Immingham Green Energy Terminal

TR030008

Volume 6

6.4 Environmental Statement Appendices

Appendix 6.B: Dispersion Modelling Assessment Method

Planning Act 2008

Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

September 2023

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

Immingham Green Energy Terminal

Development Consent Order 2023

6.4 Environmental Statement Appendices

Appendix 6.B: Dispersion Modelling Assessment Method

Regulation Reference	APFP Regulation 5(2)(a)
Planning Inspectorate Case Reference	TR030008
Application Document Reference	TR030008/APP/6.4
Author	Associated British Ports Air Products BR

Version	**Date**	**Status of Version**
Revision 1	21 September 2023	DCO Application

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1. Introduction

1.1.1 This appendix sets out the detailed methodology behind the assessment of the following sources:

a. Construction phase road traffic emissions.

b. Operational phase road traffic emissions.

c. Operational phase vessel plant emissions.

d. Operational phase landside site plant emissions.

1.1.2 The impact of these emissions (combined where applicable) is then reported at the selected air quality sensitive receptors that may potentially be affected by them.

1.1.3 The impact of road traffic emissions on nearby air quality sensitive receptors has been predicted using the Advanced Dispersion Modelling System ("ADMS") Roads (version 5.0.1.3). The impact of point source emissions has been quantified using ADMS 6 (version 6.0.0.1), also published by Cambridge Environmental Research Consultants ("CERC"). The ADMS suite of modelling software is a nationally recognised tool for the assessment of air quality impacts that has undergone extensive validation by CERC and by organisations independent of CERC.

2. Emissions Data

2.1.1 Construction traffic data was supplied by the Project transport consultant for the following scenarios:

a. Existing Baseline (2022) – for dispersion model verification.

b. Future Baseline (2026) – year of peak construction without the Project.

c. Future Construction (2026) – year of peak construction with the Project.

2.1.2 The traffic data is summarised in **Table 1**. The data on the local road network was screened following the approach set out in Institute of Air Quality Management (“IAQM”)/Environmental Protection (“EP”) UK guidance (Ref 1-1):

a. A road link not situated within or adjacent to an Air Quality Management Area (“AQMA”) experiences a:

   i. Change in annual average daily two-way Light Duty Vehicle (LDV – vehicles <3.5t) flow of 500 or more.

   ii. Change in annual average daily two-way Heavy Duty Vehicle (HDV – vehicles ≥3.5t) flow of 100 or more.

b. A road link that is situated within or adjacent to an AQMA that experiences a:

   i. Change in annual average daily two-way LDV flow of 100 or more.

   ii. Change in annual average daily two-way HDV flow of 25 or more.

Table 1: Construction phase traffic data as 24-hour daily average traffic flow

Road Link	2022 Base		2026 Base		2026 Cons.		2026 Cumulative		Speed (kph)
	LDV Flow	HDV Flow	LDV Flow	HDV Flow	LDV Flow	HDV Flow	LDV Flow	HDV Flow	
A180 E - Between East of A180/A1173 Junction	31470	3303	33172	3482	33584	3572	7209	1234	80
A1173 - Between A1173/Kiln Lane and A1173/Kings Road	6690	807	7052	851	7857	1050	3820	1233	48
Queens Road - between A1173/Kings Road and West Site Access	3368	575	3550	606	5002	805	1120	320	48
Queens Road – West Site Access and Laporte Road	3368	575	3550	606	4279	666	1120	320	48
Kings Road - between A1173/Kings Road and Kings Road/Pelham Road	7264	577	7657	608	8097	608	3624	980	48
Manby Road - between A160/Manby Road and Kings Road/Pelham Road	6372	1157	6717	1219	6847	1219	2697	960	64
A160 - Between Manby Road/A160 and A160/A1077 Roundabout	5573	5126	5874	5403	6004	5403	5397	2318	80
A160 - Between A160/A1077 Roundabout and A160/A180	6878	5410	7250	5702	7250	5702	5367	2280	80
A180 W - Between A180/A1173 and A180/A160	22043	3896	23235	4107	23384	4216	2998	1707	80
Laporte Road	2997	592	3159	624	3490	624	327	194	64
A180 Cleethorpe Road, Grimsby AQMA	24093	2246	24093	2246	24505	2336	-[1]	-[1]	24[2]
Notes: [1] Cumulative flow data unavailable for this remote link. [2] Speed reduced to estimate the influence of congestion within the AQMA.									

2.1.3 The traffic data on the Strategic Road Network ("SRN"), which includes the sections of the A180 and A160, was screened following the approach set out in National Highways guidance (Ref 1-2):

a. Annual average daily traffic (24-hr AADT) flow changes by 1000 or more two-way movements.

b. HDV 24-hr AADT changes by 200 or more two-way movements.

2.1.4 The purpose of the screening exercise is to identify road links that have the potential to contribute to a significant effect in line with relevant guidance. The screening exercise identified that the following links required detailed consideration of air quality impacts from construction phase traffic impacts:

a. Queens Road, between the Project site entrance and the Kings Road/A1173 junction.

b. A1173, between the Queens Road/Kings Road junction and the A180.

c. A180 Cleethorpe Road, east of Riby Square, Grimsby.

2.1.5 The traffic data for the road links screened into the assessment, and data for neighbouring links that could contribute to impacts, was converted into emissions data using the current version of the Emissions Factors Toolkit ("EFT") (v.11), published by Defra (Ref 1-3), assuming a typical urban fleet-mix for England.

2.1.6 Future year emission rates are projected to fall year on year, due to improving emissions technology and the evolution of the UK vehicle fleet. With past versions of Defra's EFT there has been some uncertainty in the projection of these future year emission rates and the rate at which they reduce over the years. The IAQM have published a Position Statement (Ref 1-4) to say that the current and more recent versions of the EFT do better reflect future year emission rates and there is no requirement to assume alternative or precautionary assumptions on future emission rates. Despite the confidence in the current version of the EFT, the National Highways GAP analysis tool (Ref 1-5) has been used in this assessment to offset some of the projected improvements, and thus providing a precautionary estimate of road traffic contribution impacts.

2.2 Operational Traffic

2.2.1 Operational traffic data was supplied by the Project transport consultant for the following scenarios:

a. Existing Baseline (2022) – for dispersion model verification.

b. Future Baseline (2028) – year of opening, bust assuming peak operation <u>without</u> the Project.

c. Future operational (2028) – Year of opening, but assuming peak operation <u>with</u> the Project.

2.2.2 The traffic data is summarised in **Table 2**. The data on the local road network was screened following the approach set out in IAQM)/EPUK guidance (Ref 1-1), and traffic data on the SRN was screened following the approach set out in National Highways guidance (Ref 1-6).

Table 2: Operational phase traffic data as 24-hour daily average traffic flow

Road Link	2022 Base		2028 Base		2028 Cons.		2028 Cumulative		Speed (kph)
	LDV Flow	HDV Flow	LDV Flow	HDV Flow	LDV Flow	HDV Flow	LDV Flow	HDV Flow	
A180 E - Between East of A180/A1173 Junction	31470	3303	33720	3539	33783	3583	7209	1234	80
A1173 - Between A1173/Kiln Lane and A1173/Kings Road	6690	807	7169	865	7291	961	3820	1233	48
Queens Road - between A1173/Kings Road and Queens Road/Laporte Road	3368	575	3609	616	3798	712	1120	320	48
Kings Road - between A1173/Kings Road and Kings Road/Pelham Road	7264	577	7784	618	7851	618	3624	980	48
Manby Road - between A160/Manby Road and Kings Road/Pelham Road	6372	1157	6828	1240	6848	1240	2697	960	64
A160 - Between Manby Road/A160 and A160/A1077 Roundabout	5573	5126	5971	5492	5991	5492	5397	2318	80
A160 - Between A160/A1077 Roundabout and A160/A180	6878	5410	7370	5797	7370	5797	5367	2280	80
A180 W - Between A180/A1173 and A180/A160	22043	3896	23619	4175	23642	4227	2998	1707	80
Laporte Road	2997	592	3211	634	3261	634	327	194	64

2.2.3 The screening exercise of operational traffic flow impacts did not identify any road links that exceed the criteria set out in IAQM/EPUK guidance nor the National Highways guidance. The greatest traffic impact on the local road network occurs on Queens Road and the A1773, between Queens Road and the A180 (+190 LDVs per average day and +96 HDVs per average day). As well falling below the IAQM/EPUK screening criteria, it is also noted that in the operational phase, there are no air quality sensitive receptors within 200m of these roads.

2.3 Operational Vessels

2.3.1 Vessel emissions data focuses on those released when operational phase vessels are in dock. This is considered the only time when vessel emissions are static and could potentially impact on the same locations for prolonged periods of time.

2.3.2 When vessels are in motion, travelling at c.10 knots (19kph) when manoeuvring and c.20 knots (37kph) when up to speed, emissions from each vessel movement will be transient and the impact on a location will be for a period of minutes, not hours.

2.3.3 For example, a vessel travelling at 20 knots will travel 10km within approximately 16 minutes. The Project will service 292 vessel calls per year, which equates to an average of 1.6 two-way vessel movements per day. On average, emissions from vessels in motion will impact at a given locations for around 32 minutes per day (or ~2% of the year), with the level of impact varying over that time due to the changing distance between source and receptor, and due to the direction of the wind relative to the source and the receptor.

2.3.4 With impacts occurring for such a small proportion of the year and the distance between the navigation channel through the estuary and the nearest air quality sensitive receptors, impacts from vessels in motion are considered negligible and are not included in the modelling of emissions.

2.3.5 With regards to vessel emissions when docked, energy is required to facilitate the discharge of cargo and provide amenity use for the crew. Typically, the energy demand for the discharge of cargo is provided by a vessel's auxiliary engine. At this stage it has not been possible to identify the specific vessels that will use the Project when in operation. In the absence of such information, the assessment has referred to marine auxiliary vessel engine emissions data published by Wärtsilä (Ref 1-7), as a proxy to represent the auxiliary engines of the actual vessels. The specific engine referred to for the assessment was selected to meet the typical energy demand of a docked vessel when discharging a liquified gas (Ref 1-8).

2.3.6 Wartsila publish emissions data for all their marine vessel engines. To meet the energy demand of 7.5 MW required when a vessel is in dock and discharging cargo, emissions data for a Wartsila 14V31 engine has been used. The Wartsila 14V31 engine generates 8.26 MW at 100% load. The auxiliary engine emissions data used in the assessment is provided in **Table 3**. The location of the docked vessel auxiliary engine stack is shown on **Figure 6.1 [TR030008/APP/6.3]**. NO_X emission rate data is provided for both compliance with the Tier II and Tier III MARPOL Regulation 13 emissions standards.

Table 3: Vessel Auxiliary Engine Emissions Data

Parameter	Wärtsilä 14V31 (MGO)[1]		Unit/Notes
	MARPOL NOx Tier II	MARPOL NOx Tier III	
Capacity	8,260		kW per engine
Fuel	Marine Gas Oil		MGO or LNG
Operating Load	100		%
Operating profile	7,002		Hours/year
Release point location	522292,416119		x,y
Emission release height	45		Assumed m above ground level
Internal diameter of release point	0.903[2]		m
Temperature of emissions	268		°C
Mass flow of emissions	14.7		kg/s
Engine speed	720		RPM
MARPOL emission standard	$44n^{-0.23}$ (3)	$9n^{-0.2}$ (3)	Tier II NO_X emission standard: 44·n(-0.23), where n = RPM
NO_X emission rates	9.7	2.4	g/kWh
	80,029	19,941	g/h
	22.2	5.5	g/s
Factored NO_X emission rate	17.8	4.4	g/s based on 7,002 hrs/yr
Ammonia slip concentration	n/a	10	ppm
Ammonia slip emission rate	n/a	0.063	g/s

[1] Emissions standard for SO_2: Inside an Emission Control Area, including North Sea area, established to limit SOx emissions 1.50% m/m prior to 1 July 2010; 1.00% m/m on and after 1 July 2010; 0.10% m/m on and after 1 January 2015.

[2] Recommended by Wärtsilä to maintain an exit velocity of 35 m/s

[3] Where *n* is the engine speed as RPM

2.3.7 The energy demand to facilitate crew amenity is typically provided by a marine boiler. As with the auxiliary engine, the exact type of marine boiler on vessels that will use the facility is unknown. In the absence of such data, a 'typical' marine boiler has been used as a proxy to represent the boiler of the actual vessels. In this instance, the boiler assumed as representative is the Aalborg Industries UNEX BH boiler unit, the emissions data for which is provided in **Table 4**. The location of the docked vessel auxiliary engine stack is shown on **Figure 6.1 [TR030008/APP/6.3]**.

Table 4: Vessel Boiler Emissions Data

Parameter	Marine Boiler	Unit/Notes
Capacity	7	Barg
Operating Load	100	%
Operating profile	7,002	Hours/year
Release point location	522291,416119	x,y
Emission release height	45	Assumed m above ground level
Internal diameter of release point	0.4	m
Temperature of emissions	350	°C
Mass flow of emissions	0.756	kg/s
NO_X emission rates	456	g/h
	0.127	g/s
Factored NO_X emission rate	0.101	g/s based on 7,002 hrs/yr

2.4 Operational Site Sources

2.4.1 Landside emissions sources during the operational phase are also included in the assessment. These include combustion and process emissions associated with converter plant and combustion emissions associated with flares running on pilot mode. All modelled landside sources are assumed to be operational for 8760 hours per year.

2.4.2 Emissions data for these sources are summarised in **Table 5**. The location of the modelled landside stacks is shown on **Figure 6.1 [TR030008/APP/6.3]**. Flares operating in flare mode have not been included in the assessment. This mode of operation will only happen in the event of an emergency and during plant start-up, both of which are anticipated to occur for a handful of hours per year.

Table 5: Landside Source Emissions Data

Parameter	Reformer Box Top/Flue Gas Stacks	Hydrogen Production Unit (HPU) Flare Pilot	Ammonia Storage Flare Pilot	Unit/Notes
Coordinates	520910, 415277 520906, 415305 520841, 415333 519771, 414475 519757, 414401 520009, 414578	502952, 415363 520887, 41539`1 520823, 415419 519687, 414505 519839, 414372 520092, 414549	520801, 415200	x,y
Profile	8760	8760	8760	Hours/Year
Height[1]	30.5	37	55	m
Diameter	0.45	0.15	0.6	m
Temperature	144	1700	1700	°C
Mass flow	6.296	-[3]	-[3]	kg/s
A.Vol Flow	-[3]	0.005	0.009	Am^3/s
N.Vol Flow	4.65	0.001	0.001	Nm^3/s
Emissions Concentration for NOx	94.1	-[3]	-[3]	mg/Nm_3
Emissions Concentration for NH_3[2]	3.5	-[3]	-[3]	mg/Nm_3
Mass Emission Rate for NO_X	0.437	0.002	0.002	g/s
Mass Emission Rate for NH_3[2]	0.016	-[3]	-[3]	g/s
Mass Emission Rate for CO	-[3]	0.014	0.014	g/s
Mass Emission Rate for SO_2	-[3]	0.00003	0.00003	g/s
Mass Emission Rate for VOCs	-[3]	0.001	0.001	g/s

Notes:

[1] Design not fixed, but 30.5m considered the minimum height envelope and therefore worst-case.

[2] Emissions due to NH_3 slip, provided as 5 ppm.

[3] Data not provided. Data that was provided sufficient to model emissions source.

2.5 IERRT Sources

2.5.1 Due to the relationship and proximity of the proposed Immingham Eastern Ro-Ro Terminal ("IERRT") to the Project, the contribution of IERRT emissions has been quantified and considered in this assessment alongside those of the Project.

2.5.2 The contribution of IERRT road traffic emissions is included in the future baseline and future operational traffic data scenarios listed in **Table 2**, assuming that IERRT will be operational during the year of peak IGET construction.

2.5.3 The contribution of other IERRT sources of emissions to air is as they are reported in Appendix 13A of the IERRT ES (Ref 1-9).

3. Meteorological Data

3.1.1 Wind rose plots for the six years of hourly sequential meteorological data from Humberside Airport are provided in **Plate 1**.

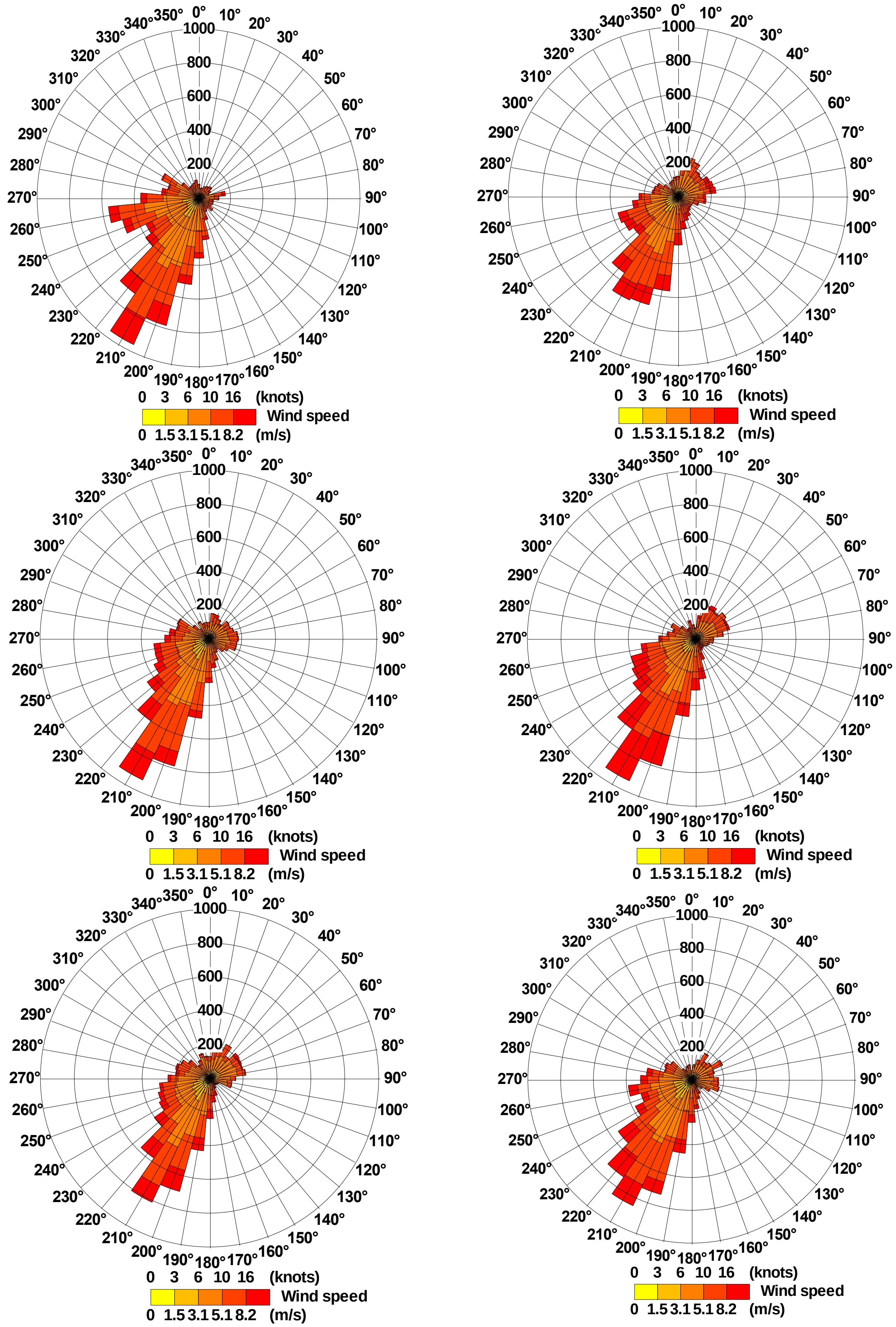
3.1.2 Five of the six years shown of hourly sequential meteorological data from Humberside Airport (2018 to 2022) has been used to inform the assessment. Humberside Airport is approximately 10km to the southwest of the Project site and conditions experienced there are considered representative of conditions experienced in the air quality study area.

3.1.3 For the modelling of road traffic emissions, it is standard practice to use a single year of meteorological data for modelling purposes, but that data should match the existing baseline year of the traffic data used to inform the assessment, which should also match the year of monitoring data being used to inform model verification.

3.1.4 For the modelling of point source emissions, it is standard practice to use five years sequential meteorological data for modelling purposes. This is to account for interannual variation with the highest impact over the five-year period at each receptor being reported in the assessment.

3.1.5 **Plate 1** shows how consistent wind speed and direction have been over the six years shown, with the clear prevalence of south-westerlies.

Plate 1: Wind Rose Plots – Humberside Airport 2017 – 2022



3.1.6 Meteorological data is crucial for the dispersion modelling of emissions from road and point sources. It is therefore important to use data that is representative of the assessment study area.

4. Building Downwash

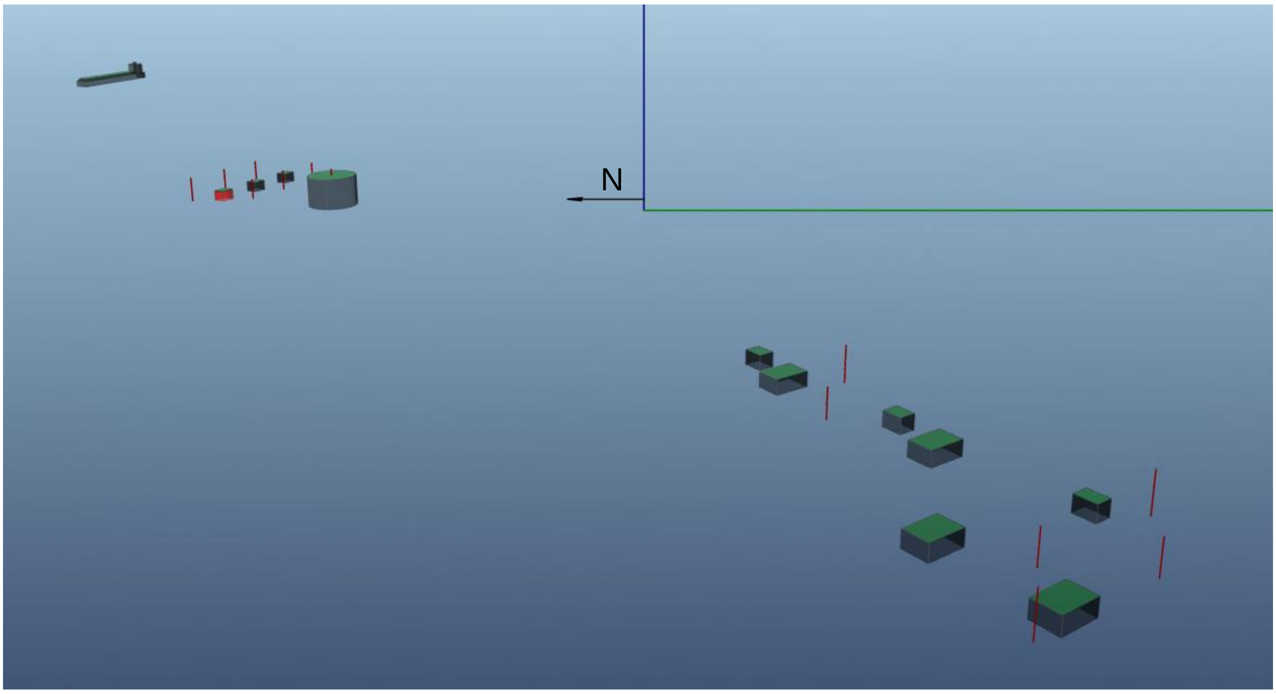
4.1.1 Buildings and structures that make up the Project have the potential to affect the dispersion of emissions from the modelled emission points, depending on their physical dimensions and proximity to the emission sources. This is because of building downwash, which is caused by the creation of a cavity of recirculating winds in the area near to buildings, which often leads to elevated concentrations downwind of affected point sources.

4.1.2 The ADMS 6 buildings effect module has therefore been used to incorporate building downwash effects as part of the modelling procedure. Site buildings or structures have been included in the model where they are as high as 40% of the stack height and the building or structure's proximity to a stack is less than five times the lesser of its height or width. The building and structures included in the model are listed in **Table 6** and illustrated in **Plate 2**.

Table 6: Building Downwash Data

Building Description	Shape	Height (m)	Length/ Diameter (m)	Width (m)
Reformer plant	Rectangular	15	20	15.92
	Rectangular	15	19.85	15.98
	Rectangular	15	20.06	16.07
	Rectangular	15	16.08	20.11
	Rectangular	15	24.11	36.16
	Rectangular	15	20.01	16.17
	Rectangular	15	24.27	26.11
	Rectangular	15	15.89	20.01
	Rectangular	15	23.8	35.93
	Rectangular	15	24.13	35.85
Ammonia Tank	Circular	45	70.2	-
Docked Vessel	Rectangular	15	29.99	204.86
	Rectangular	15	25.39	170.29
	Rectangular	20	28.46	16
	Rectangular	38	5.71	5.2

Plate 2: Illustration of Modelled Buildings (looking east)



5. Terrain Data and Surface Roughness

5.1.1 Due to the proximity of the Project to the Humber Estuary, the land in the vicinity of the Project and across the Immingham area is relatively flat with limited variation in height above sea level. The limited variation in height that does occur is not to the extent that it will influence the dispersion of emissions to air from Project sources, nor how those emissions will impact on sensitive receptors. The dispersion model of site emissions has been set up on the basis that the model domain is flat.

5.1.2 With regards to surface roughness, the dispersion model has been set up on the basis that all land areas have a surface roughness of 0.75m and all surface water areas have a surface roughness of 0.0001m. The higher value represents built-up urban areas and woodland and will overestimate the influence of surface roughness on areas of open space, such as grassland. The lower surface roughness value accounts for the limited influence of surface water to disrupt dispersion.

6. Air Quality Sensitive Receptors

6.1.1 The assessment of construction phase traffic emissions has focussed on receptors located within 200m of roads that will exceed the traffic impact screening criteria provided in **Paragraph 2.1.2** and **2.1.3**. These receptors are described in **Table 7** and shown on **Figure 6.1 [TR030008/APP/6.3]**.

Table 7: Construction Phase Human Health Sensitive Receptors

Receptor ID	X	Y	Description
C_R1	519949	414860	Residential Property on Queens Road approximately 0.1km from West Site
C_R2	519983	414833	Residential Property on Queens Road approximately 0.1km from West Site.
C_R3	520039	414794	Residential Property on Queens Road approximately 0.1km from West Site.
C_R4	519388	414955	Residential Property on Kings Road A1173 approximately 0.4km from West Site
C_R5	527773	410446	Residential Property on Cleethorpe Road approximately 8km from East Site
C_R6	527770	410427	Residential Property on Cleethorpe Road approximately 8km from East Site

6.1.2 The assessment of operational phase emissions has focused on selected human health sensitive receptors located within 10km of the Project, with the intention of identifying worst-case impacts in each direction of the modelled sources. These receptors are described in **Table 8** and shown on **Figure 6.1 [TR030008/APP/6.3]**.

Table 8: Operational Phase Human Health Sensitive Receptors

Receptor ID	X	Y	Description
O_R1	519388	414955	Residential Property on Kings Road A1173 approximately 0.4km from West Site
O_R2	519228	414998	Residential Property on Chestnut Avenue approximately 0.5km from West Site
O_R3	519015	414537	Residential Property on Talbot Road approximately 0.7km from West Site

Receptor ID	X	Y	Description
O_R4	519141	414353	Residential Property on Somerton Road approximately 0.5km from West Site
O_R5	519223	414220	Residential Property on Somerton Road approximately 0.5km from West Site
O_R6	518477	414778	Residential Property on Pelham Road approximately 1.3km from West Site
O_R7	518237	414294	Residential Property on Margaret Street approximately 1.5km from West Site
O_R8	519203	413222	Residential Property on Mauxhall Farm/Immingham Road approximately 1.1km from West Site
O_R9	521279	413116	Residential Property on North Moss Lane approximately 1.9km from West Site
O_R10	520827	412115	Residential Property on South Marsh Road approximately 2.4km from West Site
O_R11	519552	411773	Residential Property on Church Lane approximately 2.6km from West Site
O_R12	527773	410446	Residential Property on Cleethorpe Road approximately 8km from the East Site
O_R13	523712	418883	Residential Property on Stone Creek approximately 3.1km from the vessel berth
O_R14	525590	417457	Residential Property on Stone Creek approximately 3.7km from the vessel berth
O_R15	525030	418688	Residential Property on South Farm Road approximately 3.6km from the vessel berth
O_R16	524551	418946	Stone Creek Farm approximately 3.6km from the vessel berth
O_R17	523456	420121	Salthaugh Sands Estate approximately 4.2km from the vessel berth

6.1.3 The assessment of operational phase emissions has also focused on air quality sensitive nature conservation receptors within 10km of the Site Boundary, with the intention of identifying worst-case impacts in each direction of the modelled sources. The focus is on habitats that are specifically sensitive to the effects of air pollution, specifically airborne NO_X and NH_3, and nitrogen deposition. Habitats with no or very little vegetation and those that are twice daily washed out by the tide are not considered sensitive to air quality impacts. Habitats were identified using the online MAGIC resource (www.magic.defra.gov.uk). The nature conservation receptors of relevance to this assessment are summarised in **Table 9** and illustrated in **Figure 6.1 [TR030008/APP/6.3]**.

Table 9: Operational Phase Nature Conservation Sensitive Receptors

Receptor ID	X	Y	Description
O_E1	523254	418899	Saltmarsh habitat within the Humber Estuary SAC, approximately 2.7km from Vessel Berth
O_E2	523857	418287	Saltmarsh habitat within the Humber Estuary SAC, approximately 2.9km from Vessel Berth
O_E3	526249	416864	Saltmarsh habitat within the Humber Estuary SAC, approximately 4.1km from Vessel Berth
O_E4	527141	416671	Saltmarsh habitat within the Humber Estuary SAC, approximately 5km from Vessel Berth
O_E5	523790	413174	Saltmarsh habitat within the Humber Estuary SAC, approximately 3.5km from East Site
O_E6	518347	417802	Saltmarsh habitat within the Humber Estuary SAC, approximately 3.4km from East Site
O_E7	529069	416859	Saltmarsh habitat within the Humber Estuary SAC, approximately 6.9km from Vessel Berth
O_E8	525956	411375	Saltmarsh habitat within the Humber Estuary SAC, approximately 6km from Vessel Berth
O_E9	526333	411086	Saltmarsh habitat within the Humber Estuary SAC, approximately 6.4km from Vessel Berth
O_E10	527136	410868	Saltmarsh habitat within the Humber Estuary SAC, approximately 7.2km from Vessel Berth
O_E11	517001	419691	Saltmarsh habitat within the North Killingholme Haven Pitts SSSI, approximately 5.7km from East Site
O_E12	516492	420321	Saltmarsh habitat within the Humber Estuary SAC, approximately 6.5km from East Site
O_E13	519830	421761	Saltmarsh habitat within the Humber Estuary SAC, approximately 6km from Vessel Berth
O_E14	514553	422884	Saltmarsh habitat within the Humber Estuary SAC, approximately 9.7km from East Site
O_E15	514550	422998	Saltmarsh habitat within the Humber Estuary SAC, approximately 9.7km from East Site
O_E16	521516	415056	Grassland habitat within a LWS, approximately 0.1km from East Site
O_E17	518057	415529	Woodland and freshwater habitat within a LWS, approximately 1.8km from West Site

Receptor ID	X	Y	Description
O_E18	521300	412583	Woodland and freshwater habitat within a LWS, approximately 2.3km from West Site
O_E19	522057	412228	Grassland habitat within a LWS, approximately 3km from East Site and West Site

7. Background Pollutant Concentration Data

7.1.1 The dispersion model predicts the contribution of pollutants from modelled emission sources at the selected air quality sensitive receptors. To report total pollutant concentrations that can be compared to the relevant air quality standards at those receptors, this contribution needs to be added onto the background (or ambient) pollutant concentrations that are representative of those locations. Background pollutant data used in the assessment is summarised in **Table 10** to **Table 14**.

7.1.2 For human health receptors, background NO_2, PM_{10} and $PM_{2.5}$ concentration data has been sourced from Defra's background pollutant concentration maps from the dataset with a base year of 2018 (Ref 1-10).

7.1.3 For nature conservation receptors, background NO_X data has also been sourced from Defra's 2018 base year maps. SO_2, NH_3 and nitrogen deposition rate data has been sourced from the Air Pollution Information System ("APIS") (Ref 1-11). APIS reports background concentration data as a 3-year average and current background maps cover the period 2018-2020.

7.1.4 Background pollutant concentrations are anticipated to reduce year on year going forward, due to improving emissions technology and the evolution of the UK vehicle fleet. Defra provide versions of their background maps projected forward into the future, as far as 2030. The NO_X, NO_2, PM_{10} and $PM_{2.5}$ data used in the assessment of construction phase impacts and operational phase impacts has used the background map published by Defra for those specific assessment years.

7.1.5 The APIS does not provide background concentrations or deposition rates projected forward. The SO_2 and NH_3 data used in this assessment is based on the 2018-2020 background maps for all assessment years. The nitrogen deposition data obtained for APIS has been projected forward to represent conditions in future years, based on the Nitrogen Futures project (Ref 1-6) assumption that nitrogen deposition rates are on course to fall year on year by at least 0.07 kg/ha/yr.

Table 10: Background Pollutant Data – Human Health Receptors (2022)

Rec. ID	Interest Feature	Annual Mean Concentration ($\mu g/m^3$)		
		NO_2	PM_{10}	$PM_{2.5}$
C_R1	Construction receptor on Queens Road	15.2	14.6	8.4
C_R2	Construction receptor on Queens Road	15.2	14.6	8.4
C_R3	Construction receptor on Queens Road	14.4	13.9	8.1
C_R4	Construction receptor on Kings Road	15.2	14.6	8.4
C_R5	Construction receptor within Grimsby AQMA	19.6	13.1	8.4

Rec. ID	Interest Feature	Annual Mean Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
C_R6	Construction receptor within Grimsby AQMA	19.6	13.1	8.4
O_R1	Operational receptor on Kings Road	15.2	14.6	8.4
O_R2	Operational receptor on Chestnut Avenue	15.2	14.6	8.4
O_R3	Operational receptor on Talbot Road	15.2	14.6	8.4
O_R4	Operational receptor on Somerton Road	15.2	14.6	8.4
O_R5	Operational receptor on Kendal Road	15.2	14.6	8.4
O_R6	Operational receptor on Pelham Road	12.5	13.7	8.3
O_R7	Operational receptor on Margaret Street	12.5	13.7	8.3
O_R8	Operational receptor – Mauxhall Farm	11.2	15.7	8.6
O_R9	Operational receptor on North Moss Lane	11.3	15.4	8.4
O_R10	Operational receptor on South Marsh Road	11.6	15.8	8.6
O_R11	Operational receptor on Church Lane	9.6	15.3	8.3
O_R12	Operational receptor within Grimsby AQMA	19.6	13.1	8.4
O_R13	Operational receptor on Stone Creek	12.3	11.6	7.3
O_R14	Operational receptor on Stone Creek	11.7	14.7	8.1
O_R15	Operational receptor on South Farm Road	11.0	14.9	8.1
O_R16	Operational receptor at Stone Creek Farm	11.6	14.0	7.9
O_R17	Operational receptor at Salthaugh Sands Estate	10.7	14.9	8.1

Table 11: Background Pollutant Data – Human Health Receptors (2026)

Rec. ID	Interest Feature	Annual Mean Concentration (µg/m^3)		
		NO_2	PM_{10}	$PM_{2.5}$
C_R1	Construction receptor on Queens Road	14.1	14.2	8.0
C_R2	Construction receptor on Queens Road	14.1	14.2	8.0
C_R3	Construction receptor on Queens Road	13.3	13.4	7.7
C_R4	Construction receptor on Kings Road	14.1	14.2	8.0
C_R5	Construction receptor within Grimsby AQMA	18.0	12.7	8.0
C_R6	Construction receptor within Grimsby AQMA	18.0	12.7	8.0

Table 12: Background Pollutant Data – Human Health Receptors (2028)

Rec. ID	Interest Feature	Annual Mean Concentration (µg/m^3)[1]		
		NO_2	PM_{10}	$PM_{2.5}$
O_R1	Operational receptor on Kings Road	13.8	14.1	8.0
O_R2	Operational receptor on Chestnut Avenue	13.8	14.1	8.0
O_R3	Operational receptor on Talbot Road	13.8	14.1	8.0
O_R4	Operational receptor on Somerton Road	13.8	14.1	8.0
O_R5	Operational receptor on Kendal Road	13.8	14.1	8.0
O_R6	Operational receptor on Pelham Road	11.1	13.2	7.9
O_R7	Operational receptor on Margaret Street	11.1	13.2	7.9
O_R8	Operational receptor – Mauxhall Farm	9.9	15.3	8.2
O_R9	Operational receptor on North Moss Lane	10.1	14.9	8.0
O_R10	Operational receptor on South Marsh Road	9.9	15.3	8.2
O_R11	Operational receptor on Church Lane	8.5	14.8	8.0
O_R12	Operational receptor within Grimsby AQMA	17.5	12.6	8.0
O_R13	Operational receptor on Stone Creek	11.3	11.1	7.0
O_R14	Operational receptor on Stone Creek	10.6	14.3	7.7

Rec. ID	Interest Feature	Annual Mean Concentration (µg/m^3)[1]		
		NO_2	PM_{10}	$PM_{2.5}$
O_R15	Operational receptor on South Farm Road	10.0	14.5	7.7
O_R16	Operational receptor at Stone Creek Farm	10.6	13.5	7.5
O_R17	Operational receptor at Salthaugh Sands Estate	9.7	14.5	7.7

Notes:

[1] 2028 background precautionarily used to represent background conditions in 2036.

Table 13: Background Pollutant Data – Nature Conservation Receptors (2022)

Rec. ID	Interest Feature	Annual Mean Conc. (µg/m^3)			Nitrogen Deposition Rate (kg/ha/yr)[1,2]
		NO_X	SO_2	NH_3	
O_E1	Saltmarsh (SAC)	16.7	2.1	1.5	15.0
O_E2	Saltmarsh (SAC)	16.7	2.1	1.5	15.0
O_E3	Saltmarsh (SAC)	16.5	1.8	1.6	14.3
O_E4	Saltmarsh (SAC)	15.3	1.7	1.6	14.3
O_E5	Saltmarsh (SAC)	18.4	3.9	1.5	15.1
O_E6	Saltmarsh (SAC)	21.0	3.4	1.6	16.4
O_E7	Saltmarsh (SAC)	14.0	1.6	1.6	14.3
O_E8	Saltmarsh (SAC)	16.6	2.2	1.5	15.1
O_E9	Saltmarsh (SAC)	17.7	1.9	1.5	15.1
O_E10	Saltmarsh (SAC)	28.7	2.8	1.6	13.9
O_E11	Saltmarsh (SSSI)	23.0	3.4	1.6	16.4
O_E12	Saltmarsh (SAC)	37.9	3	1.6	16.4
O_E13	Saltmarsh (SAC)	15.0	2	1.5	15.0
O_E14	Saltmarsh (SAC)	13.0	1.7	2.1	16.6
O_E15	Saltmarsh (SAC)	13.0	1.7	2.1	16.6
O_E16	Grassland (LWS)	20.6	3.2	1.5	15.1
O_E17	Woodland (LWS)	18.2	3.53	1.6	26.5

Rec. ID	Interest Feature	Annual Mean Conc. (µg/m³)			Nitrogen Deposition Rate (kg/ha/yr)[1,2]
		NO_X	SO_2	NH_3	
O_E18	Woodland (LWS)	15.4	1.75	1.5	25.4
O_E19	Grassland (LWS)	14.8	2.22	1.5	15.1
Air Quality Standard (Critical Levels and Critical Loads)		**30**	**20**	**3**	**10**

[1] Short vegetation, such as grassland and marsh, has a lower deposition velocity then tall vegetation, hence lower background deposition rates.

[2] Tall vegetation, such as woodland, has a higher deposition velocity than short vegetation, hence higher background deposition rates.

Table 14: Background Pollutant Data – Nature Conservation Receptors (2028)

Rec. ID	Interest Feature	Annual Mean Conc. (µg/m³)			Nitrogen Deposition Rate (kg/ha/yr)[1,2]
		NO_X[1]	SO_2	NH_3	
O_E1	Saltmarsh (SAC)	15.1	2.1	1.5	14.6
O_E2	Saltmarsh (SAC)	15.1	2.1	1.5	14.6
O_E3	Saltmarsh (SAC)	14.9	1.8	1.6	13.9
O_E4	Saltmarsh (SAC)	13.8	1.7	1.6	13.9
O_E5	Saltmarsh (SAC)	16.6	3.9	1.5	14.7
O_E6	Saltmarsh (SAC)	19.1	3.4	1.6	16.0
O_E7	Saltmarsh (SAC)	12.6	1.6	1.6	13.9
O_E8	Saltmarsh (SAC)	14.6	2.2	1.5	14.7
O_E9	Saltmarsh (SAC)	15.8	1.9	1.5	14.7
O_E10	Saltmarsh (SAC)	25.1	2.8	1.6	13.5
O_E11	Saltmarsh (SSSI)	21.1	3.4	1.6	16.0
O_E12	Saltmarsh (SAC)	36.5	3	1.6	16.0
O_E13	Saltmarsh (SAC)	13.6	2	1.5	14.6
O_E14	Saltmarsh (SAC)	11.6	1.7	2.1	16.1
O_E15	Saltmarsh (SAC)	11.6	1.7	2.1	16.1
O_E16	Grassland (LWS)	18.4	3.2	1.5	14.7

Rec. ID	Interest Feature	Annual Mean Conc. (µg/m³)			Nitrogen Deposition Rate (kg/ha/yr)[1,2]
		NO_X[1]	SO_2	NH_3	
O_E17	Woodland (LWS)	16.2	3.53	1.6	25.5
O_E18	Woodland (LWS)	13.1	1.75	1.5	26.0
O_E19	Grassland (LWS)	13.0	2.22	1.5	14.7
Air Quality Standard (Critical Levels and Critical Loads)		**30**	**20**	**3**	**10**

Notes:

[1] 2028 background precautionarily used to represent background conditions in 2036.

[2] Short vegetation, such as grassland and marsh, has a lower deposition velocity then tall vegetation, hence lower background deposition rates.

[3] Tall vegetation, such as woodland, has a higher deposition velocity than short vegetation, hence higher background deposition rates.

8. Pollutant Conversion

8.1 NO_X to NO_2

8.1.1 Emissions of nitrogen oxides from combustion sources are typically dominated by nitric oxide (NO), typically in the ratio of NO to NO_2 of 9:1. However, it is NO_2 that has specified environmental standards due to its potential impact on human health and indirect impacts on sensitive habitat.

8.1.2 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.

8.1.3 For road source emissions, the conversion of NO_X to NO_2 is calculated using the Defra NO_X to NO_2 calculator tool (Ref 1-12), which assigns the conversion of that contribution based on Local Authority specific conditions.

8.1.4 For the point source emissions modelled, a NO_X to NO_2 conversion rate of 70% has been assumed over an annual mean averaging period and a conversion rate of 35% has been assumed for an hourly mean averaging period, in line with Environment Agency guidance (Ref 1-13).

8.2 NO_2 and NH_3 to Nitrogen Deposition

8.2.1 Annual mean NO_2 concentrations are converted to N deposition using the following factors as set out in Environment Agency guidance (Ref 1-14):

a. Deposition flux (as µg/m^2/s) is calculated by applying deposition velocity factors of:

   i. 0.0015 m/s to the annual mean NO_2 contribution (as µg/m^3) at habitats with short vegetation (non-woodland) and a deposition velocity factor of 0.003 m/s to annual mean NO_2 (as µg/m^3) contribution at habitats with tall vegetation (woodland).

   ii. 0.020 m/s to the annual mean NH_3 contribution (as µg/m^3) at habitats with short vegetation (non-woodland) and a deposition velocity factor of 0.030 m/s to annual mean NH_3 (as µg/m^3) contribution at habitats with tall vegetation (woodland);

b. Deposition rate (as kgN/ha/yr) is then calculated by applying unit conversion factors of:

   i. 95.9 to the calculated deposition flux for NO2 (as µg/m2/s).

   ii. 260 to the calculated deposition flux for NH_3 (as µg/m^2/s).

8.2.2 Total nitrogen deposition is then the sum of the deposition rate calculated from NO_2 and NH_3 concentrations at any specific location.

9. Road Traffic Emission Model Verification

9.1.1 It's standard practice for the modelling of road traffic emissions to be verified by comparing modelled predictions against actual measured concentrations. This has been done for this assessment in line with Defra guidance (Ref 1-15). Where model predictions do not align well enough with measured concentrations, which is referred to as model bias, an adjustment factor is applied to model predictions to account for any difference.

9.1.2 The verification exercise used to inform this assessment is summarised in **Table 15**. The measured data used to inform the verification exercise is that gathered during the Project-specific survey undertaken between February and April 2023, and following adjustment to represent an annual mean value for 2022.

9.1.3 The table shows that unadjusted modelled NO_2 concentrations underpredict by 11% on average across the four monitoring locations used. The biggest underprediction occurs at the Continuous Monitoring Station ("CMS") on Cleethorpes Road, Grimsby.

9.1.4 Because of the greater level of under-prediction at the CMS, and because of its different geographical location relative to the other monitoring locations, the CMS is treated as its own zone in the verification exercise.

9.1.5 Following the comparison of total NO_2 concentrations, the modelled road NO_X concentrations are then compared. The table shows that on average, the model underpredicts road NO_X at the monitoring site in Immingham by 68%, and the CMS site in Grimsby by 46%. It is from this comparison that the verification bias-adjustment factor is calculated, to bring the underprediction in line with the measured values. For the monitoring locations in Immingham, a factor of 3.74 needs to be applied to modelled road NO_X concentrations. For the CMS at Grimsby, a factor of 1.85 needs to be applied.

9.1.6 Following the application of the bias-adjustment factor, total NO_2 concentrations are compared again to confirm if the adjusted modelled total NO_2 concentrations align with total measured concentrations. The table demonstrates that following adjustment, modelled total NO_2 concentrations at the monitoring locations in Immingham and the location in Grimsby are within 1% of measured concentrations.

9.1.7 To demonstrate the robustness of the model, the RMSE is calculated for both unadjusted and adjusted models. Ideally, the calculated RMSE should be within 10% of the air quality objective, which equates to 4 $\mu g/m^3$. In this instance, the unadjusted model has an RMSE of 3.6 $\mu g/m^3$ and the adjusted model has an RMSE of 0.4 $\mu g/m^3$. The adjusted model is therefore considered robust.

Table 15: Road Traffic Emissions Model Verification

Location	Measured Concentration (µg/m³)	Modelled Concentration (µg/m³)	Individual Performance (modelled/ Measured)	Combined Performance (Modelled/ Measured)
Total NO_2 comparison before adjustment				
DT1	15.9	15.3	0.96	0.89
DT2	16.2	14.8	0.91	
DT3	22.1	19.6	0.89	
CMS	33.4	26.8	0.80	
Road NO_X comparison before adjustment				
DT1	2.0	0.9	0.46	0.32
DT2	3.5	0.9	0.25	
DT3	6.1	1.4	0.23	
CMS	29.5	16.0	0.54	n/a
Total NO_2 comparison after adjustment				
DT1	15.9	16.7	1.05	1.01
DT2	16.2	16.1	0.99	
DT3	22.1	21.7	0.98	
CMS	33.4	33.4	1.00	n/a

10. Modelled Results

10.1.1 **Section 6.8** of **Chapter 6: Air Quality [TR030008/APP/6.2]** provide the results of this assessment as µg/m^3 and kgN/ha/yr as appropriate for comparison against the relevant air quality standards. **Table 16** to **Table 20** provide the same results but as a percentage of their relevant air quality standards.

Table 16: Construction Phase Concentrations as a percentage of the Air Quality Objectives at nearest human health sensitive receptors for 2026

Receptor ID	Annual Mean Background Contribution (%)[1]			Annual Mean Modelled Baseline Contribution (%)[2]			Annual Mean Modelled IGET Contribution (%)[3]			Annual Mean Concentration (%)[4]		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
C_R1	35.3	35.5	40.0	6.8	2.0	2.0	0.8	0.5	0.5	43.0	37.8	43.0
C_R2	35.3	35.5	40.0	6.0	1.8	2.0	0.8	0.3	0.5	42.0	37.5	42.5
C_R3	33.3	33.5	38.5	6.3	1.8	2.0	0.8	0.3	0.5	40.3	35.8	41.0
C_R4	35.3	35.5	40.0	7.5	2.5	2.5	0.1	0.1	0.2	43.0	37.8	43.0
C_R5	45.0	31.8	40.0	23.5	4.8	5.5	0.3	0.1	0.2	68.8	36.5	45.5
C_R6	45.0	31.8	40.0	22.5	4.5	5.0	0.3	0.1	0.2	67.8	36.3	45.5
AQ Objective	**40 µg/m^3**	**40 µg/m^3**	**20 µg/m^3**	**40 µg/m^3**	**40 µg/m^3**	**20 µg/m^3**	**40 µg/m^3**	**40 µg/m^3**	**20 µg/m^3**	**40 µg/m^3**	**40 µg/m^3**	**20 µg/m^3**

Notes:

[1] Background contribution of existing sources, minus the contribution from the sources specifically modelled.

[2] Model contribution, including the contribution from the IERRT project and other cumulative sources.

[3] Modelled contribution (Process Contribution) from IGET construction traffic emissions.

[4] Annual mean concentration (Predicted Environmental Concentration) is the combined contribution of background and modelled sources.

Table 17: Operational concentrations as a percentage of the Air Quality Objectives at nearest human health sensitive receptors for 2028 (also representing 2036) – Assuming MARPOL Tier III Emissions Standards (with SCR)

Receptor ID	Annual Mean Background Contribution (%)			Annual Mean Modelled IGET Contribution (%)[1]			Annual Mean Concentration (%)[2]		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
O_R1	35	35	40	0.6	<0.1	<0.1	35	35	40
O_R2	35	35	40	0.5	<0.1	<0.1	35	35	40
O_R3	35	35	40	0.6	<0.1	<0.1	35	35	40
O_R4	35	35	40	0.7	<0.1	<0.1	35	35	40
O_R5	35	35	40	0.8	<0.1	<0.1	35	35	40
O_R6	28	33	40	0.3	<0.1	<0.1	28	33	40
O_R7	28	33	40	0.3	<0.1	<0.1	28	33	40
O_R8	25	38	41	0.4	<0.1	<0.1	25	38	41
O_R9	25	37	40	0.3	<0.1	<0.1	26	37	40
O_R10	25	38	41	0.2	<0.1	<0.1	25	38	41
O_R11	21	37	40	0.2	<0.1	<0.1	21	37	40
O_R12	44	32	40	0.1	<0.1	<0.1	44	32	40
O_R13	28	28	35	0.8	<0.1	<0.1	29	28	35
O_R14	27	36	39	0.4	<0.1	<0.1	27	36	39
O_R15	25	36	39	0.5	<0.1	<0.1	26	36	39
O_R16	27	34	38	0.6	<0.1	<0.1	27	34	38
O_R17	24	36	39	0.5	<0.1	<0.1	25	36	39
AQ Objective	**40 µg/m^3**	**40 µg/m^3**	**20 µg/m^3**	**40 µg/m^3**	**40 µg/m^3**	**20 µg/m^3**	**40 µg/m^3**	**40 µg/m^3**	**20 µg/m^3**
Notes: [1] Process Contribution [2] Predicted Environmental Concentration									

Table 18: Operational concentrations as a percentage of the Air Quality Objectives at nearest human health sensitive receptors for 2028 (also representing 2036) – Assuming MARPOL Tier II Emissions Standard (without SCR)

Receptor ID	Annual Mean Background Contribution (%)			Annual Mean Modelled IGET Contribution (%)			Annual Mean Concentration (%)		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
O_R1	35	35	40	1.1	<0.1	<0.1	36	35	40
O_R2	35	35	40	0.9	<0.1	<0.1	36	35	40
O_R3	35	35	40	0.9	<0.1	<0.1	36	35	40
O_R4	35	35	40	1.1	<0.1	<0.1	36	35	40
O_R5	35	35	40	1.2	<0.1	<0.1	36	35	40
O_R6	28	33	40	0.7	<0.1	<0.1	28	33	40
O_R7	28	33	40	0.6	<0.1	<0.1	28	33	40
O_R8	25	38	41	0.7	<0.1	<0.1	25	38	41
O_R9	25	37	40	0.8	<0.1	<0.1	26	37	40
O_R10	25	38	41	0.5	<0.1	<0.1	25	38	41
O_R11	21	37	40	0.4	<0.1	<0.1	22	37	40
O_R12	44	32	40	0.1	<0.1	<0.1	44	32	40
O_R13	28	28	35	2.5	<0.1	<0.1	31	28	35
O_R14	27	36	39	1.1	<0.1	<0.1	28	36	39
O_R15	25	36	39	1.4	<0.1	<0.1	26	36	39
O_R16	27	34	38	1.8	<0.1	<0.1	28	34	38
O_R17	24	36	39	1.5	<0.1	<0.1	26	36	39
AQ Objective	**40 $\mu g/m^3$**	**40 $\mu g/m^3$**	**20 $\mu g/m^3$**	**40 $\mu g/m^3$**	**40 $\mu g/m^3$**	**20 $\mu g/m^3$**	**40 $\mu g/m^3$**	**40 $\mu g/m^3$**	**20 $\mu g/m^3$**

Notes:

[1] Process Contribution

[2] Predicted Environmental Concentration

Table 19: Operational concentrations and deposition rates as a percentage of the Critical Levels and Critical Load at selected nature conservation sensitive receptors for 2028 (also representing 2036) – Assuming MARPOL Tier III Emissions Standards (with SCR)

Rec. ID	Annual Mean Background Contribution (%)				Annual Mean Modelled IGET Contribution (%)[1]				Annual Mean Concentration/ Deposition Rate (%)[2]			
	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep
O_E1	50	11	50	146	1.6	<0.1	0.3	1.0	52	11	52	147
O_E2	50	11	50	**146**	1.8	<0.1	0.4	1.1	52	11	52	**147**
O_E3	50	9	53	**139**	0.7	<0.1	0.1	0.4	50	9	52	**139**
O_E4	46	9	53	**139**	0.5	<0.1	0.1	0.3	46	9	52	**139**
O_E5	55	20	50	**147**	0.4	<0.1	0.1	0.3	56	20	51	**147**
O_E6	64	17	53	**160**	0.3	<0.1	0.1	0.2	64	17	54	**160**
O_E7	42	8	53	**139**	0.4	<0.1	0.1	0.2	42	8	52	**139**
O_E8	49	11	50	**147**	0.2	<0.1	<0.1	0.1	49	11	51	**147**
O_E9	53	10	50	**147**	0.1	<0.1	<0.1	0.1	53	10	51	**147**
O_E10	84	14	53	**135**	0.1	<0.1	<0.1	0.1	84	14	52	**135**
O_E11	70	17	53	**160**	0.1	<0.1	<0.1	0.1	71	17	54	**160**
O_E12	**122**	15	53	**160**	0.1	<0.1	<0.1	0.1	**122**	15	54	**160**
O_E13	45	10	50	**146**	0.2	<0.1	0.1	0.1	46	10	51	**146**
O_E14	39	9	70	**161**	0.1	<0.1	<0.1	0.1	39	9	70	**161**
O_E15	39	9	70	**161**	0.1	<0.1	<0.1	0.1	39	9	70	**161**
O_E16	61	16	50	**147**	2.6	<0.1	0.8	2.0	64	16	52	**149**
O_E17	54	18	53	**255**	0.4	<0.1	0.1	0.3	62	18	52	**255**
O_E18	44	9	50	**260**	0.4	<0.1	0.1	0.3	62	9	51	**261**
O_E19	43	11	50	**147**	0.3	<0.1	0.1	0.2	62	11	51	**147**
Critical Level and Load	**30 µg/m³**	**20 µg/m³**	**3 µg/m³**	**10 kg/ha/ yr**	**30 µg/m³**	**20 µg/m³**	**3 µg/m³**	**10 kg/ha/ yr**	**30 µg/m³**	**20 µg/m³**	**3 µg/m³**	**10 kg/ha/ yr**

Rec. ID	Annual Mean Background Contribution (%)				Annual Mean Modelled IGET Contribution (%)[1]				Annual Mean Concentration/ Deposition Rate (%)[2]			
	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep

Notes:

[1] Process Contribution

[2] Predicted Environmental Concentration

Table 20: Operational concentrations and deposition rates at selected nature conservation sensitive receptors for 2028 (also representing 2036) – Assuming MARPOL Tier II Emissions Standard (without SCR)

Rec. ID	Annual Mean Background Contribution (%)				Annual Mean Modelled IGET Contribution (%)[1]				Annual Mean Concentration/Deposition Rate (%)[2]			
	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep
O_E1	50	11	50	**146**	4.9	<0.1	0.2	1.7	55	11	52	**148**
O_E2	50	11	50	**146**	5.4	<0.1	0.2	1.9	56	11	52	**148**
O_E3	50	9	53	**139**	1.9	<0.1	0.1	0.7	52	9	52	**140**
O_E4	46	9	53	**139**	1.4	<0.1	0.1	0.5	47	9	52	**139**
O_E5	55	20	50	**147**	0.9	<0.1	0.1	0.4	56	20	51	**147**
O_E6	64	17	53	**160**	0.7	<0.1	0.1	0.3	65	17	54	**160**
O_E7	42	8	53	**139**	0.9	<0.1	0.1	0.4	43	8	52	**139**
O_E8	49	11	50	**147**	0.4	<0.1	<0.1	0.2	49	11	51	**147**
O_E9	53	10	50	**147**	0.3	<0.1	<0.1	0.1	53	10	51	**147**
O_E10	84	14	53	**135**	0.3	<0.1	<0.1	0.1	84	14	52	**135**
O_E11	70	17	53	**160**	0.4	<0.1	<0.1	0.2	71	17	54	**160**
O_E12	**122**	15	53	**160**	0.3	<0.1	<0.1	0.1	**122**	15	54	**160**
O_E13	45	10	50	**146**	0.4	<0.1	<0.1	0.2	46	10	51	**146**
O_E14	39	9	70	**161**	0.2	<0.1	<0.1	0.1	39	9	70	**161**
O_E15	39	9	70	**161**	0.2	<0.1	<0.1	0.1	39	9	70	**161**

Rec. ID	Annual Mean Background Contribution (%)				Annual Mean Modelled IGET Contribution (%)[1]				Annual Mean Concentration/Deposition Rate (%)[2]			
	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep
O_E16	61	16	50	**147**	4.8	<0.1	0.7	2.5	66	16	52	**149**
O_E17	54	18	53	**255**	0.9	<0.1	0.1	0.4	62	18	52	**255**
O_E18	44	9	50	**260**	1.1	<0.1	0.1	0.5	63	9	51	**261**
O_E19	43	11	50	**147**	0.8	<0.1	0.1	0.3	62	11	51	**147**
Critical Level and Load	**30 µg/m³**	**20 µg/m³**	**3 µg/m³**	**10 kg/ha/yr**	**30 µg/m³**	**20 µg/m³**	**3 µg/m³**	**10 kg/ha/yr**	**30 µg/m³**	**20 µg/m³**	**3 µg/m³**	**10 kg/ha/yr**

Notes:

[1] Process Contribution

[2] Predicted Environmental Concentration

11. References

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