, SHBPS and the Proposed Development are located in close proximity to each other so there is the potential for 99.79th percentile 1 hour NO_2 impacts to coincide in the same geographical location. Therefore separate analysis of this pollutant averaging period is displayed in the 'South Humber Bank Power Station' section below.

The future impact on ambient air quality of the Great Coates Renewable Energy Centre, North Beck Energy Centre, Waste Tyre Pyrolysis – Immingham Railfreight, and VPI Immingham Energy Park A, in combination with the Proposed Development been considered within this assessment of cumulative impacts, using dispersion modelling. As in the main assessment, the impacts presented are the maximum results obtained from modelling with 5 years of meteorological data.

The assessment of cumulative impacts for this PEI Report has not included a consideration of the emissions to air from the proposed Sustainable Transport Fuels Facility adjacent to the Site, or the VPI Immingham OCGT DCO which have been reported on since the assessment of the Consented Development was undertaken. However these sources will be included in the final ES for the Proposed Development.

Other consented developments have been identified and shortlisted for cumulative environmental effects assessment as described in Chapter 17: Cumulative and Combined Effects of the PEI Report Volume I. Apart from the consented developments described above, the other shortlisted developments identified in Chapter 17 have been scoped out of the cumulative dispersion modelling assessment as follows:

- Stallingborough Link Road and engineering works at Paragon House – scoped out as there are no/ minimal point sources of emissions; and
- Renewable power facility Kiln Lane, Selvic Shipping CHP Boilers, and Stallingborough Interchange Business Park – scoped out because the available information is not sufficient to enable replication of ADMS 5 disperson modelling.

Model Inputs

The model inputs for the additional emission sources are presented in this section. The model inputs for the Proposed Development are unchanged.

The Great Coates Renewable Energy Centre modelling information is sourced from the DM_0329_18_FUL-Air_Quality_Assessment-1382893 (Gair Consulting Ltd, 2018). The North Beck Energy Centre modelling information is sourced from the North Beck Energy Centre Appendix 8.2 Emissions Modelling (EP SHB Ltd., 2018). The Waste Tyre Pyrolysis modelling information was sourced from the DM_0333_17_FUL-

AIR_QUALITY-ASSESSMENT (Earthcare Technical, 2017) chapter. However, no exact grid references for the sources were provided so AECOM used professional judgement to put these locations in the dispersion model. The VPI Immingham Energy Park A model input data was sourced from the Environmental Statement (AECOM, 2018). The SHBPS information was sourced from EP SHB Limited (EP SHB Limited, 2018). The locations of these cumulative sites are displayed in Figure 7A-5.

All cumulative model schemes have been assumed to run continuously at full output. Table D.1 displays the model input data.

Table D.1: Summary of stack parameters for Great Coates, North Beck, Waste Tyre Pyrolysis, VPI Immingham Energy Park A and SHBPS

PARAMETER	GREAT COATES	NORTH BECK	WASTE TYRE PYROLYSIS					VPI IMMINGHAM ENERGY PARK A	SHBPS
			PYR ENERGY GEN	PYR FLUE GAS	PYR REFINER STACK	PYR PELLETISER & DRYER	PYR TYRE PREP STACK		
Number of stacks	1	1	24	1	1	1	1	33	3 (A1, A2, A3)
Stack height (m)	65	90	12	14.5	14.5	14.5	14.5	10	75
Flue diameter (m)	2.27	3.3	0.2	0.4	0.3	0.4	0.9	0.37 per stack	A1: 5.6 A2 & A3: 7.9
Normalised volumetric flow rate (Nm^3/s)	39.8	124.91	1.11	3.1	1.05	Not provided	8.33	2.84 per stack	9.8 per stack
Reference conditions	273 K, 1 atmosphere, dry & 11% oxygen	273.15 K, dry gas, 11% oxygen	273 K, 5% O_2, dry, 101.3 kPa	273 K, 11% O_2, dry, 101.3 kPa	293.15 K, 20.95% O_2, 1% H_2O, 101.3 kPa	-	273 K, 20.95% O_2, 1% H_2O, 101.3 kPa	-	-
Actual Flow rate (Am^3/s)	61.0	173.12	4.17	3.38	1.41	3.11	9.4	39.5	-
Actual conditions	-	-	-	293 K, 11% O_2, dry, 101.3 kPa	393.15 K, 20.95% O_2, 1% H_2O, 101.3 kPa	380.35 K, 20.95% O_2, 15% H_2O,101.3 kPa	308.15 K, 20.95% O_2, 1% H_2O, 101.3 kPa	-	-

PARAMETER	GREAT COATES	NORTH BECK	WASTE TYRE PYROLYSIS					VPI IMMINGHAM ENERGY PARK A	SHBPS
			PYR ENERGY GEN	PYR FLUE GAS	PYR REFINER STACK	PYR PELLETISER & DRYER	PYR TYRE PREP STACK		
Actual Flow rate (m/s)	-	-	-	-	-	3.11	14.8	-	-
Emission temperature (°C)	145	140	442	22.5	120	107.2	35	388	90
Grid Reference of Stack (X,Y)	523550,412401	520638,414600	520794, 414488 to 520816, 414540	520610, 414394	520618, 414352	520617, 414335	520753, 414430	516577, 417353 to 516558, 417307	A1: 522894, 413280 A2: 522903, 413247 A3: 522936, 413136
Particle emission rate (PM_{10}) (g/s)	0.40	0.535	-	0.03	0.005	0.003	0.08	-	-
NO_X (g/s)	8.0	10.7	0.28	0.62	-	-	-	0.27	A1: 12.06 A2 & A3: 24.01
SO_2 (g/s)	2.0	2.7	-	0.15	-	-	-	-	-
CO (g/s)	2.0	2.7	1.55	0.15	-	-	-	1.05	A1: 24.14 A2 & A3: 48.04
HF (g/s)	0.040	0.054	-	0.03	-	-	-	-	-
HCl (g/s)	0.40	0.535	-	0.03	-	-	-	-	-

PARAMETER	GREAT COATES	NORTH BECK	WASTE TYRE PYROLYSIS					VPI IMMINGHAM ENERGY PARK A	SHBPS
			PYR ENERGY GEN	PYR FLUE GAS	PYR REFINER STACK	PYR PELLETISER & DRYER	PYR TYRE PREP STACK		
TOC (g/s)	0.40	0.535	-	0.03	-	-	-	-	-
Dioxins and Furans	4.0×10^{-9}	5.35×10^{-9}	-	3.72×10^{-10}	-	-	-	-	-
Cd & Tl (g/s)	2.0×10^{-3}	3.0×10^{-3}	-	5.0×10^{-5}	-	-	-	-	-
Hg (g/s)	2.0×10^{-3}	3.0×10^{-3}	-	5.0×10^{-5}	-	-	-	-	-
Other metals (As, Cr, Co, Cu, Pb, Mn, Ni, Sb and V)	2.0×10^{-2}	2.7×10^{-2}	-	5.0×10^{-4}	-	-	-	-	-
PAH (as Benzo[a]pyrene)	3.6×10^{-6}	1.12×10^{-6}	-	3.72×10^{-6}	-	-	-	-	-
PCBs	-	2.68×10^{-6}	-	1.86×10^{-5}	-	-	-	-	-

A consideration of building downwash effects has been made by including information on building dimensions associated with the Vireol Plc energy centre, North Beck energy centre, Energy Pyrolysis, VPI Immingham and SHBPS within the model. The building dimensions are presented in Table D.2.

Table D.2: Building parameters – Great Coates, North Beck, Waste Tyre Pyrolysis, VPI Immingham Energy Park A and SHBPS

SITE	BUILDING	NATIONAL GRID REFERENCE OF CENTRE POINT (X,Y)	LENGTH (m)	WIDTH (m)	HEIGHT (m)	ANGLE (°)
Great Coates	Vireol Plc Bld 1	523524, 412452	95	220	19.3	46
	Vireol Plc Bld 2	523515, 412467	95	22	32.4	317
	Vireol Plc Bld 3	523534, 412474	80	14	25.6	317
North Beck	NB Boiler House	520722, 414663	45.5	55	48	53
	NB Flue Gas	520673, 414626	78	55	48	53
	NB Bunker	520759, 414691	78	55	48	53
	NB Waste Reception	520793, 414712	35	83.7	26.6	53
	NB TH	520747, 414627	40	32	24	53
	NB ACC	520679, 414567	74	26	20	53
Waste Tyre Pyrolysis	Pyrolysis Main Bld	520678, 414373	182.92	70.86	13.5	57.02
VPI Immingham Energy Park A	VPI Generator Housin	516565, 417338	65	80	7	60
	VPI Main Site	516718, 417296	130	35	22	60
	VPI Workshop	516586, 417397	30	15	10	60
	VPI Water Tank	516614, 417357	12	12	10	Circular shape
	VPI Transformer	516607, 417372	16	12	10	60
	VPI Gas Receiving Co	516622, 417339	25	20	7	60
SHBPS	Turbine Building 1	522906, 413145	30.7	73.6	85.6	74.2
	Turbine Building 2	522874, 413372	29.7	82.3	115.4	74.6

Model Results

The results of the cumulative impact modelling are presented in the Tables below. The maximum predicted impact location from each individual facility will vary spatially due to their different position within the model domain and source characteristics. The maximum impact from all the modelled sources will include a contribution from each individual source and may not occur at the same location as individual maximum impacts.

The change in annual mean NO_2 concentrations at the selected discrete receptors is shown in Table D.3. The highest combined PC of 1.1 µg/m^3 is predicted to occur at R1, R7 and R8 (Table D.3). No annual mean concentration above the annual mean Environmental Standard for NO_2 is predicted to occur, even at the selected receptors (Table D.3).

9.1 The maximum combined impacts within the modelled domain (due to the operation of the Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre, Waste Tyre Pyrolysis and VPI Immingham Energy Park A) are shown in

Table D.5. With six exceptions, the modelled PECs are all within the Environmental Standards for the protection of human health. As in the assessment of impacts of the Proposed Development alone, the assumption of worst case emission rates for result in predicted combined PC values in excess of the Environmental Standard., due almost entirely to the estimated baseline concentration exceeding the Environmental Standard.

Further analysis of Cr(VI), nickel, arsenic and Benzo[a]pyrene was therefore undertaken later in this section.

The assessment results show that the predicted impacts at ecological receptors are not significant at all of the selected receptors, with the exception of the Humber Estuary (Acid Fixed Dunes). A PC of more than 1% of the long-term Critical Load has however been predicted to occur at Humber Estuary (Acid Fixed Dunes) in respect of acid deposition, in an area which already exceeds the relevant standard.

At the acid fixed dunes, the cumulative PC to acid deposition is 1.5% of the lower range Critical Load. The PC from the Proposed Development alone was 0.6% of the lower range Critical Load. 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 PEI Report Volume III). Please refer to the Chapter 10: Ecology for discussion about the significance of the in-combination emissions on sensitive ecological receptors.

Table D.3: Predicted change in annual mean NO_2 concentrations at discrete receptors (µg/m³) due to operational point sources and traffic emissions from the Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre, Waste Tyre Pyrolysis – Immingham Railfreight and VPI Immingham Energy Park A with comparison against Environmental Standard criteria

RECEPTOR	BACKGROUND	CHANGE DUE TO ROAD (µg/m³)	COMBINED PC FROM POINT SOURCE EMISSIONS (µg/m³)	COMBINED CHANGE % ENV STD	PEC (µg/m³)	PEC % ENV STD
R1	12.5	+0.2	+0.7	2.5	12.8	52.7
R2	12.5	+0.2	+0.6	2.2	12.7	44.5
R3	12.5	+0.2	+0.7	2.3	12.7	45.0
R4	12.5	+0.2	+0.6	2.2	12.7	50.5
R5	12.5	+0.2	+0.6	2.2	12.7	52.5
R6	12.5	+0.3	+0.6	2.2	12.7	59.3
R7	12.5	+0.3	+0.6	2.3	12.7	68.0
R8	12.5	+0.4	+0.6	2.4	12.8	77.1
R9	12.5	+0.2	+0.5	1.8	12.5	52.9
R10	12.5	+0.1	+0.5	1.7	12.5	45.7
R11	12.5	+0.1	+0.5	1.6	12.4	44.0
R12	12.5	+0.2	+0.5	1.7	12.5	45.7
R13	12.5	+0.1	+0.2	0.9	12.2	49.8
R14	12.5	+<0.1	+0.8	2.5	12.8	39.8
R15	12.5	+<0.1	+0.6	2.0	12.6	39.8
R16	12.5	+<0.1	+0.6	1.9	12.6	42.9
R17	12.5	+0.1	+0.5	1.8	12.5	46.1
R18	12.5	+0.1	+0.4	1.5	12.4	52.2
R19	12.5	+<0.1	+0.2	1.1	12.2	47.0
R20	12.5	+0.2	+0.2	1.5	12.4	81.4
R21	33.5	+<0.1	+0.2	0.6	37.5	94.5

Table D.4: Predicted change in annual mean PM_{10} concentrations at receptors from the Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre, and Waste Tyre Pyrolysis – Immingham Railfreight, with comparison against Environmental Standard criteria

RECEPTOR	BACKGROUND	CHANGE DUE TO ROAD (µg/m^3)	COMBINED PC FROM POINT SOURCE EMISSIONS	PC % ENV STD	PEC (µg/m^3)	PEC % ENV STD
R1	14.1	+<0.1	+<0.1	<1	14.2	36
R2	14.1	+<0.1	+<0.1	<1	14.2	36
R3	14.1	+<0.1	+<0.1	<1	14.2	36
R4	14.1	+<0.1	+<0.1	<1	14.2	36
R5	14.1	+<0.1	+<0.1	<1	14.2	36
R6	14.1	+<0.1	+<0.1	<1	14.2	36
R7	14.1	+<0.1	+<0.1	<1	14.2	36
R8	14.1	+<0.1	+<0.1	<1	14.2	36
R9	14.1	+<0.1	+<0.1	<1	14.2	36
R10	14.1	+<0.1	+<0.1	<1	14.1	36
R11	14.1	+<0.1	+<0.1	<1	14.1	36
R12	14.1	+<0.1	+<0.1	<1	14.1	36
R13	14.1	+<0.1	+<0.1	<1	14.1	36
R14	14.1	+<0.1	+<0.1	<1	14.1	36
R15	14.1	+<0.1	+<0.1	<1	14.1	36
R16	14.1	+<0.1	+<0.1	<1	14.1	36
R17	14.1	+<0.1	+<0.1	<1	14.1	36
R18	14.1	+<0.1	+<0.1	<1	14.1	36
R19	14.1	+<0.1	+<0.1	<1	14.1	36
R20	14.1	+<0.1	+<0.1	<1	14.2	36
R21	14.1	+<0.1	+<0.1	<1	14.1	36

Table D.5: Maximum Process Contribution from the Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre, VPI Immingham Energy Park A and Waste Tyre Pyrolysis – Immingham Railfreight predicted environmental concentration, all modelled pollutants, for the worst case meteorological year

POLLUTANT	AVERAGING PERIOD	BACKGROUND (µg/m^3)	ENV STD (µg/m^3)	COMBINED PC (µg/m^3)	COMBINED PC % ENV STD	TOTAL PEC (µg/m^3)	TOTAL PEC% ENV STD
NO_2	Annual Mean[13]	12.5	40	27.1	67.7	39.6	99
	99.79th %ile of 1-hour means	25.0	200	74.6	37.3	99.6	50
PM_{10}	Annual Mean	14.1	40	1.3	3	15.4	39
	90.41st %ile of 24-hour means	21.2	50	2.9	6	24.1	48
$PM_{2.5}$	Annual Mean	8.2	25	1.3	5	9.5	38
SO_2	Annual Mean	16.7	50	1.2	2	17.9	36
	99.9th %le of 15-min means	33.4	266	19.5	7	52.9	20
	99.73rd %ile of 1-hour means	33.4	350	15.3	4	48.7	14
	99.18th %ile of 24-hour means	33.4	125	7.1	6	40.5	32
VOC, as Benzene	Annual Mean	0.368	5	0.3	5	0.6	13

[13] Annual mean NO_2 PC is for the Proposed Development, Great Coates, North Beck and Waste Tyre Pyrolysis

POLLUTANT	AVERAGING PERIOD	BACKGROUND (µg/m^3)	ENV STD (µg/m^3)	COMBINED PC (µg/m^3)	COMBINED PC % ENV STD	TOTAL PEC (µg/m^3)	TOTAL PEC% ENV STD
CO	Max daily 8-hr running mean	258	10000	1569.2	16	1827.2	18
HCl	Max 1-hour mean	0.2	750	5.2	1	5.4	1
HF	Monthly mean	0.003	16	0.5	3	0.5	3
	Max 1-hour mean	0.006	160	0.5	0	0.5	0
PAH (as BaP)	Annual Mean	0.00082	0.00025	0.00026	105	0.0011	434
Pb	Annual Mean	1.85×10^{-01}	0.25	6.12×10^{-03}	2	0.2	76
Cd	Annual Mean	0.00047	0.005	0.0086	171	0.0090	181
Hg	Annual Mean	0.002	0.25	0.0086	3	0.011	4
	Max 1-hr mean	0.004	7.5	0.0081	0.1	0.012	0
Sb	Annual Mean	0.00078	5	0.061	0.1	0.01	0.1
	Max 1-hr mean	0.0016	150	0.099	0.1	0.1	0.1
As	Annual Mean	0.001	0.003	0.006	204	0.0071	238
Total Cr	Annual Mean	0.004	5	0.0061	0.1	0.01	0.2
	Max 1-hr Mean	0.008	150	0.099	0.1	0.1	0.1
Cr (VI) oxidation state in PM_{10} fraction	Annual Mean	0.00080	0.0002	0.0061	3061	0.0069	3463
Cu (dusts and mists)	Annual Mean	0.006	10	0.0061	0.1	0.01	0.1
	Max 1-hr mean	0.011	200	0.099	<0.1	0.1	0.1
Mn	Annual Mean	0.11	0.15	0.0061	4	0.1	75

POLLUTANT	AVERAGING PERIOD	BACKGROUND ($\mu g/m^3$)	ENV STD ($\mu g/m^3$)	COMBINED PC ($\mu g/m^3$)	COMBINED PC % ENV STD	TOTAL PEC ($\mu g/m^3$)	TOTAL PEC% ENV STD
	Max 1-hr mean	0.21	1500	0.099	0.01	0.3	0.02
Ni	Annual Mean	0.001	0.02	0.0061	31	0.01	37
V	Annual Mean	0.01	5	0.0061	0.1	0.02	0
	Max 1-hour mean	0.02	1	0.099	10	0.1	12
Dioxins and Furans	Annual Mean	1.20×10^{-5}	-	2.90×10^{-9}		1.20×10^{-5}	

Additional Consideration of Group 3 Metals Using EA Guidance

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 detailed in paragraph 4.28. As arsenic, nickel 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.

As set out above, in the first instance, a worst-case screening step was carried out. 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 D.6 presents the revised PC and PEC values within the modelled domain, for arsenic, nickel and chromium (VI) using the mean, maximum and minimum emission concentrations provided by the EA guidance.

The results show that the mean and minimum PC for Cr(VI), As and Ni are less than 1% of the Environmental Standard so they can be screened out as insignificant. The maximum As and Ni values gives a predicted PC greater than 1% of the Environmental Standard, however the PEC is well below the Environmental Standard. The maximum Cr(VI) PC is 1.8% of the Environmental Standard, and occurs in a similar location to the maximum predicted annual mean impact from the Proposed Development alone, at national grid reference 523480, 414010 which is in the Humber Estuary some 200 metres from the nearest landmass. The annual mean isoline plot (Figure 7A.3) shows that impacts on land would be less than half the maximum and it is therefore concluded that the contribution to cumulative annual mean Cr(VI) concentrations made by the Proposed Development would not be significant.

Table D.6: Maximum Process Contribution and predicted environmental concentration, for As and Cr (VI) for all cumulative developments, for the worst case meteorological year

POLLUTANT		AVERAGING PERIOD	ENV STD (µg/m^3)	TOTAL PC (µg/m^3)	PC % ENV STD	PEC (µg/m^3)	PEC % ENV STD
Cr (VI)	Mean emissions	Annual Mean	0.0002	9.83×10^{-7}	0.5	8.05×10^{-4}	402
	Max emissions	Annual Mean	0.0002	3.65×10^{-6}	1.8	8.08×10^{-4}	404
	Min emissions	Annual Mean	0.0002	6.46×10^{-8}	0.03	8.04×10^{-4}	402
As	Mean emissions	Annual Mean	0.003	2.81×10^{-5}	0.9	1.04×10^{-3}	35
	Max emissions	Annual Mean	0.003	7.01×10^{-4}	23.4	1.71×10^{-3}	57
	Min emissions	Annual Mean	0.003	5.61×10^{-6}	0.2	1.02×10^{-3}	34
Ni	Mean emissions	Annual Mean	0.02	4.21×10^{-4}	2.1	1.64×10^{-3}	8
	Max emissions	Annual Mean	0.02	6.16×10^{-3}	30.8	7.38×10^{-3}	37
	Min emissions	Annual Mean	0.02	7.01×10^{-5}	0.4	1.29×10^{-3}	6

Additional Consideration of Benzo[a]Pyrene Emissions

The results presented in Table D.7 showed that the need for more detailed consideration of Benzo[a]Pyrene, as 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.

Benzo[a]pyrene emissions have been considered using emission rates derived from total benzo[a]pyrene concentrations measured at a UK waste incineration facility in Sheffield. This provides a more realistic basis for assessment, based on emissions from comparable processes to those assessed here.

The PC of the Environmental Standard is 11.4% which is still potentially significant. However, this maximum contribution is located at national grid reference 520700, 414550 near to the North Beck Energy Centre and Waste Tyre Pyrolysis – Immingham Railfreight facilities, 2.5 km north-west of the Proposed Development. The PC from the Proposed Development at the same place to annual mean B[a]P concentrations is 8.2×10^{-9} µg/m^3. It is therefore concluded that the emissions from the Proposed Development would not make a significant cumulative contribution to B[a]P concentrations at this location.

Table D.7: Predicted total Process Contribution for all the cumulative developments and predicted environmental concentration, for B[a]P, for the worst case meteorological data year, using a measured emissions concentration

POLLUTANT	AVERAGING PERIOD	ENV STD (µg/m^3)	PC (µg/m^3)	PC % ENV STD	PEC (µg/m^3)	PEC % ENV STD
B[a]P	Annual Mean	2.5×10^{-4}	0.00003	11.4	8.52×10^{-4}	341

Table D.8: Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre, and Waste Tyre Pyrolysis – Immingham Railfreight combined impact on sensitive ecological receptors - NO_X

RECEPT OR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)[14]						24 HOUR MEAN (µg/m^3)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E1_1	Humber Estuary (Atlantic Salt Meadows)	29.2	30	2.2	7.2	19.3	104	64.3	75	15.2	20.3	59.0	79
E1_2	Humber Estuary (Atlantic Salt Meadows)	29.2	30	2.0	6.8	19.1	104	63.6	75	15.1	20.1	58.9	79
E1_3	Humber Estuary (Atlantic Salt Meadows)	29.2	30	2.3	7.6	19.4	105	64.7	75	14.6	19.5	58.4	78
E2_1	Humber Estuary (Atlantic Salt Meadows)	27.3	30	0.5	1.6	27.8	93	41.0	75	5.4	7.2	46.4	62
E2_2	Humber Estuary (Atlantic Salt Meadows)	28.7	30	0.5	1.5	29.1	97	43.1	75	5.1	6.8	48.1	64

[14] This includes PC from VPI Immingham Energy Park A

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)[14]						24 HOUR MEAN (µg/m³)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E2_3	Humber Estuary (Atlantic Salt Meadows)	28.7	30	0.4	1.4	29.1	97	43.1	75	5.0	6.6	48.0	64
E2_4	Humber Estuary (Atlantic Salt Meadows)	28.7	30	0.4	1.4	29.1	97	43.1	75	4.6	6.1	47.6	63
E3_1	Humber Estuary (Atlantic Salt Meadows)	37.1	30	0.4	1.2	37.4	125	55.7	75	3.6	4.8	59.2	79
E4_1	Humber Estuary (Acid Fixed Dunes)	22.8	30	0.2	0.6	22.9	76	34.1	75	1.8	2.4	35.9	48
E4_2	Humber Estuary (Acid Fixed Dunes)	22.8	30	0.2	0.6	22.9	76	34.1	75	1.7	2.3	35.9	48
E4_3	Humber Estuary (Acid Fixed Dunes)	22.8	30	0.2	0.6	22.9	76	34.1	75	1.7	2.3	35.8	48
E4_4	Humber Estuary (Acid Fixed Dunes)	22.8	30	0.2	0.6	22.9	76	34.1	75	1.7	2.2	35.8	48
E4_5	Humber Estuary (Acid Fixed Dunes)	21.2	30	0.2	0.6	21.4	71	31.8	75	1.7	2.2	33.5	45

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)[14]						24 HOUR MEAN (µg/m³)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E4_6	Humber Estuary (Acid Fixed Dunes)	21.2	30	0.2	0.6	21.4	71	31.8	75	1.6	2.2	33.5	45
E5_1	Humber Estuary (Atlantic Salt Meadows)	22.8	30	0.2	0.6	22.9	76	34.1	75	1.7	2.3	35.8	48
E5_2	Humber Estuary (Atlantic Salt Meadows)	21.2	30	0.2	0.6	21.4	71	31.8	75	1.7	2.3	33.5	45
E5_3	Humber Estuary (Atlantic Salt Meadows)	21.2	30	0.2	0.6	21.4	71	31.8	75	1.7	2.2	33.5	45
E5_4	Humber Estuary (Atlantic Salt Meadows)	21.2	30	0.2	0.5	21.4	71	31.8	75	1.6	2.2	33.4	45
E5_5	Humber Estuary (Atlantic Salt Meadows)	21.2	30	0.2	0.5	21.4	71	31.8	75	1.6	2.1	33.4	45
E5_6	Humber Estuary (Atlantic Salt Meadows)	19.6	30	0.2	0.5	19.7	66	29.3	75	1.6	2.1	30.9	41

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)[14]						24 HOUR MEAN (µg/m³)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E5_7	Humber Estuary (Atlantic Salt Meadows)	19.6	30	0.2	0.5	19.7	66	29.3	75	1.5	2.1	30.9	41
E5_8	Humber Estuary (Atlantic Salt Meadows)	19.6	30	0.2	0.5	19.7	66	29.3	75	1.5	2.0	30.8	41
E5_9	Humber Estuary (Atlantic Salt Meadows)	19.6	30	0.1	0.5	19.7	66	29.3	75	1.5	2.0	30.8	41
E5_10	Humber Estuary (Atlantic Salt Meadows)	19.6	30	0.1	0.5	19.7	66	29.3	75	1.4	1.9	30.7	41
E6_1	Laporte Road (neutral grassland)	30.3	30	5.5	18.3	35.6	119	45.4	75	28.5	38.0	73.9	98
E6_2	Laporte Road (neutral grassland)	30.3	30	5.2	17.4	35.3	118	45.4	75	29.3	39.0	74.6	100
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	25.0	30	0.9	3.0	25.8	86	37.5	75	8.6	11.5	46.1	61

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)[14]						24 HOUR MEAN (µg/m³)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	25.0	30	0.9	2.9	25.8	86	37.5	75	8.0	10.7	45.5	61
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	24.0	30	0.9	3.1	24.8	83	35.9	75	8.7	11.6	44.6	60
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	24.0	30	0.9	3.1	24.8	83	35.9	75	8.2	10.9	44.1	59
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	31.2	30	0.6	2.0	31.7	106	46.8	75	8.5	11.4	55.3	74
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	31.2	30	0.6	2.0	31.7	106	46.8	75	10.5	14.0	57.3	76
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	31.2	30	0.6	1.9	31.7	106	46.8	75	8.7	11.6	55.4	74

Table D.9: Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre, and Waste Tyre Pyrolysis – Immingham Railfreight combined impact on sensitive ecological receptors - SO_2

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)					
		BKGD	CRITICAL LEVEL	COMBINED PC	PC/CL	PEC	PEC/CL
E1_1	Humber Estuary (Atlantic Salt Meadows)	4.9	20	0.5	2.4	5.3	27
E1_2	Humber Estuary (Atlantic Salt Meadows)	4.9	20	0.5	2.3	5.3	27
E1_3	Humber Estuary (Atlantic Salt Meadows)	4.9	20	0.5	2.5	5.4	27
E2_1	Humber Estuary (Atlantic Salt Meadows)	6.4	20	0.1	0.4	6.5	32
E2_2	Humber Estuary (Atlantic Salt Meadows)	4.6	20	0.1	0.4	4.7	23
E2_3	Humber Estuary (Atlantic Salt Meadows)	4.6	20	0.1	0.4	4.7	23
E2_4	Humber Estuary (Atlantic Salt Meadows)	4.6	20	0.1	0.4	4.7	23
E3_1	Humber Estuary (Atlantic Salt Meadows)	4.3	20	0.1	0.3	4.4	22
E4_1	Humber Estuary (Acid Fixed Dunes)	2.7	20	0.03	0.1	2.8	14
E4_2	Humber Estuary (Acid Fixed Dunes)	2.7	20	0.03	0.1	2.8	14
E4_3	Humber Estuary (Acid Fixed Dunes)	2.7	20	0.03	0.1	2.8	14
E4_4	Humber Estuary (Acid Fixed Dunes)	2.7	20	0.03	0.1	2.8	14
E4_5	Humber Estuary (Acid Fixed Dunes)	2.6	20	0.03	0.1	2.6	13

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)					
		BKGD	CRITICAL LEVEL	COMBINED PC	PC/CL	PEC	PEC/CL
E4_6	Humber Estuary (Acid Fixed Dunes)	2.6	20	0.03	0.1	2.6	13
E5_1	Humber Estuary (Atlantic Salt Meadows)	2.7	20	0.03	0.1	2.8	14
E5_2	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.03	0.1	2.6	13
E5_3	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.03	0.1	2.6	13
E5_4	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.03	0.1	2.6	13
E5_5	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.03	0.1	2.6	13
E5_6	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.02	0.1	2.6	13
E5_7	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.02	0.1	2.6	13
E5_8	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.02	0.1	2.6	13
E5_9	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.02	0.1	2.6	13
E5_10	Humber Estuary (Atlantic Salt Meadows)	2.6	20	0.02	0.1	2.6	13
E6_1	Laporte Road (neutral grassland)	3.7	20	0.2	1.2	4.0	20
E6_2	Laporte Road (neutral grassland)	3.7	20	0.2	1.2	4.0	20
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	3.7	20	0.1	0.7	3.9	19

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)					
		BKGD	CRITICAL LEVEL	COMBINED PC	PC/CL	PEC	PEC/CL
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	3.7	20	0.1	0.7	3.9	19
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	3.7	20	0.2	0.9	3.9	20
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	3.7	20	0.2	0.9	3.9	20
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	3.7	20	0.1	0.6	3.8	19
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	3.7	20	0.1	0.6	3.8	19
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	3.7	20	0.1	0.5	3.8	19

Table D.10: Proposed Development, Great Coates Renewable Energy Centre and North Beck Energy Centrecombined impacts on sensitive ecological receptors - NH_3

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m^3)					
		BKGD	CLe	COMBINED PC	PC/CLe	PEC	PEC/CLe
E1_1	Humber Estuary (Atlantic Salt Meadows)	1.2	3	0.09	3.0	1.3	44
E1_2	Humber Estuary (Atlantic Salt Meadows)	1.2	3	0.09	2.9	1.3	44
E1_3	Humber Estuary (Atlantic Salt Meadows)	1.2	3	0.09	3.1	1.3	44
E2_1	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.02	0.6	0.0	1
E2_2	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.02	0.6	0.0	1
E2_3	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.01	0.5	0.0	0
E2_4	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.01	0.5	0.0	0
E3_1	Humber Estuary (Atlantic Salt Meadows)	0.0	3	0.01	0.4	0.0	0
E4_1	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.01	0.2	0.9	30
E4_2	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.01	0.2	0.9	30
E4_3	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.006	0.2	0.9	30
E4_4	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.006	0.2	0.9	30
E4_5	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.006	0.2	0.9	30
E4_6	Humber Estuary (Acid Fixed Dunes)	0.9	3	0.006	0.2	0.9	30
E5_1	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.006	0.2	0.9	30
E5_2	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.006	0.2	0.9	30
E5_3	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.006	0.2	0.9	30
E5_4	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.006	0.2	0.9	30
E5_5	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.005	0.2	0.9	30
E5_6	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.005	0.2	0.9	30
E5_7	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.005	0.2	0.9	30
E5_8	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.005	0.2	0.9	30
E5_9	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.005	0.2	0.9	30
E5_10	Humber Estuary (Atlantic Salt Meadows)	0.9	3	0.005	0.2	0.9	30
E6_1	Laporte Road (neutral grassland)	1.2	3	0.03	1.1	1.3	42
E6_2	Laporte Road (neutral grassland)	1.2	3	0.03	1.1	1.3	42

RECEPTOR ID	SITE NAME & LAND USE TYPE	ANNUAL MEAN (µg/m³)					
		BKGD	CLe	COMBINED PC	PC/CLe	PEC	PEC/CLe
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	1.2	3	0.04	1.2	1.3	42
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	1.2	3	0.04	1.2	1.3	42
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	1.2	3	0.04	1.4	1.3	42
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	1.2	3	0.04	1.3	1.3	42
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	1.2	3	0.02	0.7	1.3	42
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	1.2	3	0.02	0.7	1.3	42
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	1.2	3	0.02	0.7	1.3	42
Energy Pyrolysis and VPI Immingham do not release NH_3.							

Table D.11: Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre, and Waste Tyre Pyrolysis – Immingham Railfreight combined impact on sensitive ecological receptors - HF

ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m³)						168 HOUR MEAN (µg/m³)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E1_1	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.1	2.1	0.1	2	0.006	0.5	0.04	7.1	0.04	8
E1_2	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.1	2.1	0.1	2	0.006	0.5	0.04	7.2	0.04	8
E1_3	Humber Estuary	0.006	5	0.1	2.1	0.1	2	0.006	0.5	0.04	7.9	0.05	9

ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m^3)						168 HOUR MEAN (µg/m^3)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
	(Atlantic Salt Meadows)												
E2_1	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.03	0.6	0.04	1	0.006	0.5	0.01	2.9	0.02	4
E2_2	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.03	0.6	0.03	1	0.006	0.5	0.01	2.8	0.02	4
E2_3	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.03	0.6	0.03	1	0.006	0.5	0.01	2.6	0.02	4
E2_4	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.03	0.5	0.03	1	0.006	0.5	0.01	2.5	0.02	4
E3_1	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.02	0.4	0.03	1	0.006	0.5	0.01	2.0	0.02	3
E4_1	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.2	0.02	0	0.006	0.5	0.004	0.9	0.01	2
E4_2	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.9	0.01	2

ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m^3)						168 HOUR MEAN (µg/m^3)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E4_3	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.9	0.01	2
E4_4	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.9	0.01	2
E4_5	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.9	0.01	2
E4_6	Humber Estuary (Acid Fixed Dunes)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.9	0.01	2
E5_1	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.8	0.01	2
E5_2	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.8	0.01	2
E5_3	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.8	0.01	2
E5_4	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.8	0.01	2

ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (μg/m³)						168 HOUR MEAN (μg/m³)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E5_5	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.8	0.01	2
E5_6	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.8	0.01	2
E5_7	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.8	0.01	2
E5_8	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.8	0.01	2
E5_9	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.2	0.01	0	0.006	0.5	0.004	0.7	0.01	2
E5_10	Humber Estuary (Atlantic Salt Meadows)	0.006	5	0.01	0.1	0.01	0	0.006	0.5	0.004	0.7	0.01	2
E6_1	Laporte Road (neutral grassland)	0.006	5	0.03	0.7	0.04	1	0.006	0.5	0.02	3.1	0.02	4

ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m^3)						168 HOUR MEAN (µg/m^3)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E6_2	Laporte Road (neutral grassland)	0.006	5	0.03	0.7	0.04	1	0.006	0.5	0.01	2.9	0.02	4
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	0.006	5	0.04	0.9	0.05	1	0.006	0.5	0.02	4.2	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	0.5	0.02	4.4	0.03	6
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	0.006	5	0.1	1.4	0.08	2	0.006	0.5	0.03	7.0	0.04	8
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	0.006	5	0.1	1.4	0.07	1	0.006	0.5	0.03	6.0	0.04	7
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	0.006	5	0.1	1.1	0.06	1	0.006	0.5	0.04	7.1	0.04	8

ID	SITE NAME & LAND USE TYPE	24 HOUR MEAN (µg/m^3)						168 HOUR MEAN (µg/m^3)					
		BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL	BKGD	CLe	COMBINED PC	PC/CL	PEC	PEC/CL
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	0.006	5	0.1	1.4	0.07	1	0.006	0.5	0.03	6.3	0.04	7
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	0.006	5	0.1	1.1	0.06	1	0.006	0.5	0.02	4.1	0.03	5
VPI Immingham Energy Park A does not produce HF and is therefore not included in this table													

Table D.12: Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre, Waste Tyre Pyrolysis – Immingham Railfreight and VPI Immingham Energy Park A combined impact on sensitive ecological receptors - nutrient nitrogen deposition

RECEPTOR ID	SITE NAME & LAND USE TYPE	BKGD NITROGEN DEPOSITION (kgn/ha/yr)	CRITICAL LOAD (kg/ha/yr)	PC (kg/ha/yr)	PC/CL	PEC (kg/ha/yr)	PEC/CL
			LOWER		% LOWER		LOWER
E1_1	Humber Estuary (Atlantic Salt Meadows)	15.7	20	0.8	3.9	16.5	82
E1_2	Humber Estuary (Atlantic Salt Meadows)	15.7	20	0.7	3.7	16.4	82
E1_3	Humber Estuary (Atlantic Salt Meadows)	15.7	20	0.8	4.1	16.5	82
E2_1	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.2	0.8	12.8	64
E2_2	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.2	0.8	12.8	64
E2_3	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.1	0.7	12.7	64
E2_4	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.1	0.7	12.7	64
E3_1	Humber Estuary (Atlantic Salt Meadows)	12.6	20	0.1	0.6	12.7	64
E4_1	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.1	0.7	12.5	156
E4_2	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.1	0.7	12.5	156
E4_3	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.1	0.7	12.5	156
E4_4	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.1	0.7	12.5	156

RECEPTOR ID	SITE NAME & LAND USE TYPE	BKGD NITROGEN DEPOSITION (kgn/ha/yr)	CRITICAL LOAD (kg/ha/yr)	PC (kg/ha/yr)	PC/CL	PEC (kg/ha/yr)	PEC/CL
			LOWER		% LOWER		LOWER
E4_5	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.1	0.7	12.5	156
E4_6	Humber Estuary (Acid Fixed Dunes)	12.5	8	0.1	0.7	12.5	156
E5_1	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.1	0.3	12.5	63
E5_2	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.1	0.3	12.5	63
E5_3	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.1	0.3	12.5	63
E5_4	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.1	0.3	12.5	63
E5_5	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.1	0.3	12.5	63
E5_6	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.1	0.3	12.5	63
E5_7	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.0	0.2	12.5	63
E5_8	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.0	0.2	12.5	63
E5_9	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.0	0.2	12.5	63
E5_10	Humber Estuary (Atlantic Salt Meadows)	12.5	20	0.0	0.2	12.5	63
E6_1	Laporte Road (neutral grassland)	15.7	20	1.0	4.8	16.6	83
E6_2	Laporte Road (neutral grassland)	15.7	20	0.9	4.7	16.6	83

RECEPTOR ID	SITE NAME & LAND USE TYPE	BKGD NITROGEN DEPOSITION (kgn/ha/yr)	CRITICAL LOAD (kg/ha/yr)	PC (kg/ha/yr)	PC/CL	PEC (kg/ha/yr)	PEC/CL
			LOWER		% LOWER		LOWER
E7_1	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	24.5	10	0.5	4.5	25.0	250
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)	24.5	10	0.4	4.5	24.9	249
E8_1	Healing Cress Beds (broadleaved, mixed and yew woodland)	24.5	10	0.5	4.9	25.0	250
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)	24.5	10	0.5	4.7	25.0	250
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	15.7	10	0.2	2.0	15.9	159
E9_2	Sweedale Croft Drain (Fen, Marsh and Swamp)	15.7	10	0.2	2.0	15.9	159
E9_3	Sweedale Croft Drain (Fen, Marsh and Swamp)	15.7	10	0.2	1.9	15.9	159

Table D.13: Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre, Waste Tyre Pyrolysis – Immingham Railfreight, VPI Immingham Energy Park A and SHBPS combined impact on sensitive ecological receptors - total acid deposition N + S (keq/ha/yr)

RECEPTOR ID	SITE NAME & LAND USE TYPE	ACID DEPOSITION (keq/ha/yr)[15]				TOTAL ACID DEPOSITION (keq/ha/yr)[16]			
		CRITICAL LOAD[17]	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							

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

RECEPTOR ID	SITE NAME & LAND USE TYPE	ACID DEPOSITION (keq/ha/yr)[15]				TOTAL ACID DEPOSITION (keq/ha/yr)[16]			
		CRITICAL LOAD[17]	BASELINE	TOTAL	% OF CRITICAL LOAD	PC	% OF CRITICAL LOAD	PEC	PEC% OF CRITICAL LOAD
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 0.223 Min CL Max N 0.643 Min CL Max S 0.42	N: 0.89 S: 0.26	1.15	178.8	0.01	1.5	1.16	180.4
E4_2	Humber Estuary (Acid Fixed Dunes)			1.15	178.8	0.01	1.5	1.16	180.4
E4_3	Humber Estuary (Acid Fixed Dunes)			1.15	178.8	0.01	1.5	1.16	180.3
E4_4	Humber Estuary (Acid Fixed Dunes)			1.15	178.8	0.009	1.5	1.16	180.3
E4_5	Humber Estuary (Acid Fixed Dunes)			1.15	178.8	0.009	1.4	1.16	180.3
E4_6	Humber Estuary (Acid Fixed Dunes)			1.15	178.8	0.009	1.4	1.16	180.3
E5_1	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E5_2	Humber Estuary (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							

RECEPTOR ID	SITE NAME & LAND USE TYPE	ACID DEPOSITION (keq/ha/yr)[15]				TOTAL ACID DEPOSITION (keq/ha/yr)[16]			
		CRITICAL LOAD[17]	BASELINE	TOTAL	% OF CRITICAL LOAD	PC	% OF CRITICAL LOAD	PEC	PEC% OF CRITICAL LOAD
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 (Atlantic Salt Meadows)	Not sensitive to Acid Deposition							
E6_1	Laporte Road (neutral grassland)	Min CL Min N 1.071	N: 1.12 S: 0.39	1.51	29.8	0.119	2.3	1.63	32.1
E6_2	Laporte Road (neutral grassland)			1.51	29.8	0.115	2.3	1.63	32.1

RECEPTOR ID	SITE NAME & LAND USE TYPE	ACID DEPOSITION (keq/ha/yr)[15]				TOTAL ACID DEPOSITION (keq/ha/yr)[16]			
		CRITICAL LOAD[17]	BASELINE	TOTAL	% OF CRITICAL LOAD	PC	% OF CRITICAL LOAD	PEC	PEC% OF CRITICAL LOAD
		Min CL Max N 5.071 Min CL Max S 4.0							
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	2.20	19.8	0.053	0.5	2.25	20.3
E7_2	Stallingborough Fish Bonds (Broadleaved, mixed and yew woodland)			2.20	19.8	0.053	0.5	2.25	20.3
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	2.20	19.8	0.061	0.5	2.26	20.3
E8_2	Healing Cress Beds (broadleaved, mixed and yew woodland)			2.20	19.8	0.061	0.5	2.26	20.3
E9_1	Sweedale Croft Drain (Fen, Marsh and Swamp)	Not sensitive to Acid Deposition							

RECEPTOR ID	SITE NAME & LAND USE TYPE	ACID DEPOSITION (keq/ha/yr)[15]				TOTAL ACID DEPOSITION (keq/ha/yr)[16]			
		CRITICAL LOAD[17]	BASELINE	TOTAL	% OF CRITICAL LOAD	PC	% OF CRITICAL LOAD	PEC	PEC% OF CRITICAL LOAD
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							

South Humber Bank Power Station

The SHBPS has been included in this section to consider the potential for the maximum 99.79th percentile of 1-hour NO_2 concentration from the SHBPS coincide in the same geographical location as the Proposed Development. Table D.14 shows the maximum 99.79th percentile NO_2 concentration for SHBPS, the Proposed Development, Great Coates Renewable Energy Centre, North Beck Energy Centre and Waste Tyre Pyrolysis – Immingham Railfreight.

Table D.14: Maximum 99.79th percentile of 1 hour means for nitrogen dioxide for the Proposed Development, SHBPS, Great Coates Renewable Energy Centre, North Beck Energy Centre, and Waste Tyre Pyrolysis – Immingham Railfreight

GRID REFERENCE X	GRID REFERENCE Y	PC (µg/m^3)	PC% ENV STD	PEC (µg/m^3)	PEC % ENV STD
523120	413090	222.8	111.4	247.5	124

It can be seen from Table D.14 that the predicted maximum ground level concentration is in excess of the standard of 200 µg/m^3. The isoline plot in Figure 7A.6 shows that this exceedance occurs in a small uninhabited area to the south-east corner of SHBPS. Analysis of the same plot for emissions from the Proposed Development show that the maximum contribution from the Proposed Development is 2 µg/m^3 compared to 222.8 µg/m^3 from the SHBPS.

The PC from the Proposed Development is therefore very small compared to the contribution from the SHBPS and it is unlikely to contribute to any exceedance of the Environmental Standard at this location. The conversion rate assumed for NO_X to NO_2 was 35% and in the case of a very large emission source like the power station such a conversion rate is very unlikely to occur over such a short distance. It is therefore considered that the addition of the Proposed Development is not likely to significantly increase the risk of an exceedance of the short term NO_2 Environmental Standard in the area around the existing SHBPS.

Table D.15 displays the 99.79th percentile of 1 hour mean concentration for each sensitive human receptor. The maximum PC is at a location on a public right of way (PRoW) (R3). The PEC for all sensitive human receptors remain below the Environmental Standard of 200 µg/m^3.

Table D.15: 99.79th percentile of 1 hour means for nitrogen dioxide, for the worst case meteorological year for sensitive human receptor locations

RECEPTOR	TOTAL PC (µg/m^3)	PC % ENV STD	PEC (µg/m^3)	PEC % ENV STD
R1	25.5	12.8	50.5	25
R2	47.8	23.9	72.8	36
R3	56.9	28.5	81.9	41
R4	44.1	22.1	69.1	35
R5	42.2	21.1	67.2	34
R6	41.2	20.6	66.2	33
R7	51.0	25.5	76.0	38
R8	51.9	26.0	76.9	38
R9	50.3	25.2	75.3	38
R10	48.3	24.2	73.3	37
R11	48.1	24.1	73.1	37
R12	34.8	17.4	59.8	30

RECEPTOR	TOTAL PC ($\mu g/m^3$)	PC % ENV STD	PEC ($\mu g/m^3$)	PEC % ENV STD
R13	27.1	13.6	52.1	26
R14	23.6	11.8	48.6	24
R15	22.8	11.4	47.8	24
R16	20.9	10.5	45.9	23
R17	21.2	10.6	46.2	23
R18	19.2	9.6	44.2	22
R19	16.4	8.2	41.4	21
R20	16.0	8.0	41.0	21
R21	16.7	8.4	41.7	21
PROW 1	94.8	47.4	119.8	60
PROW 2	97.4	48.7	122.4	61
PROW 3	106.2	53.1	131.2	66
PROW 4	93.9	47.0	118.9	59
PROW 5	104.6	52.3	129.6	65
PROW 6	105.9	53.0	130.9	65
PROW 7	101.9	51.0	126.9	63
PROW 8	93.5	46.8	118.5	59
PROW 9	93.0	46.5	118.0	59
PROW 10	90.3	45.2	115.3	58