KEEPING BRITAIN TRADING

IMMINGHAM EASTERN RO-RO TERMINAL

Environmental Statement: Volume 3
Appendix 13.1: Construction Dust Assessment Methodology
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Associated British Ports

Immingham Eastern Ro-Ro Terminal

Environmental Statement Appendix 13A: Air Quality

December 2022





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Authors
AECOM

ABPmer
Quayside Suite, Medina Chambers, Town Quay, Southampton, Hampshire SO14 2AQ
T: +[redacted] W:[redacted]

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Executive Summary

This Appendix, Chapter 13 in Volume 1 of the Environmental Statement (ES) (Application Document Reference number 8.2) and supporting Figures (in Volume 2 of the ES (Application Document Reference number 8.3)) describe the anticipated impact and effect of the IERRT project during construction and operation.

Existing and future baseline conditions have been considered through review of existing air quality data and knowledge of local conditions, and dispersion modelling of some existing sources of emissions to air. Close to the site, monitoring data and modelled predictions have found local air quality to be of a good standard at human health sensitive receptors, with no risk of exceedance of an air quality objective in Immingham or South Killingholme. Away from the site at locations adjacent to the Strategic Road Network (SRN) that will be used by IERRT project traffic, annual mean concentrations of nitrogen dioxide (NO_2) in the existing baseline (2019) are elevated close to and above the air quality objective at some limited areas. In the future baseline (2025), concentrations have fallen below the air quality objective, due to the modernisation of the vehicle fleet and reduced emissions per vehicle, and there is little risk of an exceedance occurring.

Future baseline nitrogen oxides (NO_X) and nitrogen deposition rate conditions have been modelled at a number of designated nature conservation habitats close to the site and adjacent to the SRN to be used by IERRT project traffic. Annual mean NO_X concentrations exceed the air quality objective at a number of Local Wildlife Sites (LWS) and ancient woodlands adjacent to the M180 and M18 motorways. Annual mean ammonia (NH3) concentrations exceed the lower Critical Level for that pollutant across the SAC, but remain below the upper Critical Level. Nitrogen deposition rates exceed the Critical Load for the relevant habitat types over some areas of the Humber Estuary Special Area of Conservation (SAC), at the Edlington Wood Site of Special Scientific Interest (SSSI) adjacent to the M18 motorways, and at all LWSs and ancient woodlands considered adjacent to the M180 and M18 motorways.

The construction phase impact assessment has considered onsite emissions, including dust generating activity, site plant and construction vessels, and offsite emissions, including those from construction HGV traffic movements on routes local to the site. The assessment has identified a level of mitigation that is capable of controlling construction site emissions so that any effect is insignificant. The impact from offsite construction traffic emissions is negligible and insignificant.

The operational phase impact assessment has considered onsite IERRT project sources, including docked vessel emissions, land-tug emissions and onsite HGV emissions, and offsite IERRT project sources – HGV emissions on local roads and on the SRN. Impacts on human health sensitive receptors close to the site, in Immingham and South Killingholme, and away from the site adjacent to the SRN, are negligible and insignificant.

Impacts at the designated SAC site exceed 1% of the air quality objective for annual mean NO_X at two of five nearby saltmarsh habitats (1.6 - 1.7% of the objective) and 1% of the objective is also exceeded at sections of Priority Habitat within and adjacent to the site. With the IERRT project contribution, annual mean NO_X concentrations remain well below the air quality objective at these locations. Impacts on ammonia are less than 1% of the air quality objective at all locations considered within the SAC. Impacts on nitrogen deposition rates exceed 1% of the relevant Critical Loads at the same sections of Priority Habitat, but not at any sensitive habitat within the SAC. Away from the site but adjacent to the SRN, annual mean NOx and nitrogen deposition impacts are less than 1% of the air quality objective and Critical Load at all SSSI and ancient woodland habitats considered, and at most LWS habitats. At the two LWS habitats where annual mean NO_X impacts account for 1% of the air quality objective, the impact is limited to a small proportion of the habitats within 10m of the modelled road carriageway.

Following the implementation of mitigation measures described in the air quality chapter of the ES, the overall impact of the IERRT project will have an insignificant effect on local air quality.

13A Appendix 13

13A.1 Introduction

13A.1.1 This document provides additional information to accompany Chapter 13 of the ES. It includes the following:

- Construction Dust Emissions Assessment Method;
- Construction Road Traffic Emissions Assessment Method
- Site Emissions Assessment Method; and
- Road Traffic Emissions Assessment Method.

13A.2 Construction dust emissions assessment method

13A.2.1 This section describes the technical method by which the air quality impact of the IERRT project from construction phase particulate emissions has been considered.

Step 1: Screen the requirement for a detailed assessment

13A.2.2 Sensitive receptors were identified and the distance to the site and construction routes were determined according to the examples of sensitivity shown in **Table 13A.1**. According to the IAQM, an assessment will normally be required where there are sensitive receptors within 350 m of the boundary of a site and/or within 50 m of route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance.

13A.2.3 A human receptor, as considered within the IAQM guidance, is any location where a person or property may experience:

- The annoyance effects of airborne dust or dust soiling e.g. dwellings, industrial or commercial premises such as a vehicle showroom, food manufacturers, electronics manufacturers, amenity areas and horticultural operations; or
- Exposure to PM_{10} over a period relevant to the air quality objectives.

13A.2.4 Ecological receptors within 50 m of the boundary of the site or routes used by construction vehicles on the public highway, up to 500 m from the site entrance, also need to be identified.

13A.2.5 There are no ecological receptors which need to be considered as part of this assessment.

Table 13A.1. Definition of Significance of Fugitive Dust and PM_{10} Effects

Sensitivity	Dust Soiling	Human Health	Ecological
High	• Dwellings	• Residential properties. • Hospitals,	Locations with an international or national designation (e.g. SAC) and the

	• Museum and other culturally important collections, • Medium- and long-term car parks • Car showrooms	• Schools • Residential care homes	designated features may be affected by dust soiling
Medium	• Parks • Places of work	Office and shop workers, but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	Locations with a national designation (e.g. SSSI) where the features may be affected by dust deposition
Low	• Playing fields • Farmland (unless commercially sensitive horticultural) • Footpaths • Short term car parks • Roads	• Public footpaths • Playing fields • Parks • Shopping streets	Locations with a local designation where the features may be affected by dust deposition, such as and LWS with dust sensitive features.
Key SAC = Special Area of Conservation SSSI = Site of Special Scientific Interest LWS = Local Wildlife Site			

Step 2: Assess the risk of dust impacts

13A.2.6 The risk of dust arising in sufficient quantities to cause annoyance and/or health effects was determined for each activity (demolition, earthworks, construction works and track out), taking account of:

- The scale and nature of the works, which determines the potential dust emission magnitude (small, medium or large) (Step 2A); and
- The sensitivity of the area (low, medium or high) (Step 2B).

13A.2.7 These factors were then combined to give the risk of dust effects with no mitigation applied, as negligible, low, medium or high.

13A.2.8 It should be noted that where detailed information was not available to inform the risk category, professional judgement and experience was used and a cautious approach adopted, in accordance with the guidance.

Step 2A: Determine the dust emissions magnitude

Demolition

13A.2.9 **Table 13A.2** presents the demolition works dust emission classification. Demolition works will be minimal given the current state of the site.

Table 13A.2. Potential Demolition Works Dust Emission Classification

Emissions Class	Criteria
Large	• Total building volume >50,000 m^3 • Potentially dusty construction material (e.g. concrete) • On-site crushing and screening • Demolition activities >20 m above ground level
Medium	• Total building volume 20,000 m^3 – 50,000 m^3 • Potentially dusty construction material • Demolition activities 10-20 m above ground level
Small	• Total building volume <20,000 m^3 • Construction material with low potential for dust release (e.g. metal cladding or timber) • Demolition activities <10 m above ground • Demolition during wetter months

Earthworks

13A.2.10 Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. The classifications in **Table 13A.3** are based on examples of suitable criteria. Factors such as existing land use, topography, seasonality, duration and scale were also taken into consideration, where possible.

Table 13A.3. Potential Earthworks Dust Emission Classification

Emissions Class	Criteria
Large	• Total site area: >10,000 m^2 • Potentially dusty soil type (e.g. clay) • >10 heavy earth moving vehicle active at any one time • Formation of bunds >8 m in height • Total material moved >100,000 tonnes
Medium	• Total site area: 2,500 - 10,000 m^2 • Moderately dusty soil type (e.g. silt) • 5 -10 heavy earth moving vehicle active at any one time • Formation of bunds 4 - 8 m in height • Total material moved 20,000 – 100,000 tonnes
Small	• Total site area: <2,500 m^2 • Soil type with large grain size (e.g. sand)

	• < 5 heavy earth moving vehicle active at any one time • Formation of bunds < 4 m in height • Total material moved <20,000 tonnes • Earthworks during wetter months

Construction

13A.2.11 The key issues when determining the potential dust emission magnitude during the construction phase include the size of the building(s)/ infrastructure, method of construction, construction materials and duration of build. The classifications in **Table 13A.4** are based on examples of suitable criteria. Factors such as seasonality, building type, duration and scale were also taken into consideration, where possible.

Table 13A.4. Potential Construction Dust Emission Classification

Emissions Class	Criteria
Large	• Total building volume >100, 000 m^3 • Onsite concrete batching • Sandblasting
Medium	• Total building volume 25,000 m^3-100,000 m^3 • Potentially dusty construction material (e.g. concrete) • Onsite concrete batching
Small	• Total building volume <25,000 m^3 construction • Material with low potential for dust release (e.g. metal cladding or timber)

Track-out

13A.2.12 Track-out is the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the local road network. The classifications in **Table 13A.5** are based on examples of suitable criteria. Factors such as vehicle size, speed, numbers, geology and duration were also taken into consideration, where possible.

Table 13A.5. Potential Track-out Dust Emission Classification

Emissions Class	Criteria
Large	• 50 HGV (>3.5t) outward movements in any one day • Potentially dusty surface material • Unpaved road length > 100 m
Medium	• 25 – 100 HGV (>3.5t) outward movements in any one day • Moderately dusty surface material • Unpaved road length 50 – 100 m
Small	• < 25 HGV (>3.5t) outward movements in any one day

	• Surface material with low potential for dust release • Unpaved road length < 50 m

Step 2B: Define the sensitivity of the area

13A.2.13 The sensitivity of the area takes account of the following factors:

- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentrations; and
- Site specific factors, such as whether there are natural shelters, such as trees to reduce the risk of wind-blown dust

13A.2.14 The sensitivity of the area is determined separately for dust soiling impacts on people and properties (**Table 13A.6**), human health impacts (**Table 13A.7**) and ecology impacts (**Table 13A.8**).

Table 13A.6. Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from Source			
		< 20 m	< 50 m	< 100 m	< 350 m
High	>100	High	High	Medium	Low
Medium	10 – 100	High	Medium	Low	Low
Low	1 -10	Medium	Low	Low	Low

Table 13A.7. Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Conc. ($\mu g/m^3$)	Number of Receptors	Distance from Source (m)				
			< 20 m	< 50 m	< 100	< 200	< 350
High	>32	>100	High	High	High	Medium	Low
		10 – 100	High	High	Medium	Low	Low
		1 -10	High	Medium	Low	Low	Low
	28 – 32	>100	High	High	Medium	Low	Low
		10 – 100	High	Medium	Low	Low	Low
		1 -10	High	Medium	Low	Low	Low
	24 – 28	>100	High	Medium	Low	Low	Low
		10 – 100	High	Medium	Low	Low	Low
		1 -10	Medium	Low	Low	Low	Low
	<24	>100	Medium	Low	Low	Low	Low
		10 – 100	Low	Low	Low	Low	Low
		1 -10	Low	Low	Low	Low	Low
Medium	>32	>10	High	Medium	Low	Low	Low
		1 -10	Medium	Low	Low	Low	Low
	28 – 32	>10	Medium	Low	Low	Low	Low

		1 -10	Low	Low	Low	Low	Low
	24 – 28	>10	Low	Low	Low	Low	Low
		1 -10	Low	Low	Low	Low	Low
	<24	>10	Low	Low	Low	Low	Low
		1 -10	Low	Low	Low	Low	Low
Low	-	1 -10	Low	Low	Low	Low	Low

Table 13A.8. Sensitivity of the Area to Ecological Impacts

Receptor Sensitivity	Distance from Source	
	< 20 m	< 50 m
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Step 2C: Define the Risk of Impacts

13A.2.15 The dust emission magnitude determined at Step 2A should be combined with the sensitivity of the area determined at Step 2B to determine the risk of effects with no mitigation applied (**Table 13A.9**). This Step is undertaken for each activity undertaken on site.

Table 13A.9. Dust Risk without Mitigation

Activity	Sensitivity of Area	Dust Emission Classification		
		Large	*Medium*	*Small*
Demolition	*High*	High	Medium	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Negligible
Earthworks	*High*	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Construction	*High*	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Trackout	*High*	High	Medium	Medium
	Medium	Medium	Low	Negligible
	Low	Low	Low	Negligible

Step 3: Identify the need for site-specific mitigation

13A.2.16 Based on the risk of effects determined in Step 2C for each activity, appropriate site-specific mitigation measures were recommended. Appropriate mitigation measures are set out in the IAQM Guidance.

Step 4: Define impacts and their significance

13A.2.17 Finally, the significance of the potential residual dust impacts, i.e. after mitigation, was determined. According to the IAQM Guidance the residual impacts assumes that all mitigation measures (recommended in Step 3) to avoid or reduce impacts are adhered to, and therefore the residual impacts should be 'not significant'.

13A.3 Construction phase road traffic emissions assessment method

13A.3.1 This section describes the methodology followed to undertake the assessment of construction phase vehicle emissions impacts on local roads to the IERRT project.

13A.3.2 The assessment is based on the following information:

- 2019 baseline traffic flow data for Queens Road and Humber Road;
- The total number of construction phase vehicles (LDV and HDV) accessing and leaving the site on the day of peak construction;
- The proportion of those construction vehicles that will access and leave the IERRT project by the Port of Immingham east gate and the proportion of those vehicles that will access and leave the IERRT project by the Port of Immingham west gate.

13A.3.3 The construction traffic flow was added to the 2019 baseline flows on both Humber Road and Queens Road, to ascertain total concentrations and potential impacts from construction traffic emissions.

13A.3.4 The dispersion model ADMS Roads was used to model the dispersion of emissions from construction road traffic sources and estimate the contribution at selected air quality sensitive receptors. The focus is on local roads and, in particular, the route between the Port of Immingham west gate and the A180, and the route between the Port of Immingham east gate and the A180. The air quality sensitive receptors selected for the assessment represent sensitive residential exposure at locations adjacent to Humber Road (grid reference: 519948, 414860) and Queens Road (grid reference: 515202, 416114).

13A.3.5 The road traffic data used to inform this assessment is summarised in Table **13A.10**. Vehicle emission rates were sourced from Defra's Emission Factor Toolkit (v.11).

Table 13A.10. Construction Phase Traffic Data

Receptor	24-hour AADT	% HDV	Speed (kph)
Queens Road			
Baseline / Future baseline (2019)	3,883	14.6	48

With development construction phase	4,161	20.3	48
Humber Road			
Baseline / Future baseline (2019)	10,536	48.9	97
With development construction phase	10,814	50.2	97

13A.3.6 Background pollutant concentration data for the pollutants considered in the assessment have been sourced from Defra's background pollutant maps. The background data value used to inform the assessment are 15.8 µg/m^3 to 16.1 µg/m^3 for NO_2, 14.8 µg/m^3 to 15.2 µg/m^3 for PM_{10}, and 8.8 µg/m^3 to 8.9 µg/m^3 for $PM_{2.5}$.

13A.3.7 Hourly sequential meteorological data has been sourced from Humberside Airport for the year 2019. Humberside Airport is located approximately 11 km to the southwest of the IERRT project and is considered the most representative source of meteorological data available for the study area.

13A.3.8 In this study modelled NO_X values were converted to NO_2 using the 'NO_X to NO_2' calculator, version 8.1, released in June 2020, and available at the Air Quality Archive. The year and region for which the modelling has been undertaken are specified and local factors, such as an appropriate factor of NO_X emitted as NO_2, are used in the calculation.

13A.3.9 A model bias-adjustment factor of 3.42 has been applied to the model road source output of all pollutants modelled (see Section 13A.5 and Dispersion Model Verification).

13A.4 Operational site emissions assessment method

13A.4.1 Site emissions include those associated with the following sources:

- Roll-on Roll-off (Ro-Ro) vessel energy generation plant when docked;
- Land-tug movements within the site relating to unaccompanied loads; and
- Vehicle movements within the site relating to accompanied loads.

13A.4.2 The combined impact of site emissions is then reported at the selected air quality sensitive receptors that may potentially be impacted by those emissions.

Emissions data

Ro-Ro vessel emissions

13A.4.3 Emissions from Ro-Ro vessels when docked is based on engine emissions data provided by the potential operator. The impact of emissions on nearby air quality sensitive receptors has been predicted using the Advanced Dispersion Modelling System (ADMS) 5 (version 5.2.4), published by CERC.

13A.4.4 When docked, the primary power source for the Ro-Ro vessels will be a shore-to-ship power supply. However, should that supply fail, each Ro-Ro vessel will operate on two 1,540 kW_E STX-MAN 7L21/31 engines and one 7-barg (unit of pressure) boiler. There are three berths with Ro-Ro vessels

anticipated to be docked at each for 4,710 hours per year. A summary of the vessel emissions data used to inform the assessment is provided in **Table 13A.11**. The emissions from engines and boilers operating whilst the vessels are docked is not mitigated beyond the height and location of emissions release, and use of low sulphur Marine Gas Oil (MGO).

Table 13A.11. Vessel Emissions Data

Parameter	Value		Unit / Notes
	STX-MAN 7L21/31	Oil-fired boiler	
Capacity	1,540 kW_e	7.5 barg	Per vessel
Number of units operating	2	1	Per vessel
Operating Load	50[1]	100	%
Operating profile	4710	1533	Hours/year/ engine or boiler
Release point location	521056, 416212 521052, 416205 521031, 416166 521027, 416159 520991, 416091 520987, 416084	521054, 416209 521029, 416162 520989, 416087	x,y
Emission release height	29.2	29.2	m above ground
Internal diameter of release point	1.1	0.4	m
Temperature of emissions	334	350	ºC
Mass flow of emissions	1.535	0.756	kg/s
Mass NO_X emission rate	1.240	0.127	g/s
Notes: [1] Average load over operating profile			

13A.4.5 Emissions from vessels when sailing to and from the IERRT are not included as part of the assessment. This is because such emissions are transient and vessel movements are limited to six trips per day (three in and three out). Emissions from sailing vessels will impact on a particular location for only a limited period of time and will not occur within 200m of any air quality sensitive habitats or human receptors.

Land-tug emissions

13A.4.6 Land-tugs are required to move unaccompanied freight to and from the docked vessels, to and from the designated trailer parks. They will initially operate using diesel-fired Volvo TAD880VE-160kW vehicle engines, which are Non-Road Mobile Machinery (NRMM) Stage V compliant. It is the aspiration that these diesel-powered tugs will eventually be phased out over the years, with the aim of a 100% electric land-tug fleet at some point in future. The assessment is based on opening year conditions and a 100% diesel-fired land-tug fleet. It has been assumed in this assessment that the land-tugs will have NH_3 emissions associated with Selective Catalytic

Reduction technology. However, no reduction in NO_X emissions has been assumed.

13A.4.7 NO_X and NH_3 emissions from land-tugs movements have been modelled to quantify their contribution to impacts on the nearest nitrogen-sensitive habitats. A summary of the land-tug emissions data used to inform the assessment is provided in **Table 13A.12** and **Table 13A.13**. The first table provides the data and emission rates calculated for all anticipated land-tug movements. The second table provides a breakdown of land-tug emissions per section of onsite road.

Table 13A.12. Land-tug Emissions Data

Parameter	Value	Unit / Notes
Land-tug movements[1]	1,436	2-way movements/day
NRMM Stage V Emission Standard[2]	0.4	g/kW/hr – energy used
Power consumption[3]	160	kW
Average speed[4]	30	kph
Time taken to travel 1 km	75	seconds
Modelled NO_X emission rate	0.022	g/km/s
Modelled NH_3 emission rate[5]	0.003	g/km/s

Notes:
[1] Number of anticipated unaccompanied units, containers and trailers per day multiplied by 2 to account for return journeys.
[2] NRMM Stage V emission limit for 160kW engines.
[3] Maximum power consumption and likely to be less on average.
[4] Assumed average speed.
[5] No ammonia emission limit given in NRMM Stage V Emission Standards. Instead. Land-tug ammonia emissions are calculated based on the relationship NOx emissions from Defra's current EFT and AQC's CREAM tool.

Table 13A.13. Distribution of Land-tug Emissions Data

Site Road Link	Two-way Land-tug Movements per day	Emission Rate (g/km/s)	
		NO_X	NH_3
Pier	1436	0.0220	0.0030
Terminal road at north storage area	1296	0.0199	0.0028
North storage area	140	0.0021	0.0003
Terminal road bridge, between north storage area and central/south storage area	1296	0.0199	0.0028
Central storage area	870	0.0133	0.0018
Terminal road at south storage area	426	0.0065	0.0009
South storage area	426	0.0065	0.0009

Site traffic emissions

13A.4.8 Site traffic emissions are those associated with the LDV and accompanied HDV movements on site roads between the vessel access Pier and the Port of Immingham East and West Gates.

13A.4.9 NO_X emissions from LDVs and accompanied HDV movements are based on engine emissions data sourced from Defra's EFT (version 11). Emission rates for NH_3 have been sourced from the AQC CREAM tool and applied to the fleet mix data provided in version 11 of the EFT. A summary of the LDV and accompanied HDV movement emissions data used to inform the assessment is provided in **Table 13A.14**.

Table 13A.14. Site Traffic Emissions Data

Site Roads	Daily 2-way Movements		Emission Rate (g/km/s)	
	LDVs	HDVs	NO_X	NH_3
Pier	410	1944	0.0184	0.0025
Terminal road at north storage area	0	1800	0.0162	0.0022
North storage area	0	0	0.0000	0.0000
Terminal road bridge, between north storage area and central/south storage area	0	1800	0.0162	0.0022
Central storage area	0	0	0.0000	0.0000
Terminal road at south storage area	0	1932	0.0173	0.0024
South storage area	0	0	0.0000	0.0000
HGV compound	0	1932	0.0173	0.0024
HGV Pier Road	410	0	0.0010	0.0001
Route to and from East Gate	349	1652	0.0156	0.0022
Terminal Road beneath terminal road bridge	61	1652	0.0150	0.0021
Terminal road towards west storage area	0	1946	0.0175	0.0024
West storage area	0	1946	0.0175	0.0024
Route to and from West Gate	61	292	0.0028	0.0004

Meteorological data

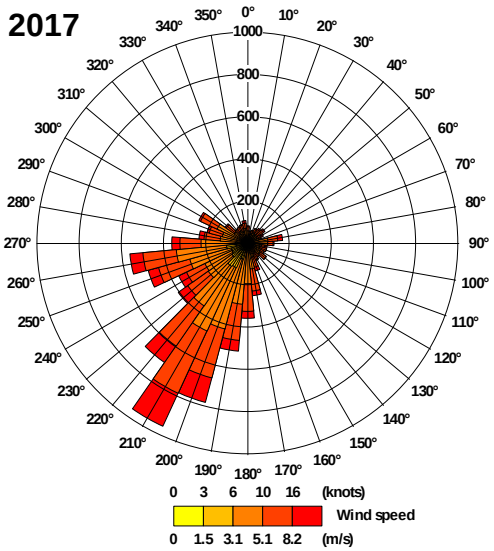
13A.4.10 It is standard practice to model point source emissions, such as those associated with the vessel engines and plant, with up to five years of meteorological data. This is to account for interannual variation and the maximum yearly contribution from the point sources at each receptor over the five years is the value used to represent this source.

13A.4.11 Five years of hourly sequential meteorological data from Humberside Airport has been used to inform the quantification of vessel emissions contributions to air quality impacts from onsite sources. Humberside Airport is approximately 10km to the southwest of the IERRT project. Wind rose plots for the five-year data is provided in Figure 13A.1, below.

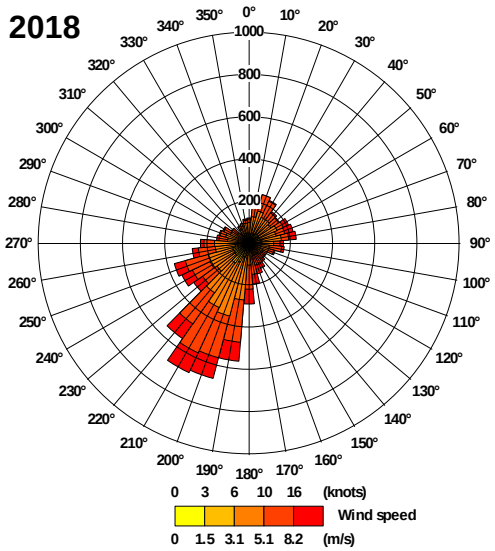
13A.4.12 The figure shows how consistent wind speed and direction has been over the five years considered, with the clear prevalence of south-westerlies.

Figure 13A.1. Humberside Airport Wind Rose Plots 2017 – 2021

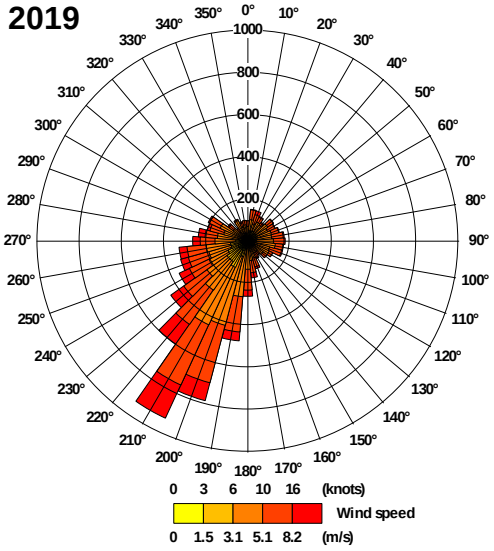
2017



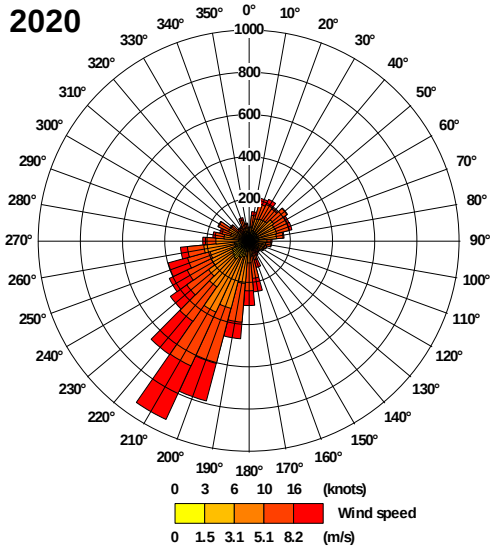
2018



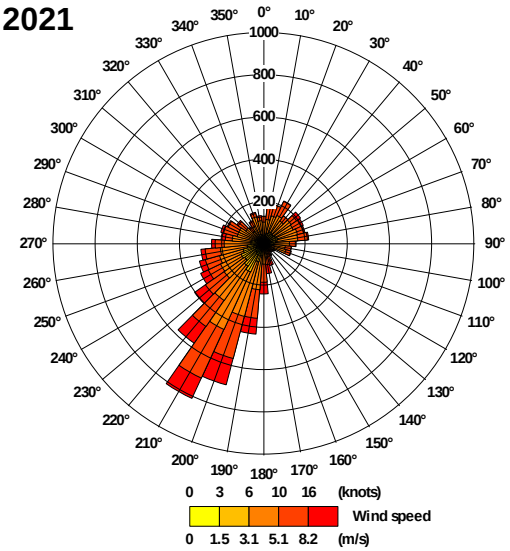
2019



2020



2021

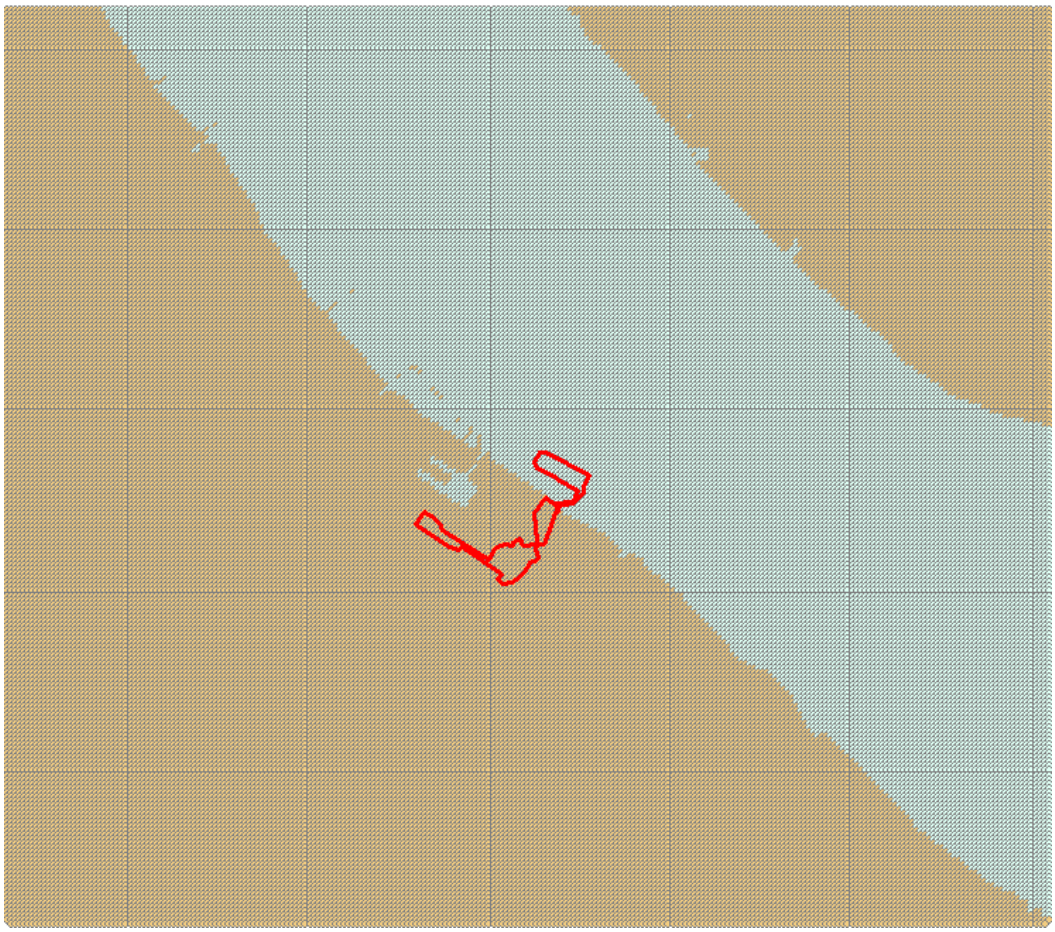


Variable surface roughness

13A.4.13 Due to the location of the IERRT project on the southern shore of the Humber Estuary, a variable surface roughness file has used to inform the dispersion modelling of vessel emissions. A surface roughness value of 0.75 m has been used to represent the built-up port and surrounding industrial area, and a surface roughness value of 0.0001 m has been used to represent the estuary. The variable surface roughness data has a resolution of 50m.

13A.4.14 The spatial variation in surface roughness assumed is illustrated in Figure 13A.2, below.

Figure 13A.2. Surface Roughness Plot



NO_X to NO_2 conversion

13A.4.15 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.

13A.4.16 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.

13A.4.17 For the point source emissions modelled – the vessel engines and boilers – a NO_X to NO_2 conversion rate of 70% has been assumed over an annual mean averaging period, in line with Environment Agency guidance (2022).

13A.4.18 For emissions associated with land-tug movements and onsite traffic, the conversion of NO_X to NO_2 has been accounted for by use of Defra's NO_X to NO_2 calculator. This tool accounts for localised conversion factors of NO_X emissions from vehicle exhausts.

Dispersion model verification

13A.4.19 A verification factor of 3.42 has been applied to the modelled land-tug and onsite LDV and HDV emissions model outputs to account for road source model bias (see Section 13A.5 and Dispersion Model Verification).

Air quality sensitive receptors

13A.4.20 The assessment of site emissions focuses on specific nature conservation receptors due to the potential for impacts from increased rates of nitrogen deposition. Nitrogen deposition rates could increase from the operation of the IERRT project due to an increase in airborne concentrations of NO_2 and NH_3 from the sources described above. The former is a by-product of combustion, the latter a by-product of urea-based SCR emissions technology. The nature conservation receptors of relevance to this assessment are summarised in **Table 13A.15** and illustrated in **Figure 13.1** in Volume 2 of this ES (Application Document Reference number 8.3)**.**

Table 13A.15. Modelled Receptor Locations

Receptor ID	Location	Description
Humber Estuary SAC (North East Lincolnshire estuary shore and East Riding of Yorkshire estuary shore)		
SAC1	518489, 417847	Saltmarsh habitat within the Humber Estuary SAC, approximately: - 3km west-northwest of docked vessel emissions source - 2.3km northwest of western trailer park - 1.3km north of site traffic route to/from West Gate
SAC2	523789, 413171	Saltmarsh habitat within the Humber Estuary SAC, approximately: - 4km southeast of docked vessel emissions source - 4km east-southeast of central trailer park - 3.9 east-southeast of site traffic route to/from East Gate
SAC3	521951, 419696	Saltmarsh habitat within the Humber Estuary SAC, approximately: - 3.6km north-northeast of docked vessel emissions source

Receptor ID	Location	Description
		- 3.8km north-northeast of trailer park route - 3.8km north-northeast of site traffic route to/from West and East Gate
SAC4	523237, 418505	Saltmarsh habitat within the Humber Estuary SAC, approximately: - 3.2km northeast of docked vessel emissions source - 3.0km northeast of trailer park route - 3.0km northeast of site traffic route to/from West and East Gate
SAC5	524349, 417648	Saltmarsh habitat within the Humber Estuary SAC, approximately: - 3.6km east-northeast of docked vessel emissions source - 3.4km east-northeast of trailer park route - 3.4km east-northeast of site traffic route to/from West and East Gate
Local Wildlife Site (Homestead Park, Immingham)		
LWS1	518051, 415615	Woodland habitat, approximately: - 2.9km west-southwest of docked vessel emission source - 1.3km west-southwest of western trailer park - 800m south-southwest site traffic route to/from West Gate
Site of Importance for Nature Conservation (adjacent to Manby Road Immingham)		
SINC1	518286, 415761	Grassland habitat, approximately: - 2.7km west-southwest of docked vessel emission source - 1km west of western trailer park source - 570m south-southwest site traffic route to/from West Gate
Priority Habitats (within and adjacent to the Port of Immingham)		
PH1	521269, 415512	Woodland habitat, approximately: - 650m southeast of docked vessel emission source - 620m east of western trailer park route - 650m east of site traffic route to/from East Gate
PH2	520742, 414998	Woodland habitat, approximately: - 1km south of docked vessel emission source - 480m east of central and southern trailer park route - 370m east of site traffic route to/from East Gate[1]
PH3	519956, 415190	Grassland habitat, approximately: - 1.3km southwest of docked vessel emission source - 10m south of wester trailer park route - 700m west-southwest of site traffic route to/from East Gate
PH4	516446, 417896	Woodland habitat, approximately: - 4.8km west-northwest of docked vessel emission source - 4.4km northwest of western trailer park - 1.8km northwest of site traffic route to/from West Gate
Notes: [1] Within 10m of Queens Road, 300m beyond East Gate		

13A.4.21 In addition to the nature conservation receptors listed above, the impact of onsite emissions sources has also been quantified at the nearest human health sensitive receptors to the IERRT project site. These are residential properties on Kings Road (519241,415169) and Queens Road (519949, 414860).

Background Pollutant Data

13A.4.22 The dispersion model predicts the contribution of pollutants from onsite emissions sources at selected air quality sensitive receptors. To report total pollutant concentrations that can be compared to the relevant air quality standards at the selected air quality sensitive receptors, this contribution needs to be added onto the background (or ambient) pollutant concentrations that are representative of those locations. Background pollutant data is summarised in **Table 13A.16**.

13A.4.23 Background NO_X concentration data has been sourced from Defra's background pollutant concentration maps from background maps with a 2018 base year. Background nitrogen deposition rate data has been sourced from the Air Pollution Information System (APIS), from background maps with a 2018 base year.

Table 13A.16. Background Pollutant Data

Receptor ID	Location	NO_X Conc. ($\mu g/m^3$)[1]	Nitrogen Deposition Rate (kgN/ha/yr)[1]
Humber Estuary SAC (North East Lincolnshire estuary shore and East Riding of Yorkshire estuary shore)			
SAC1	518489, 417847	19.8	**20.4**
SAC2	523789, 413171	17.2	19.2
SAC3	521951, 419696	14.2	19.0
SAC4	523237, 418505	15.7	19.0
SAC5	524349, 417648	16.0	17.9
Local Wildlife Site (Homestead Park, Immingham)			
LWS1	518051, 415615	16.9	**34.2**
Site of Importance for Nature Conservation (adjacent to Manby Road Immingham)			
SINC1	518286, 415761	16.9	**20.4**
Priority Habitats (within and adjacent to the Port of Immingham)			
PH1	521269, 415512	19.2	**32.3**
PH2	520742, 414998	18.6	**32.3**
PH3	519956, 415190	26.2	**20.4**
PH4	516446, 417896	14.0	**34.2**
Air Quality Standard		**30**	**10 – 20[2,3]** **20 – 30[4]**

Notes:
[1] **Bold** values denote and exceedance of the relevant air quality standard.
[2] Broadleaved deciduous woodland. [3] Acid grassland. [4] Coastal saltmarsh.

13A.4.24 **Table 13A.16** shows that at the nature conservation habitats close to the IERRT project, background NO_X concentrations are well below the air quality objective. However, nitrogen deposition rates are either in excess of the relevant Critical Loads, or close to an exceedance.

Calculating Nitrogen Deposition Rates

13A.4.25 The input data described in the sections above is used by the model to predict the dispersion of emissions from the sources and to report the contribution of those emissions to annual mean NO_X concentrations and nitrogen deposition rates at the selected receptor locations.

13A.4.26 In line with current guidance (Highways England, 2019) nitrogen deposition rates are calculated by applying factors to the modelled NO_2 and NH_3 concentrations as µg/m^3. This concentration data is converted into a deposition rate by first applying the appropriate dry deposition velocity, followed by the appropriate dry deposition flux conversion factor. Finally, the converted impact value can be added to a representative background deposition rate to provide total nitrogen deposition. The appropriate factors are summarised in **Table 13A.17.**

Table 13A.17. Concentration to Deposition Rate Conversion

Habitat Type[1]	Receptors	Pollutant	Dry Deposition Velocity[2]	Dry Deposition Flux Conversion Factor[3]
Short vegetation	SAC1, SAC2, SAC3, SAC4, SAC5, SINC1, PH3	NO_2	0.0015	95.9
		NH_3	0.020	260
Tall vegetation	LWS1, PH1, PH2, PH4	NO_2	0.003	95.9
		NH_3	0.030	260

Notes:
[1] "Short vegetation" = grassland or similar and "tall vegetation" = woodland or similar.
[2] Dry deposition flux (µg/m^2/s) = ground level concentration (µg/m^3) × deposition velocity (m/s).
[3] To convert the dry deposition flux µg/m^2/s into a nitrogen deposition rate (kg N/ha/yr).

13A.5 Operational Road Traffic Emissions Assessment Method

13A.5.1 Road traffic emissions are those associated with vehicle movements on the public road network on journeys to and from the IERRT project.

13A.5.2 The greatest increase in vehicle movements due to the operation of the IERRT project are anticipated to occur on roads local to the site, on the route between the Port of Immingham East Gate and the A180, via Queens Road, the route between the Port of Immingham West Gate and the A180,

via the A160 Humber Road, and the A180/M180 between Immingham and the M18.

13A.5.3 An increase in vehicle flows, particularly in HDVs, will be experienced on other sections of the Strategic Road Network (SRN) that are remote from the IERRT project, including sections of the M18 and M1 in South Yorkshire, the M1 in Northern Derbyshire, and the M62 in West Yorkshire.

Traffic Data

13A.5.4 Traffic data has been supplied by the Competent Expert for Traffic and Transport. Baseline traffic data for roads local to the IERRT project in Immingham and South Killingholme are based on traffic counts commissioned specifically for the Transport Assessment (Appendix 17.1 in Volume 3 of the ES (Application Document Reference number 8.4)). Baseline traffic data for the remote links on the SRN are based on published data made available by the Department for Transport. **Table 13A.18** provides the traffic data used to inform the assessment, which involves all local roads that exceed the IAQM/EPUK screening criteria (=/+500 two-way LDV movements or =/+100 two-way HDV movements) and all sections of the SRN that exceed the DMRB screening criteria (=/+1000 two-way LDV movements or =/+200 two-way HDV movements), as 2-way flows.

Table 13A.18. Road Traffic Data

Link	Two-way AADT	Two-way %HDV	One-way (in) AADT	One-way (in) % HDV	One-way (out) AADT	One-way (out) % HDV	Speed (kph)[1,2]
2019 Baseline							
West Gate	2,707	25	n/a	n/a	n/a	n/a	48
East Gate	5,735	14	n/a	n/a	n/a	n/a	64
Queens Road	3,817	15	n/a	n/a	n/a	n/a	48
A1173	7,260	12	n/a	n/a	n/a	n/a	64
A160	n/a	n/a	6,726	41	5,362	49	105
A180	n/a	n/a	12,689	15	25,513	15	111
M180 (J4-J5)	n/a	n/a	18,656	24	18,888	24	109
M180 (J3-J4)	n/a	n/a	14,556	26	13,916	24	109
M180 (J2-J3)	n/a	n/a	19,546	23	19,699	23	109
M180 (J1-J2)	n/a	n/a	19,957	27	19,957	27	109
M18 (J3-J4)	n/a	n/a	25,623	19	26,827	18	110

Link	Two-way AADT	Two-way %HDV	One-way (in) AADT	One-way (in) % HDV	One-way (out) AADT	One-way (out) % HDV	Speed (kph)[1,2]
M1 (J28-J29)	n/a	n/a	64,351	22	63,054	20	110
M1 (J30-J31)	n/a	n/a	59,615	22	58,184	22	109
M18 (J1-J2)	n/a	n/a	45,783	19	45,522	21	110
M62 (J29-J30)	n/a	n/a	52,302	18	29,534	17	110
M62 (J27-J28)	n/a	n/a	61,852	18	59,491	16	111
M62 (J26-J27)	n/a	n/a	77,040	16	75,930	19	110
M18 (J5-J6)	n/a	n/a	28,608	21	28,922	21	110
A15 (south of M180)	11,446	19	n/a	n/a	n/a	n/a	97
A15 (north of A361)	11,503	20	n/a	n/a	n/a	n/a	97
M62 (J22-J23)	n/a	n/a	52,606	16	52,946	17	110
M18 (J4-J5)	n/a	n/a	27,249	15	34,958	19	110
A180 (east of M180)	n/a	n/a	18,656	24	18,888	24	109
2025 Future Baseline							
West Gate	3,940	21	n/a	n/a	n/a	n/a	48
East Gate	6,696	12	n/a	n/a	n/a	n/a	64
Queens Road	4,372	20	n/a	n/a	n/a	n/a	48
A1173	13,902	10	n/a	n/a	n/a	n/a	64
A160	n/a	n/a	12,218	26	12,159	26	109
A180	n/a	n/a	17,897	16	31,598	15	111

Link	Two-way AADT	Two-way %HDV	One-way (in) AADT	One-way (in) % HDV	One-way (out) AADT	One-way (out) % HDV	Speed (kph)[1,2]
M180 (J4-J5)	n/a	n/a	20,365	24	20,621	25	109
M180 (J3-J4)	n/a	n/a	15,812	26	15,124	24	109
M180 (J2-J3)	n/a	n/a	21,103	23	21,274	23	109
M180 (J1-J2)	n/a	n/a	21,283	27	21,289	27	109
M18 (J3-J4)	n/a	n/a	27,770	19	29,072	18	110
M1 (J28-J29)	n/a	n/a	70,249	22	68,835	20	110
M1 (J30-J31)	n/a	n/a	63,887	22	62,355	22	109
M18 (J1-J2)	n/a	n/a	48,944	19	48,667	21	110
M62 (J29-J30)	n/a	n/a	56,332	18	31,813	17	110
M62 (J27-J28)	n/a	n/a	67,615	18	65,035	16	111
M62 (J26-J27)	n/a	n/a	82,167	16	80,984	19	110
M18 (J5-J6)	n/a	n/a	30,454	21	30,789	21	110
A15 (south of M180)	12,108	19	n/a	n/a	n/a	n/a	97
A15 (north of A361)	12,168	20	n/a	n/a	n/a	n/a	97
M62 (J22-J23)	n/a	n/a	56,194	16	56,558	17	110
M18 (J4-J5)	n/a	n/a	29,007	15	37,215	19	110
A180 (east of M180)	n/a	n/a	20,365	24	20,621	25	109
2025 Future Operational							

Link	Two-way AADT	Two-way %HDV	One-way (in) AADT	One-way (in) % HDV	One-way (out) AADT	One-way (out) % HDV	Speed (kph)[1,2]
West Gate	4,293	26	n/a	n/a	n/a	n/a	48
East Gate	8,697	29	n/a	n/a	n/a	n/a	64
Queens Road	6,152	41	n/a	n/a	n/a	n/a	48
A1173	15,644	20	n/a	n/a	n/a	n/a	64
A160	n/a	n/a	12,371	27	12,312	26	109
A180	n/a	n/a	18,719	19	32,419	17	110
M180 (J4-J5)	n/a	n/a	21,271	27	21,527	28	109
M180 (J3-J4)	n/a	n/a	16,495	29	15,807	28	109
M180 (J2-J3)	n/a	n/a	21,786	25	21,957	25	109
M180 (J1-J2)	n/a	n/a	21,967	29	21,972	29	108
M18 (J3-J4)	n/a	n/a	28,019	20	29,321	19	110
M1 (J28-J29)	n/a	n/a	70,426	22	69,012	20	110
M1 (J30-J31)	n/a	n/a	64,084	23	62,552	22	109
M18 (J1-J2)	n/a	n/a	49,176	19	48,899	21	110
M62 (J29-J30)	n/a	n/a	56,460	18	31,942	17	110
M62 (J27-J28)	n/a	n/a	67,722	18	65,142	16	110
M62 (J26-J27)	n/a	n/a	82,275	16	81,091	19	110
M18 (J5-J6)	n/a	n/a	30,582	21	30,917	21	110
A15 (south of M180)	12,479	22	n/a	n/a	n/a	n/a	97
A15 (north of A361)	12,540	22	n/a	n/a	n/a	n/a	97

Link	Two-way AADT	Two-way %HDV	One-way (in) AADT	One-way (in) % HDV	One-way (out) AADT	One-way (out) % HDV	Speed (kph)[1,2]
M62 (J22-J23)	n/a	n/a	56,294	16	56,658	17	110
M18 (J4-J5)	n/a	n/a	29,256	15	37,464	19	110
A180 (east of M180)	n/a	n/a	21,271	27	21,527	28	109
Notes: [1] Speed limit on free-flowing sections of road, reduce speed assumed for approach to junctions. [2] For multiple-carriageway roads the modelled speed is the speed limit for LDVs and HDVs, weighted by the proportion of LDVs and HDVs on each link.							

13A.5.5 A summary of the key traffic flow impacts considered in the air quality assessment is provided as follows:

- Local Road Network:
  - Queens Road, Immingham, will experience an increase of 1,641 two-way HDV movements (all as HGV) per average day;
  - A1173, Immingham, will experience an increase of 1,641 two-way HGV movements per average day;
  - A15, south of junction M18 junction 4, will experience an increase of 371 two-way HGV movements per average day;

- Strategic Road Network
  - A160 Humber Road, South Killingholme, will experience an increase of 292 two-way HGV movements per average day;
  - A180, between the A1173 and A160 Humber Road junctions, will experience an increase of 1,567 two-way HGV movements per average day;
  - M180, west of A180, will experience an increase of 1,735 two-way HGV movements per average day;
  - M180 at Doncaster and North Lincolnshire LWSs, east of the M18 junction, will experience an increase of 1,364 two-way HGV movements per average day;
  - M18 adjacent to Doncaster Council LWSs, between junction 5 and 6, will experience an increase of 257 two-way HGV movements per average day;
  - M18 adjacent to Doncaster Council AQMA No.4, Potteric Carr SSSI, ancient woodlands and LWSs, between junctions 3 and 4, will experience an increase of 497 two-way HGV movements per average day;
  - M18 adjacent to Edlington Wood SSSI, between junctions 1 and 2, will experience an increase of 463 two-way HGV movements per average day;

- M1 adjacent to Rotherham Council AQMA No.1 (Part 3) and Bolsover Council Barlborough AQMA No.2 (revoked 02/03/2022), between junctions 30 and 31, will experience an increase of 393 two-way HGV movements per average day;
- M1 at Bolsover Council South Normanton AQMA (revoked 02/03/2022), between junctions 28 and 29, will experience an increase of 355 two-way HGV movements per average day;
- M62 near to Wakefield City AQMA, between junctions 29 and 30, will experience an increase of 257 two-way HGV movements per average day; and
- M62 adjacent to Kirklees Council AQMA No.4, between junctions 26 and 27, will experience an increase of 215 two-way HGV movements per average day.

13A.5.6 The summary above is not an inclusive list of all links and traffic impacts that have been considered in this assessment but does list those considered that exceed the current IAQM/EPUK screening criteria (Moorcroft and Barrowcliffe. et al., 2017) and National Highways screening criteria (Highways England, 2019). Links not considered in this air quality assessment, due to limited traffic impacts falling below relevant screening criteria, include those listed below:

- A180 east of the junction with the A1173;
- City centre roads within the Lincoln City AQMA;
- A18 north of M180 junction 4;
- A1 north of M18 junction 2;
- A1 south of M62 junction 33;
- M1 north of junction 32;
- M1 south of junction 28;
- M62 east of junction 35 (and A63 through Kingston Upon Hull); and
- M62 west of junction 26.

Emissions Data

13A.5.7 The traffic data provided has been converted into NO_X, PM_{10} and $PM_{2.5}$ emissions data using Defra's Emission Factor Toolkit (EFT) (version 11).

13A.5.8 In July 2018, the Institute of Air Quality Management (IAQM) released a Position Statement on dealing with uncertainty in vehicle NO_X emissions. This was due to uncertainties in the accuracy of fleet projections and emissions technologies contained with the EFT that was current at that time. In 2020, the IAQM withdrew the Position Statement, stating that more recent EFTs (version 9 onwards) reflect real-world NO_X emissions more accurately.

13A.5.9 Despite this, the main assessment reported in Chapter 13 of the ES does still follow a precautionary approach. Whilst modelling is based on projected vehicle emission rates from the current EFT (version 11) for the year 2019, to represent the existing baseline and verification year, and 2025, to represent the year of IERRT project opening, the total NO_2 and NO_X concentrations predicted have been processed through National Highways

Long-Term Trends calculator (also known as GAP analysis) (Highways England, 2012).

13A.5.10 In addition to this, sensitivity scenarios have also been modelled that precautionarily assume that 2019 emission rates in the current EFT represent conditions in 2025, thereby representing no improvement in vehicle emissions between the assessment baseline year and the year of opening. The sensitivity test does not inform the determination of significance, nor the conclusion of the main assessment, but does provide a useful indicator as to the sensitivity of assessment with regards to vehicle emissions assumptions. The sensitivity analysis informs consideration of NO_X-related impacts and is reported within this appendix. It does not consider impact associated with PM_{10} or $PM_{2.5}$, because these pollutants are not subject to the same uncertainties with regards to projected future improvements.

Meteorological Data

13A.5.11 Dispersing modelling of road traffic emissions sources requires hourly sequential meteorological data from a measurement site that is representative of the modelled study area. The year of meteorological data should be consistent with the existing baseline year of traffic data and consistent with the existing baseline year of air quality monitoring data being used for model verification. For this assessment, that year is 2019, the last complete meteorological year where conditions were not being influenced by factors caused by the Covid-19 pandemic, which commenced in 2020.

13A.5.12 Due to the spatial extent of the air quality study area, with traffic impacts occurring close to the IERRT project and at Air Quality Management Areas (AQMAs) adjacent to the M18 and M1 in South Yorkshire, the M1 in Northern Derbyshire, and the M62 in West Yorkshire, one single meteorological data measurement site cannot be representative of all these locations. As such, the assessment has made use of 2019 meteorological data from the following four sites:

- Humberside Airport, approximately 6 km southwest of South Killingholme and c.10 km west-southwest of Queens Road, Immingham;
- Doncaster/Sheffield Airport, approximately 4 km east-southeast of Doncaster Council's M18 AQMA, approximately 22 km east-southeast and southeast of Rotherham Council's M1 AQMAs, approximately 27 km northeast of Bolsover Council's M1 AQMA at Barlborough (revoked 02/03/2022), approximately 5 km east of Potteric Carr SSSI and c.10 km east of Edlington Wood SSSI;
- Watnall (former RAF site), approximately 12 km north-northwest of Bolsover Council's M1 AQMA at South Normanton (revoked 02/03/2022); and
- Emley Moor, approximately 15 km south of the Kirklees Council M62 AQMA at Gomersal.

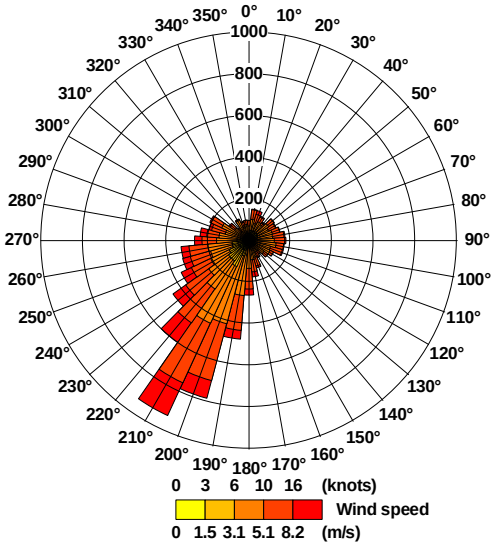
13A.5.13 Wind rose plots for the 2019 meteorological data for these sites are presented in Figure 13A.3, below.

13A.5.14 Surface roughness affects the dispersion of emissions across the study area and varies depending on the predominant land use. For example, an area with lots of open land will have a lower surface roughness that will encourage dispersion. An area with lots of buildings, such as a city, will have a high surface roughness that will constrain dispersion.

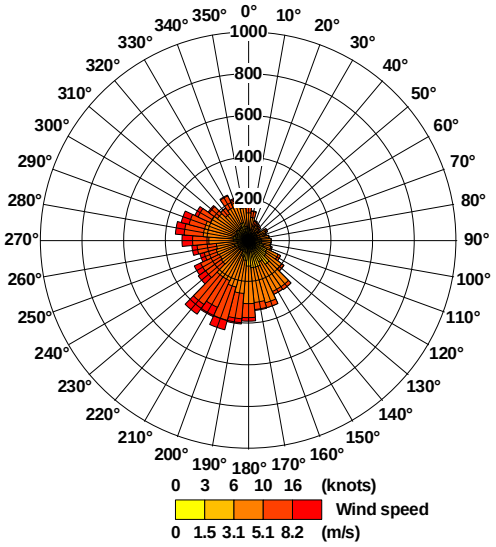
13A.5.15 The dispersion model requires the surface roughness to be defined at the meteorological site and the dispersion site (the modelled study area). The surface roughness at the meteorological sites ranges from 0.2 m to 0.5 m. These are lower-end surface roughness values commonly associated with airports and smaller airfields where the surrounding areas are dominated by concrete or grassland. The surface roughness at the dispersion sites varies from 0.5 m to 1 m. These values are typical of areas that are not overly urbanised, but still characterised by structures and trees that will have some influence on dispersion.

Figure 13A.3. 2019 Wind Rose Plots

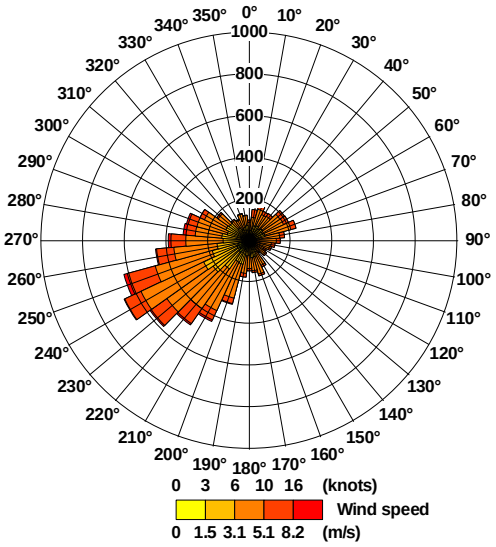
Humberside



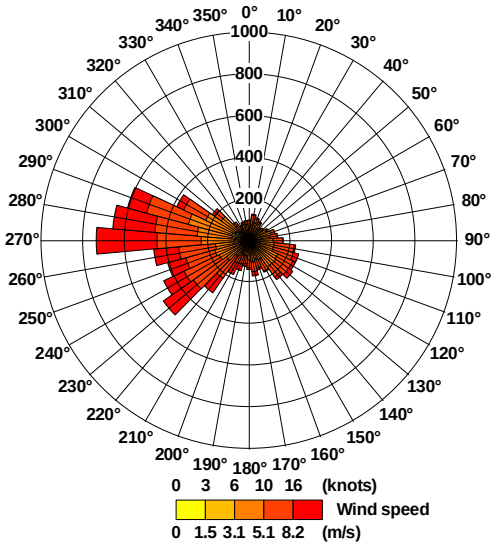
Doncaster



Watnall



Emley Moor



Air Quality Sensitive Receptors

13A.5.16 The impact of offsite road traffic emissions impacts has been predicted at a series of discrete receptors that represent locations of human exposure to the pollutants of concern adjacent to roads used by IERRT project traffic.

13A.5.17 Human health sensitive air quality receptors typically include residential dwellings, schools and medical facilities. In this instance, they represent residential dwellings located adjacent to local roads between the IERRT project and the A180, between the A180 and the M18, and locations on the M18, M1 and M62, where IERRT project traffic flows pass through or adjacent to an AQMA. These locations are listed in **Table 13A.19** and are

illustrated on Figure 13.1 (in Volume 2 of the ES). Discrete receptors have been selected from review of aerial photography and represent worst-case impacts that are considered to be representative of other sensitive receptors in their vicinity.

Table 13A.19. Road Traffic Emissions Assessment Receptors (Human Health)

Receptor ID	Grid Ref. (x,y)	Description
Immingham		
R1	520039,414794	Residential property on Queens Road, Immingham
R2	519983,414833	Residential property on Queens Road, Immingham
R3	519949,414860	Residential property on Queens Road, Immingham
South Killingholme		
R4	515278,416079	Residential property off A160 Humber Road, South Killingholme
R5	515201,416114	Residential property off A160 Humber Road, South Killingholme
R6	515082,414245	Residential property off A180, South Killingholme
R7	514919,416086	Residential property off A160 Humber Road, South Killingholme
R8	514820,416001	Residential property off A160 Humber Road, South Killingholme
A180 / M180 Corridor		
R9	514772,414025	Residential property off A180, South Killingholme
R10	501317,409312	Residential property off M180, Brigg
R11	500069,408416	Residential property off M180, Brigg
R12	498506,407235	Residential property off M180, Brigg
R13	496345,406366	Residential property off M180, Brigg
R14	495703,405334	Residential property off A15, Woodhouse
R15	493852,406558	Residential property off M180, Brigg
R16	489177,406075	Residential property off M180, Brigg
R17	475959,408917	Residential property off M180, Scunthorpe
R18	467604,411179	Residential property off M180, Scunthorpe
Doncaster Council – AQMA No.4		
R19	462671,400891	Residential property off M18, Doncaster (AQMA No.4)
R20	462523,400762	Residential property off M18, Doncaster (AQMA No.4)
R21	462318,400196	Residential property off M18, Doncaster (AQMA No.4)
R22	462292,400375	Residential property off M18, Doncaster (AQMA No.4)
Rotherham Council – Rotherham AQMA 1 – Part 3		
R23	447398,382926	Residential property off M1, Wales (Rotherham AQMA 1 - Part 3)
R24	447301,382889	Residential property off M1, Wales (Rotherham AQMA 1 - Part 3)
Bolsover Council – Barlborough AQMA No.2 (revoked 02/03/2022)		

Receptor ID	Grid Ref. (x,y)	Description
R25	447169,377218	Residential property off M1, Barlborough (AQMA No.2 revoked 02/03/2022)
Bolsover Council – South Normanton AQMA (revoked 02/03/2022)		
R26	445240,356539	Residential property off M1, South Normanton (AQMA revoked 02/03/2022)
Near to Wakefield Council – M1 AQMA		
R27	434130,425918	Residential property off M62, Lofthouse (near Wakefield City AQMA)
R28	433166,425859	Residential property off M62, Lofthouse (near Wakefield City AQMA)
Between Wakefield Council – M1 AQMA and Kirklees Council – AQMA No.4		
R29	427213,426127	Residential property off M62, Morley (between Wakefield City AQMA and Kirklees AQMA No.4)
R30	425591,426479	Residential property off M62, Morley (between Wakefield City AQMA and Kirklees AQMA No.4)
Kirklees Council – AQMA No.4		
R31	420521,427331	Residential property off M62, Gomersal (Kirklees AQMA No.4)
R32	420388,427384	Residential property off M62, Gomersal (Kirklees AQMA No.4)

13A.5.18 Nature conservation air quality receptors include habitats that are sensitive to nitrogen deposition and airborne concentrations of NO_X. In this instance, they represent all SSSI habitats located within 200m of roads screened into the assessment and LWS and Ancient Woodland designations adjacent to roads that experience the greatest traffic impact as a result of the IERRT project, focusing on sites adjacent to the A180m M180 and M18. These locations are listed in Table 13A.20, below, and are illustrated on Figure 13.1 (in Volume 2 of the ES). Discrete receptors have been selected to represent worst-case impacts that are considered to be representative of other sensitive receptors in their vicinity.

Table 13A.20. Road Traffic Emissions Assessment Receptors (Nature Conservation)

Receptor ID[1]	Grid Ref. (x,y)[2]	Description
Potteric Carr SSSI (adjacent to the M18 motorway)		
SSSI1	461150, 399528	Broadleaved deciduous woodland habitat adjacent to the M18, near to Bessacarr, Doncaster
SSSI2	459456, 399563	Broadleaved deciduous woodland habitat adjacent to the M18, near to Bessacarr, Doncaster
Edlington Wood SSSI (adjacent to the M18 motorway)		
SSSI3	455001, 397280	Meso- and eutrophic Quercus woodland habitat adjacent to the M18, near to Wadworth
Local Wildlife Sites (selected locations adjacent to the A180, M180 and M18)		
LWS2	506969, 411704	Grassland habitat adjacent to A180, near to Melton Ross

Receptor ID[1]	Grid Ref. (x,y)[2]	Description
LWS3	503046, 410458	Woodland habitat adjacent to the M180, near to Wrawby
LWS4	496597, 406375	Woodland habitat adjacent to the M180, near to Scawby
LWS5	496027, 406301	Woodland habitat adjacent to the M180, near to Scawby
LWS6	494780, 406446	Woodland habitat adjacent to the M180, near to Scawby
LWS7	470928, 409534	Grassland habitat adjacent to the M180, near to near to Stone Hill
LWS8	467002, 412896	Woodland habitat adjacent to the M18, near to Thorne
LWS9	466931, 412904	Woodland habitat adjacent to the M18, near to Thorne
LWS10	466753, 408789	Grassland habitat adjacent to the M18, near to Hatfield
LWS11	466694, 408709	Grassland habitat adjacent to the M18, near to Hatfield
LWS12	462803, 401179	Woodland habitat adjacent to the M18, near to Bessacarr, Doncaster
LWS13	462438, 400475	Woodland habitat adjacent to the M18, near to Bessacarr, Doncaster
LWS14	462408, 400483	Woodland habitat adjacent to the M18, near to Bessacarr, Doncaster
Ancient Woodland (selected locations adjacent to the M18 motorway)		
AW1	462496, 400537	Woodland habitat adjacent to the M18, near to Bessacarr, Doncaster
AW2	461829, 399816	Woodland habitat adjacent to the M18, near to Bessacarr, Doncaster
AW3	462396, 400523	Woodland habitat adjacent to the M18, near to Bessacarr, Doncaster

Notes:
[1] Each nature conservation receptor modelled as a series of points in a transect, which runs perpendicular to the nearest modelled road. The transects start at the nearest part of each habitat to the modelled road and run backwards up to 200 m from the modelled road, at 10m intervals.
[2] Coordinate provided is the nearest part of the receptor transect to the modelled road.

Background Pollutant Data

13A.5.19 Total pollutant concentrations reported for each scenario are the combined contributions from modelled sources and background sources. Background sources include emissions from roads that are not specifically modelled, and other emissions sources not modelled, such as those associated with industry, agriculture and domestic energy use.

13A.5.20 The background pollutant concentration data used to inform the assessment of offsite human health impacts associated with IERRT project traffic flow has been sourced from Defra background pollution maps. Last updated in 2020 with a base year of 2018, these maps provide background NO_2, PM_{10} and $PM_{2.5}$ concentrations at a 1 km^2 resolution across the UK, for all years up to 2030. The pollutant background data used to inform this assessment is summarised in **Table 13A.21**. Defra also provide a tool that allows particular background sources to be removed from the background concentrations, when those source form part of the modelled contribution, to avoid double counting. The values presented in **Table 13A.21** have had modelled sources removed.

Table 13A.21. Background Pollutant Concentration Data – Human Health Receptors

Receptor	1km² Grid Square[1]	2019			2025		
		NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
R1	520500,414500	15.5	14.4	8.6	13.5	13.4	7.8
R2	519500,414500	16.3	15.2	8.9	14.3	14.2	8.1
R3	519500,414500	16.3	15.2	8.9	14.3	14.2	8.1
R4	515500,416500	11.3	14.8	8.8	9.5	13.9	8.1
R5	515500,416500	11.3	14.8	8.8	9.5	13.9	8.1
R6	515500,414500	11.0	16.8	9.2	9.2	15.9	8.4
R7	514500,416500	10.9	15.9	8.8	9.1	14.9	8.1
R8	514500,416500	10.9	15.9	8.8	9.1	14.9	8.1
R9	514500,414500	10.7	17.2	9.4	8.9	16.2	8.6
R10	501500,409500	9.8	19.5	10.2	8.0	18.5	9.5
R11	500500,408500	10.2	18.5	10.0	8.3	17.5	9.2
R12	498500,407500	10.1	18.9	10.2	8.2	17.9	9.4
R13	496500,406500	9.7	17.7	9.8	7.7	16.7	9.0
R14	495500,405500	9.3	16.8	9.1	7.4	15.9	8.3
R15	493500,406500	8.8	17.0	9.5	7.2	16.1	8.8
R16	489500,406500	9.5	16.5	9.6	7.8	15.5	8.8
R17	475500,408500	10.0	18.9	11.5	8.4	17.9	10.7
R18	467500,411500	9.9	16.0	9.2	7.9	15.1	8.5
R19	462500,400500	11.6	14.5	8.9	9.0	13.7	8.2
R20	462500,400500	11.6	14.5	8.9	9.0	13.7	8.2
R21	462500,400500	11.6	14.5	8.9	9.0	13.7	8.2
R22	462500,400500	11.6	14.5	8.9	9.0	13.7	8.2
R23	447500,382500	11.6	14.1	8.4	9.2	13.3	7.8
R24	447500,382500	11.6	14.1	8.4	9.2	13.3	7.8
R25	447500,377500	11.6	14.7	8.6	9.0	13.9	8.0
R26	445500,356500	14.4	14.8	9.1	11.1	14.0	8.4
R27	434500,425500	13.6	15.3	8.9	10.5	14.5	8.3
R28	433500,425500	15.0	15.0	9.0	11.5	14.2	8.4
R29	427500,426500	18.4	15.7	9.8	14.3	14.9	9.2
R30	425500,426500	16.1	15.3	9.7	12.8	14.5	9.1
R31	420500,427500	16.3	14.0	9.3	12.7	13.2	8.7
R32	420500,427500	16.3	14.0	9.3	12.7	13.2	8.7
Notes:							

Receptor	1km² Grid Square[1]	2019			2025		
		NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
[1] Centre point of 1 km by 1 km grid square							

13A.5.21 For nature conservation impacts, background NO_X concentration data has been sourced from Defra's background pollutant concentration maps from background maps with a 2018 base year. Background nitrogen deposition rate data has been sourced from the Air Pollution Information System (APIS), from background maps with a 2018 base year. These are summarised in Table **13A.22**.

Table 13A.22. Background Pollutant Data – Nature Conservation Receptors

Receptor ID	Location[1]	2019		2025	
		NO_X Conc. (µg/m³)	Nitrogen Deposition Rate (kgN/ha/yr)	NO_X Conc. (µg/m³)	Nitrogen Deposition Rate (kgN/ha/yr)
Potteric Carr SSSI (adjacent to the M18 motorway)					
SSSI1	461500,399500	14.5	31.9	11.3	31.9
SSSI2	459500,399500	15.1	32.9	11.7	32.9
Edlington Wood SSSI (adjacent to the M18 motorway)					
SSSI3	455500,397500	14.8	32.9	11.3	32.9
Local Wildlife Sites (selected locations adjacent to the A180, M180 and M18)					
LWS2	506500,411500	12.9	23.0	10.3	23.0
LWS3	503500,410500	12.7	42.6	10.1	42.6
LWS4	496500,406500	12.7	51.7	10.0	51.7
LWS5	496500,406500	12.7	51.7	10.0	51.7
LWS6	494500,406500	11.8	37.9	9.3	37.9
LWS7	470500,409500	11.0	20.9	8.7	20.9
LWS8	467500,412500	14.7	34.2	11.5	34.2
LWS9	466500,412500	12.7	34.2	10.1	34.2
LWS10	466500,408500	13.0	18.9	10.1	18.9
LWS11	466500,408500	13.0	18.9	10.1	18.9
LWS12	462500,401500	15.4	31.2	11.8	31.2
LWS13	462500,400500	15.4	31.2	11.7	31.2
LWS14	462500,400500	15.4	31.2	11.7	31.2
Ancient Woodland (selected locations adjacent to the M18 motorway)					
AW1	462500,400500	15.4	31.2	11.7	31.2
AW2	461500,399500	14.5	31.9	11.3	31.9
AW3	462500,400500	15.4	31.2	11.7	31.2
Notes: [1] Centre point of 1 km by 1 km grid square in which the nearest part of the receptor transect to the modelled road is located.					

Dispersion Model Verification

13A.5.22 It is standard practice for the dispersion modelling of road traffic emissions to be verified against air quality monitoring data gathered within the study area. This process requires the comparison of predicted annual mean NO_2 concentrations against monitored annual mean NO_2 concentrations, with modelling informed by traffic data and meteorological data representative of the year in which the monitoring data was gathered. Where modelled NO_2 concentrations deviate from monitored concentrations by more than 25%, guidance published by Defra suggests that the model requires adjustment for model bias. The extent of this adjustment is determined by the comparison of the modelled and monitored road NO_X contributions.

13A.5.23 The verification process is summarised in **Table 13A.23** and **Table 13A.24**. Because of the spatial extent of the study area, the use of different meteorological sites and monitoring data obtained from multiple sources, verification has been split into zones that either reflect the area local to the site or the individual AQMAs considered.

Table 13A.23. Dispersion Model Verification (Unadjusted NO_2 Comparison)

Monitoring Location[1]	Modelled NO_2 Conc. ($\mu g/m^3$)	Monitored NO_2 Conc. ($\mu g/m^3$)	Model NO_2 Performance (%)		Road NO_X Bias-adjustment Factor?[4]
			Per Location[2]	Per Zone[3]	
Zone 1 – Local Roads (Queens Road, Immingham, A160 Humber Road, South Killingholme (Humberside Airport Meteorological Data)[5,6]					
North Lincolnshire_DT13	12.7	17.0	-25.4	-30.8	Yes
North Lincolnshire_DT14	16.5	29.0	-43.2		
North Lincolnshire_DT15	14.1	18.0	-21.7		
North Lincolnshire_DT16	15.3	25.0	-38.9		
IERRT_2	17.0	23.7	-28.0		
IERRT_4	13.5	18.8	-27.8		
Zone 2 – Strategic Road Network A180 and M180 (Humberside Airport Meteorological Data)[5,6]					
IERRT_8	16.3	14.4	13.0	+3.6	No
IERRT_9	14.4	15.3	-5.7		
Zone 3 – Strategic Road Network M18 and M1 at Rotherham and Bolsover (Doncaster Sheffield Airport Meteorological Data)					
Doncaster_DT13	32.6	38.0	-14.2	-17.7	Yes
Rotherham_Wales	35.2	39.0	-9.7		
Rotherham_RDT66	31.3	37.5	-16.5		
Rotherham_RDT67	17.9	23.5	-23.7		
Rotherham_RDT68	19.1	25.3	-24.5		
Zone 4 – Strategic Road Network M1 at Bolsover (Watnall Meteorological Station Data)					
Bolsover_27	34.9	39.6	-11.9	-7.8	No
Bolsover_6	26.1	30.2	-13.7		
Bolsover_8	22.1	24.4	-9.6		
Bolsover_10	23.6	25.7	-8.2		
Bolsover_15	33.8	32.6	3.7		
Bolsover_20	28.7	30.9	-7.0		
Zone 5 – Strategic Road Network M62 at Kirklees (Emley Moor Meteorological Station Site)					

Kirklees_K15,K16,K17	33.9	36.5	-7.0	+4.1	No
Kirklees_K62	29.8	26.4	+13.0		
Kirklees_K63	27.2	27.3	-0.4		
Kirklees_K66	27.5	24.8	+10.9		

Notes:

[1] Where monitoring locations have multiple IDs (e.g. Kirklees_K15,K16,K17), this is because multiple sampling devices have been used at the same monitoring location. The values provided are the average values of all data at that monitoring location.

[2] Model performance is calculated as [((modelled NO_2 - monitored NO_2) / monitored NO_2) x 100]. A negative value means that the model has underpredicted NO_2 concentrations. A positive value means that the model has overpredicted NO_2 concentrations

[3] Where modelled/monitored locations share similar characteristics (such as the meteorological conditions experienced at those locations, the type and nature of nearby roads, the location of monitoring/receptors relative to the predominant road emissions source (e.g. upwind or downwind), and the distance of monitoring/receptor locations to the predominant road emissions source), the approach to verification is to group such locations together.

[4] Guidance on model verification suggests that modelled NO_2 concentrations should be within 25% of monitored concentrations, and ideally within 10%. Where modelled concentrations are beyond 25% of monitored concentrations, an adjustment factor is required to account for the model bias. An adjustment factor is not necessarily required where modelled concentrations are less than 25% of monitored concentrations, but more than 10%. However, to do so can improve the robustness of the model.

[5] Monitoring locations with the prefix “IERRT” represent the data gathered during the project-specific NO_2 monitoring survey, undertaken to increase the coverage of data on road links close to the proposed IERRT project. Data was gathered over a 3-month period and annualised following the approach set out in LAQM TG(16) (Defra, 2021).

[6] It is noted that the project-specific survey included 10 monitoring locations, but only four are referred to in the verification exercise. This is because monitoring location IERRT_3 was vandalised on every month of the survey and no data is available for that location, IERRT_7 gathered extremely low NO_2 concentrations, which, when annualised, had an NO_2 no higher than the background concentration and too low a road contribution to inform verification, IERRT_1 and IERRT_5 performed very differently to all other monitoring locations in their localities and were therefore considered to be unrepresentative, and IERRT_10 was a colocation with the Immingham AURN monitoring station, which is located at a background location and therefore not suitable for verification.

13A.5.24 Where modelled NO_2 concentrations are within 10% of monitored concentrations, guidance suggests that adjustment for model bias is not necessarily required, as model performance is already acceptable. For completeness, a bias-adjustment factor has been calculated for all monitoring locations used to inform this verification exercise, even where model performance is already within acceptable limits.

Table 13A.24. Dispersion Model Verification (NO_X Comparison)

Monitoring Location	Modelled Road NO_X Conc. ($\mu g/m^3$)	Monitored Road NO_X Conc. ($\mu g/m^3$)	Model Road NO_X Performance (%)		Road NO_X Bias-adjustment Factor
			Per Location[1]	Per Group	
Zone 1 – Local Roads (Queens Road, Immingham, A160 Humber Road, South Killingholme (Humberside Airport Meteorological Data)					
North Lincolnshire_DT13	3.4	11.4	-70.5	-71	3.42
North Lincolnshire_DT14	10.4	35.3	-70.6		
North Lincolnshire_DT15	5.1	12.4	-59.1		
North Lincolnshire_DT16	7.2	26.1	-72.3		
IERRT_2	2.9	15.6	-81.6		
IERRT_4	4.0	13.8	-71.0		
Zone 2 – Strategic Road Network A180 and M180 (Humberside Airport Meteorological Data)					
IERRT_8	6.8	3.3	+104.8	+37	0.68[2]
IERRT_9	3.4	5.0	-32.4		
Zone 3 – Strategic Road Network M18 and M1 at Rotherham and Bolsover (Doncaster Sheffield Airport Meteorological Data)					
Doncaster_DT13	41.5	53.5	-22.4	-31	1.30
Rotherham_Wales	47.4	55.9	-15.2		
Rotherham_RDT66	38.8	52.5	-26.0		
Rotherham_RDT67	12.5	23.3	-46.6		
Rotherham_RDT68	15.1	27.4	-44.8		
Zone 4 – Strategic Road Network M1 at Bolsover (Watnall Meteorological Station Data)					
Bolsover_27	39.4	49.8	-21.0	-17	1.17
Bolsover_6	22.6	31.1	-27.3		
Bolsover_8	12.9	17.5	-26.2		
Bolsover_10	15.9	20.1	-20.7		
Bolsover_15	36.9	34.3	+7.4		
Bolsover_20	26.3	30.8	-14.6		
Zone 5 – Strategic Road Network M62 at Kirklees (Emley Moor Meteorological Station Site)					

Kirklees_K15,K16,K17	34.9	39.0	+10.6	+14	0.95[2]
Kirklees_K62	26.3	19.4	+36.1		
Kirklees_K63	22.3	22.6	-0.9		
Kirklees_K66	21.6	16.2	+33.3		

Notes:

[1] Model performance is calculated as…

[((modelled road NO_X - monitored road NO_X) / monitored road NO_X) x 100]. A negative value means that the model has underpredicted road NO_X concentrations. A positive value means that the model has overpredicted road NO_X concentrations.

[2] At locations where the model over-predicts an adjustment factor of 1.0 has been applied.

13A.5.25 The application of the calculated bias-adjustment factor should improve model performance at most if not all individual monitoring locations included within the verification exercise. It will certainly increase model performance on average across the study area (**Table 13A.25**).

Table 13A.25. Dispersion Model Verification (NO_X and NO_2 Performance Following Adjustment)

Monitoring Location	Road NO_X Contribution ($\mu g/m^3$)		Model Road NO_X Perform. Post- Adj. Factor (%)	NO_2 Concentration ($\mu g/m^3$)		Model NO_2 Perform. Post-Adj. Factor (%)
	Modelled	Monitored		Modelled	Monitored	
Zone 1 – Local Roads (Queens Road, Immingham, A160 Humber Road, South Killingholme (Humberside Airport Meteorological Data)						
North Lincolnshire_DT13	11.5	11.4	+0.9	17.1	17.0	+0.4
North Lincolnshire_DT14	35.5	35.3	+0.5	29.1	29.0	+0.3
North Lincolnshire_DT15	17.3	12.4	+39.7	20.6	18.0	+14.2
North Lincolnshire_DT16	24.7	26.1	-5.3	24.3	25.0	-2.8
IERRT_2	9.8	15.6	-37.0	20.7	23.7	-12.5
IERRT_4	13.7	13.8	-0.9	18.7	18.8	-0.3
Zone 2 – Strategic Road Network A180 and M180 (Humberside Airport Meteorological Data)						
IERRT_8	4.6	3.3	40.0	15.1	14.4	+5.0
IERRT_9	2.3	5.0	-53.8	13.9	15.3	-9.5
Zone 3 – Strategic Road Network M18 and M1 at Rotherham and Bolsover (Doncaster Sheffield Airport Meteorological Data)						
Doncaster_DT13	53.9	53.5	+0.7	38.2	38.0	+0.5
Rotherham_Wales	61.6	55.9	+10.1	41.4	39.0	+6.2
Rotherham_RDT66	50.5	52.5	-3.9	36.6	37.5	-2.4
Rotherham_RDT67	16.2	23.3	-30.6	19.9	23.5	-15.4
Rotherham_RDT68	19.6	27.4	-28.3	21.4	25.3	-15.3
Zone 4 – Strategic Road Network M1 at Bolsover (Watnall Meteorological Station Data)						
Bolsover_27	45.9	49.8	-7.8	37.9	39.6	-4.4
Bolsover_6	26.4	31.1	-15.3	27.9	30.2	-7.6
Bolsover_8	15.1	17.5	-14.0	23.2	24.4	-5.1
Bolsover_10	18.6	20.1	-7.5	24.9	25.7	-3.0
Bolsover_15	43.0	34.3	+25.3	36.6	32.6	+12.3

Bolsover_20	30.6	30.8	-0.4	30.8	30.9	-0.2
Zone 5 – Strategic Road Network M62 at Kirklees (Emley Moor Meteorological Station Site)						
Kirklees_K15,K16,K17	33.1	39.0	-15.3	32.6	37.8	-13.8
Kirklees_K62	24.9	19.4	+28.9	28.8	26.4	+9.1
Kirklees_K63	21.2	22.6	-6.2	26.3	27.3	-3.7
Kirklees_K66	20.4	16.2	+26.3	26.6	24.8	+7.4
Notes: [1] Model performance is calculated as… [((modelled road NO_X - monitored road NO_X) / monitored road NO_X) x 100] A negative value means that the model has underpredicted road NO_X concentrations. A positive value means that the model has overpredicted road NO_X concentrations.						

13A.5.26 Defra suggest a number of statistical tools that can be used to describe the performance of modelled predictions and the comparison against the monitoring data used for verification, with ideal results to indicate whether or not a model can be considered robust (**Table 13A.26**).

13A.5.27 Figure 13A.4, below illustrates the effectiveness of the model verification undertaken. Unadjusted model predictions included some locations that were beyond 25% of monitored concentrations. Adjusted model predictions are with 25% of monitored concentrations at all locations considered. Average performance is around 1% of monitored concentrations following adjustment.

Table 13A.26. Dispersion Model Verification (Statistics)

Monitoring Location	Pre-Bias Adjustment Factor			Post-Bias Adjustment Factor		
	Correlation Coefficient[1]	Root Mean Square Error[2]	Fractional Bias[3]	Correlation Coefficient[1]	Root Mean Square Error[2]	Fractional Bias[3]
Zone 1	0.9	7.7	+0.4	0.9	**1.6**	**0.0**
Zone 2	**1.0**	**1.5**	**0.0**	**1.0**	**1.1**	**0.0**
Zone 3	**1.0**	5.5	+0.2	**1.0**	**2.6**	**0.0**
Zone 4	0.9	**3.0**	+0.1	0.9	**2.1**	**0.0**
Zone 5	0.9	**2.5**	**0.0**	0.9	**2.5**	**0.0**
Overall (Model-wide)	0.9	5.1	+0.1	**1.0**	**2.1**	**0.0**

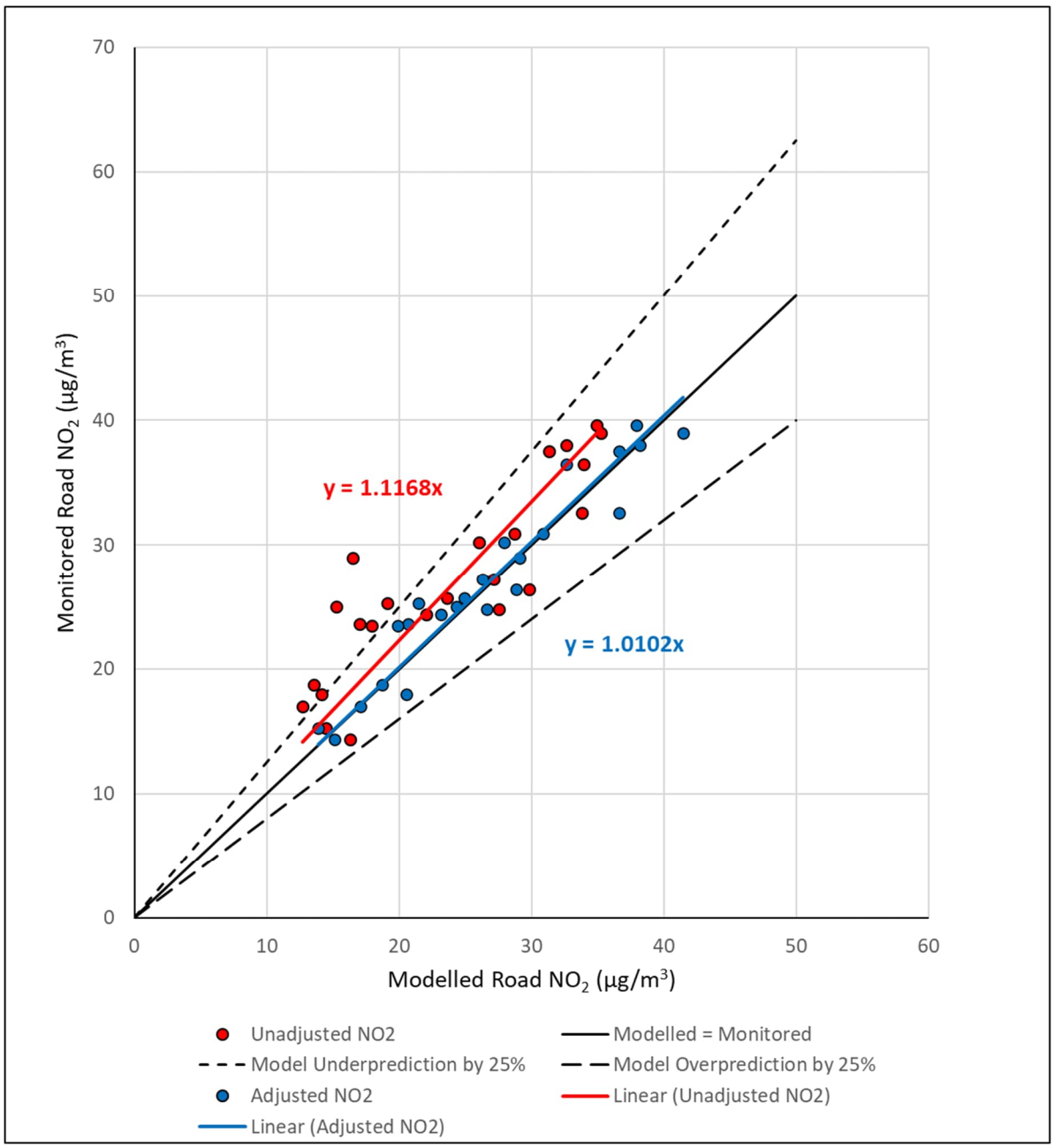
Notes:

[1] It is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship (shown in **bold**). This statistic can be particularly useful when comparing a large number of model and observed data points (overall model-wide performance).

[2] RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared (NO_2 as $\mu g/m^3$) and the perfect value is zero, but <4 $\mu g/m^3$ is considered ideal (shown in **bold**).

[3] It is used to identify if the model shows a systematic tendency to over or under predict. Fractional Bias values vary between +2 and -2 and have an ideal value of zero (shown in **bold**). Negative values suggest a model over-prediction and positive values suggest a model under-prediction.

Figure 13A.4. Dispersion Model Performace (Unadjusted and Adjusted)



13A.6 Full Nature Conservation Results

13A.6.1 Within the air quality chapter of the ES, air quality statistics reported at roadside nature conservation receptors are those predicted at the single point of the nature conservation receptor that is closest to the nearest modelled road.

13A.6.2 To gauge how pollutant concentrations decrease across a roadside nature conservation site with increasing distance from the modelled road source, a transect of points have been modelled at each receptor. The full nature

conservation results across at nature conservation site transects close to modelled roads are provide in **Table 13A.27.**

Table 13A.27. Predicted operational pollutant statistics (nature conservation senstive receptors)

Receptor ID[1]	Annual Mean NO_X ($\mu g/m^3$)		Nitrogen Deposition Rate (kg N/ha/yr)	
	Concentration	Change	Deposition Rate	Change
SSSI1_65.25m	27.8	<+0.1	**34.8**	+0.01
SSSI1_70m	27.1	<+0.1	**34.7**	+0.01
SSSI1_80m	25.7	<+0.1	**34.5**	+0.01
SSSI1_90m	24.6	<+0.1	**34.3**	<+0.01
SSSI1_100m	23.6	<+0.1	**34.1**	<+0.01
SSSI1_110m	22.8	<+0.1	**34.0**	<+0.01
SSSI1_120m	22.1	<+0.1	**33.9**	<+0.01
SSSI1_130m	21.4	<+0.1	**33.8**	<+0.01
SSSI1_140m	20.9	<+0.1	**33.7**	<+0.01
SSSI1_150m	20.4	<+0.1	**33.6**	<+0.01
SSSI1_160m	20.0	<+0.1	**33.6**	<+0.01
SSSI1_170m	19.6	<+0.1	**33.5**	<+0.01
SSSI1_180m	19.2	<+0.1	**33.4**	<+0.01
SSSI1_190m	18.9	<+0.1	**33.4**	<+0.01
SSSI1_200m	18.6	<+0.1	**33.3**	<+0.01
SSSI2_100.25m	23.9	<+0.1	**35.1**	+0.01
SSSI2_110m	23.1	<+0.1	**35.0**	<+0.01
SSSI2_120m	22.4	<+0.1	**34.9**	<+0.01
SSSI2_130m	21.7	<+0.1	**34.8**	<+0.01
SSSI2_140m	21.2	<+0.1	**34.7**	<+0.01
SSSI2_150m	20.6	<+0.1	**34.6**	<+0.01
SSSI2_160m	20.2	<+0.1	**34.5**	<+0.01
SSSI2_170m	19.8	<+0.1	**34.4**	<+0.01
SSSI2_180m	19.4	<+0.1	**34.4**	<+0.01
SSSI2_190m	19.1	<+0.1	**34.3**	<+0.01
SSSI2_200m	18.8	<+0.1	**34.3**	<+0.01
SSSI3_30.25m	**49.5**	<+0.1	**39.0**	+0.01
SSSI3_40m	**44.7**	<+0.1	**38.3**	+0.01
SSSI3_50m	**40.8**	<+0.1	**37.7**	+0.01
SSSI3_60m	**37.9**	<+0.1	**37.3**	+0.01
SSSI3_70m	**35.6**	<+0.1	**36.9**	<+0.01
SSSI3_80m	**33.8**	<+0.1	**36.7**	<+0.01
SSSI3_90m	**32.2**	<+0.1	**36.4**	<+0.01
SSSI3_100m	**30.8**	<+0.1	**36.2**	<+0.01
SSSI3_110m	29.7	<+0.1	**36.0**	<+0.01
SSSI3_120m	28.6	<+0.1	**35.9**	<+0.01
SSSI3_130m	27.7	<+0.1	**35.7**	<+0.01
SSSI3_140m	26.9	<+0.1	**35.6**	<+0.01
SSSI3_150m	26.2	<+0.1	**35.5**	<+0.01

SSSI3_160m	25.5	<+0.1	**35.4**	<+0.01
SSSI3_170m	24.9	<+0.1	**35.3**	<+0.01
SSSI3_180m	24.4	<+0.1	**35.2**	<+0.01
SSSI3_190m	23.9	<+0.1	**35.1**	<+0.01
SSSI3_200m	23.4	<+0.1	**35.0**	<+0.01
LWS2_19.35m	21.0	+0.2	**23.9**	+0.01
LWS2_20m	20.8	+0.1	**23.9**	+0.01
LWS2_30m	18.4	+0.1	**23.7**	+0.01
LWS2_40m	17.0	+0.1	**23.6**	+0.01
LWS2_50m	15.9	+0.1	**23.5**	+0.01
LWS2_60m	15.2	+0.1	**23.4**	+0.01
LWS2_70m	14.6	+0.1	**23.4**	+0.01
LWS2_80m	14.1	+0.1	**23.3**	<+0.01
LWS2_90m	13.7	+0.1	**23.3**	<+0.01
LWS2_100m	13.4	+0.1	**23.3**	<+0.01
LWS2_110m	13.1	<+0.1	**23.3**	<+0.01
LWS2_120m	12.9	<+0.1	**23.2**	<+0.01
LWS2_130m	12.7	<+0.1	**23.2**	<+0.01
LWS2_140m	12.4	<+0.1	**23.2**	<+0.01
LWS2_150m	12.3	<+0.1	**23.2**	<+0.01
LWS2_160m	12.1	<+0.1	**23.2**	<+0.01
LWS2_170m	12.0	<+0.1	**23.2**	<+0.01
LWS2_180m	11.9	<+0.1	**23.2**	<+0.01
LWS2_190m	11.8	<+0.1	**23.2**	<+0.01
LWS2_200m	11.7	<+0.1	**23.1**	<+0.01
LWS3_21.75m	24.1	+0.2	**45.0**	+0.03
LWS3_30m	22.0	+0.2	**44.7**	+0.03
LWS3_40m	20.3	+0.1	**44.4**	+0.03
LWS3_50m	19.1	+0.1	**44.2**	+0.02
LWS3_60m	18.1	+0.1	**44.1**	+0.02
LWS3_70m	17.4	+0.1	**43.9**	+0.02
LWS3_80m	16.8	+0.1	**43.8**	+0.01
LWS3_90m	16.3	+0.1	**43.7**	+0.02
LWS3_100m	15.8	+0.1	**43.7**	+0.01
LWS3_110m	15.5	+0.1	**43.6**	+0.01
LWS3_120m	15.2	+0.1	**43.6**	+0.01
LWS3_130m	14.9	+0.1	**43.5**	+0.01
LWS3_140m	14.6	+0.1	**43.5**	+0.01
LWS3_150m	14.4	+0.1	**43.4**	+0.01
LWS3_160m	14.2	+0.1	**43.4**	+0.01
LWS3_170m	14.0	+0.1	**43.4**	+0.01
LWS3_180m	13.8	+0.1	**43.3**	+0.01
LWS3_190m	13.7	+0.1	**43.3**	+0.01
LWS3_200m	13.5	+0.1	**43.3**	+0.01
LWS4_13.2m	22.6	+0.2	**53.9**	+0.03
LWS4_20m	20.3	+0.1	**53.6**	+0.02
LWS4_30m	18.2	+0.1	**53.2**	+0.02
LWS4_40m	16.9	+0.1	**53.0**	+0.02

LWS4_50m	16.0	+0.1	**52.8**	+0.02
LWS4_60m	15.3	+0.1	**52.7**	+0.01
LWS4_70m	14.7	+0.1	**52.6**	+0.01
LWS4_80m	14.3	+0.1	**52.5**	+0.01
LWS4_90m	13.9	+0.1	**52.5**	+0.01
LWS4_100m	13.6	+0.1	**52.4**	+0.01
LWS4_110m	13.3	+0.1	**52.4**	+0.01
LWS4_120m	13.1	<+0.1	**52.4**	+0.01
LWS4_130m	12.9	<+0.1	**52.3**	+0.01
LWS4_140m	12.7	<+0.1	**52.3**	+0.01
LWS4_150m	12.6	<+0.1	**52.3**	+0.01
LWS4_160m	12.4	<+0.1	**52.2**	+0.01
LWS4_170m	12.3	<+0.1	**52.2**	<+0.01
LWS4_180m	12.2	<+0.1	**52.2**	<+0.01
LWS4_190m	12.1	<+0.1	**52.2**	<+0.01
LWS5_16.5m	27.2	+0.2	**54.7**	+0.04
LWS5_20m	25.6	+0.2	**54.4**	+0.03
LWS5_30m	22.4	+0.2	**53.9**	+0.02
LWS5_40m	20.4	+0.1	**53.6**	+0.02
LWS5_50m	19.1	+0.1	**53.3**	+0.02
LWS5_60m	18.1	+0.1	**53.2**	+0.02
LWS5_70m	17.3	+0.1	**53.1**	+0.02
LWS5_80m	16.7	+0.1	**53.0**	+0.01
LWS5_90m	16.2	+0.1	**52.9**	+0.02
LWS5_100m	15.7	+0.1	**52.8**	+0.01
LWS5_110m	15.4	+0.1	**52.7**	+0.01
LWS5_120m	15.0	+0.1	**52.7**	+0.01
LWS5_130m	14.8	+0.1	**52.6**	+0.01
LWS5_140m	14.5	+0.1	**52.6**	+0.01
LWS5_150m	14.3	+0.1	**52.6**	+0.01
LWS5_160m	14.1	+0.1	**52.5**	+0.01
LWS5_170m	13.9	+0.1	**52.5**	+0.01
LWS5_180m	13.7	+0.1	**52.5**	+0.01
LWS5_190m	13.6	+0.1	**52.4**	+0.01
LWS5_200m	13.4	+0.1	**52.4**	+0.01
LWS6_11m	19.5	+0.1	**39.8**	+0.02
LWS6_20m	16.9	+0.1	**39.4**	+0.02
LWS6_30m	15.4	+0.1	**39.1**	+0.01
LWS6_40m	14.4	+0.1	**39.0**	+0.01
LWS6_50m	13.8	+0.1	**38.8**	+0.01
LWS6_60m	13.3	+0.1	**38.8**	+0.01
LWS6_70m	12.9	<+0.1	**38.7**	+0.01
LWS6_80m	12.6	+0.1	**38.6**	+0.01
LWS6_90m	12.3	<+0.1	**38.6**	+0.01
LWS6_100m	12.1	<+0.1	**38.6**	+0.01
LWS6_110m	11.9	<+0.1	**38.5**	+0.01
LWS6_120m	11.8	<+0.1	**38.5**	+0.01
LWS6_130m	11.6	<+0.1	**38.5**	+0.01

LWS6_140m	11.5	<+0.1	**38.5**	<+0.01
LWS6_150m	11.4	<+0.1	**38.4**	<+0.01
LWS6_160m	11.3	<+0.1	**38.4**	<+0.01
LWS6_170m	11.2	<+0.1	**38.4**	<+0.01
LWS6_180m	11.1	<+0.1	**38.4**	<+0.01
LWS6_190m	11.1	<+0.1	**38.4**	<+0.01
LWS7_5m	**34.4**	+0.3	**22.9**	+0.02
LWS7_10m	25.6	+0.2	**22.3**	+0.01
LWS7_20m	21.8	+0.1	**22.0**	+0.01
LWS7_30m	19.6	+0.1	**21.8**	+0.01
LWS7_40m	18.1	+0.1	**21.7**	+0.01
LWS7_50m	16.9	+0.1	**21.6**	+0.01
LWS8_30m	28.6	<+0.1	**37.1**	<+0.01
LWS8_22.5m	31.1	<+0.1	**37.5**	<+0.01
LWS8_40m	26.1	<+0.1	**36.8**	<+0.01
LWS8_50m	24.3	<+0.1	**36.5**	<+0.01
LWS8_60m	22.8	<+0.1	**36.2**	<+0.01
LWS8_70m	21.7	<+0.1	**36.0**	<+0.01
LWS8_80m	20.7	<+0.1	**35.9**	<+0.01
LWS8_90m	19.9	<+0.1	**35.8**	<+0.01
LWS8_100m	19.2	<+0.1	**35.6**	<+0.01
LWS8_110m	18.6	<+0.1	**35.5**	<+0.01
LWS8_120m	18.1	<+0.1	**35.5**	<+0.01
LWS8_130m	17.6	<+0.1	**35.4**	<+0.01
LWS8_140m	17.2	<+0.1	**35.3**	<+0.01
LWS8_150m	16.9	<+0.1	**35.2**	<+0.01
LWS8_160m	16.5	<+0.1	**35.2**	<+0.01
LWS8_170m	16.2	<+0.1	**35.1**	<+0.01
LWS8_180m	16.0	<+0.1	**35.1**	<+0.01
LWS8_190m	15.7	<+0.1	**35.1**	<+0.01
LWS8_200m	15.5	<+0.1	**35.0**	<+0.01
LWS9_12.75m	42.1	<+0.1	**39.4**	<+0.01
LWS9_20m	35.5	<+0.1	**38.4**	<+0.01
LWS9_30m	30.2	<+0.1	**37.6**	<+0.01
LWS9_40m	26.8	<+0.1	**37.1**	<+0.01
LWS9_50m	24.4	<+0.1	**36.7**	<+0.01
LWS9_60m	22.7	<+0.1	**36.4**	<+0.01
LWS9_70m	21.3	<+0.1	**36.2**	<+0.01
LWS9_80m	20.2	<+0.1	**36.0**	<+0.01
LWS9_90m	19.2	<+0.1	**35.8**	<+0.01
LWS9_100m	18.4	<+0.1	**35.7**	<+0.01
LWS9_110m	17.7	<+0.1	**35.6**	<+0.01
LWS9_120m	17.1	<+0.1	**35.5**	<+0.01
LWS9_130m	16.6	<+0.1	**35.4**	<+0.01
LWS9_140m	16.1	<+0.1	**35.3**	<+0.01
LWS9_150m	15.7	<+0.1	**35.3**	<+0.01
LWS9_160m	15.3	<+0.1	**35.2**	<+0.01
LWS9_170m	15.0	<+0.1	**35.1**	<+0.01

LWS9_180m	14.7	<+0.1	**35.1**	<+0.01
LWS9_190m	14.4	<+0.1	**35.0**	<+0.01
LWS9_200m	14.1	<+0.1	**35.0**	<+0.01
LWS10_4.25m	**62.5**	**+0.3**	**22.8**	<+0.01
LWS10_10m	**50.0**	+0.2	**22.0**	<+0.01
LWS10_20m	**39.3**	+0.2	**21.2**	<+0.01
LWS10_30m	**33.4**	+0.1	**20.8**	<+0.01
LWS10_40m	29.6	+0.1	**20.5**	<+0.01
LWS10_50m	26.9	+0.1	**20.3**	<+0.01
LWS10_60m	24.9	+0.1	**20.2**	<+0.01
LWS10_70m	23.2	+0.1	**20.0**	<+0.01
LWS10_80m	21.9	+0.1	**19.9**	<+0.01
LWS10_90m	20.8	+0.1	**19.9**	<+0.01
LWS10_100m	19.9	+0.1	**19.8**	<+0.01
LWS10_110m	19.1	+0.1	**19.7**	<+0.01
LWS10_120m	18.4	<+0.1	**19.7**	<+0.01
LWS10_130m	17.8	<+0.1	**19.6**	<+0.01
LWS10_140m	17.3	<+0.1	**19.6**	<+0.01
LWS10_150m	16.8	<+0.1	**19.5**	<+0.01
LWS10_160m	16.4	<+0.1	**19.5**	<+0.01
LWS10_170m	16.0	<+0.1	**19.5**	<+0.01
LWS10_180m	15.6	<+0.1	**19.4**	<+0.01
LWS10_190m	15.3	<+0.1	**19.4**	<+0.01
LWS10_200m	15.0	<+0.1	**19.4**	<+0.01
LWS11_4.25m	**69.4**	**+0.4**	**23.2**	<+0.01
LWS11_10m	**54.2**	+0.3	**22.3**	<+0.01
LWS11_20m	**41.9**	+0.2	**21.4**	<+0.01
LWS11_30m	**35.5**	+0.2	**21.0**	<+0.01
LWS11_40m	**31.4**	+0.1	**20.7**	<+0.01
LWS11_50m	28.5	+0.1	**20.5**	<+0.01
LWS11_60m	26.3	+0.1	**20.3**	<+0.01
LWS11_70m	24.5	+0.1	**20.1**	<+0.01
LWS11_80m	23.1	+0.1	**20.0**	<+0.01
LWS11_90m	21.9	+0.1	**19.9**	<+0.01
LWS11_100m	20.9	+0.1	**19.9**	<+0.01
LWS11_110m	20.0	+0.1	**19.8**	<+0.01
LWS11_120m	19.2	+0.1	**19.7**	<+0.01
LWS11_130m	18.5	+0.1	**19.7**	<+0.01
LWS11_140m	17.9	<+0.1	**19.6**	<+0.01
LWS11_150m	17.3	<+0.1	**19.6**	<+0.01
LWS11_160m	16.8	<+0.1	**19.5**	<+0.01
LWS11_170m	16.4	<+0.1	**19.5**	<+0.01
LWS11_180m	16.0	<+0.1	**19.5**	<+0.01
LWS11_190m	15.6	<+0.1	**19.4**	<+0.01
LWS11_200m	15.3	<+0.1	**19.4**	<+0.01
LWS12_6.5m	**49.6**	+0.1	**37.3**	+0.01
LWS12_10m	**45.0**	+0.1	**36.7**	+0.01
LWS12_20m	**37.1**	+0.1	**35.5**	+0.01

LWS12_30m	**32.6**	+0.1	**34.8**	+0.01
LWS12_40m	29.6	+0.1	**34.3**	+0.01
LWS12_50m	27.4	<+0.1	**34.0**	+0.01
LWS12_60m	25.8	<+0.1	**33.7**	+0.01
LWS12_70m	24.4	<+0.1	**33.5**	+0.01
LWS12_80m	23.4	<+0.1	**33.3**	<+0.01
LWS12_90m	22.5	<+0.1	**33.2**	<+0.01
LWS12_100m	21.7	<+0.1	**33.1**	+0.01
LWS12_110m	21.0	<+0.1	**33.0**	<+0.01
LWS12_120m	20.4	<+0.1	**32.9**	<+0.01
LWS12_130m	19.9	<+0.1	**32.8**	<+0.01
LWS12_140m	19.5	<+0.1	**32.7**	<+0.01
LWS12_150m	19.1	<+0.1	**32.6**	<+0.01
LWS12_160m	18.7	<+0.1	**32.6**	<+0.01
LWS12_170m	18.4	<+0.1	**32.5**	<+0.01
LWS12_180m	18.1	<+0.1	**32.5**	<+0.01
LWS12_190m	17.9	<+0.1	**32.4**	<+0.01
LWS12_200m	17.6	<+0.1	**32.4**	<+0.01
LWS13_3m	**56.5**	+0.1	**38.3**	+0.01
LWS13_10m	**45.5**	+0.1	**36.7**	+0.01
LWS13_20m	**37.6**	+0.1	**35.6**	+0.01
LWS13_30m	**33.1**	+0.1	**34.9**	+0.01
LWS13_40m	**30.1**	<+0.1	**34.4**	+0.01
LWS13_50m	28.0	<+0.1	**34.1**	+0.01
LWS13_60m	26.3	<+0.1	**33.8**	+0.01
LWS13_70m	25.0	<+0.1	**33.6**	+0.01
LWS13_80m	23.9	<+0.1	**33.4**	<+0.01
LWS13_90m	23.0	<+0.1	**33.3**	<+0.01
LWS13_100m	22.2	<+0.1	**33.2**	<+0.01
LWS13_110m	21.6	<+0.1	**33.1**	<+0.01
LWS13_120m	21.0	<+0.1	**33.0**	<+0.01
LWS13_130m	20.5	<+0.1	**32.9**	<+0.01
LWS13_140m	20.1	<+0.1	**32.8**	<+0.01
LWS13_150m	19.7	<+0.1	**32.8**	<+0.01
LWS13_160m	19.3	<+0.1	**32.7**	<+0.01
LWS13_170m	19.0	<+0.1	**32.6**	<+0.01
LWS13_180m	18.7	<+0.1	**32.6**	<+0.01
LWS13_190m	18.4	<+0.1	**32.5**	<+0.01
LWS13_200m	18.2	<+0.1	**32.5**	<+0.01
LWS14_2.5m	**62.7**	+0.1	**39.1**	+0.01
LWS14_10m	**49.2**	+0.1	**37.3**	+0.01
LWS14_20m	**40.6**	+0.1	**36.0**	+0.01
LWS14_30m	**35.8**	+0.1	**35.3**	+0.01
LWS14_40m	**32.6**	+0.1	**34.8**	+0.01
LWS14_50m	**30.3**	+0.1	**34.5**	+0.01
LWS14_60m	28.5	<+0.1	**34.2**	+0.01
LWS14_70m	27.1	<+0.1	**34.0**	<+0.01
LWS14_80m	25.9	<+0.1	**33.8**	<+0.01

LWS14_90m	24.9	<+0.1	**33.6**	<+0.01
LWS14_100m	24.0	<+0.1	**33.5**	<+0.01
LWS14_110m	23.3	<+0.1	**33.3**	<+0.01
LWS14_120m	22.6	<+0.1	**33.2**	<+0.01
LWS14_130m	22.0	<+0.1	**33.1**	<+0.01
LWS14_140m	21.5	<+0.1	**33.1**	<+0.01
LWS14_150m	21.1	<+0.1	**33.0**	<+0.01
LWS14_160m	20.7	<+0.1	**32.9**	<+0.01
LWS14_170m	20.3	<+0.1	**32.9**	<+0.01
LWS14_180m	20.0	<+0.1	**32.8**	<+0.01
LWS14_190m	19.7	<+0.1	**32.8**	<+0.01
LWS14_200m	19.4	<+0.1	**32.7**	<+0.01
AW1_29.75m	**34.3**	+0.1	**35.1**	+0.01
AW1_30m	**34.3**	+0.1	**35.1**	+0.01
AW1_40m	**31.0**	+0.1	**34.6**	+0.01
AW1_50m	28.6	<+0.1	**34.2**	+0.01
AW1_60m	26.9	<+0.1	**33.9**	+0.01
AW1_70m	25.5	<+0.1	**33.7**	<+0.01
AW1_80m	24.3	<+0.1	**33.5**	<+0.01
AW1_90m	23.4	<+0.1	**33.4**	<+0.01
AW1_100m	22.5	<+0.1	**33.2**	<+0.01
AW1_110m	21.8	<+0.1	**33.1**	<+0.01
AW1_120m	21.2	<+0.1	**33.0**	<+0.01
AW1_130m	20.7	<+0.1	**32.9**	<+0.01
AW1_140m	20.2	<+0.1	**32.8**	<+0.01
AW1_150m	19.8	<+0.1	**32.8**	<+0.01
AW1_160m	19.4	<+0.1	**32.7**	<+0.01
AW1_170m	19.1	<+0.1	**32.7**	<+0.01
AW1_180m	18.7	<+0.1	**32.6**	<+0.01
AW1_190m	18.5	<+0.1	**32.6**	<+0.01
AW1_200m	18.2	<+0.1	**32.5**	<+0.01
AW2_18.25m	**43.1**	+0.1	**37.1**	+0.01
AW2_20m	**41.7**	+0.1	**36.9**	+0.01
AW2_30m	**36.2**	+0.1	**36.1**	+0.01
AW2_40m	**32.6**	+0.1	**35.6**	+0.01
AW2_50m	**30.0**	+0.1	**35.2**	+0.01
AW2_60m	28.1	<+0.1	**34.9**	+0.01
AW2_70m	26.6	<+0.1	**34.6**	+0.01
AW2_80m	25.3	<+0.1	**34.4**	<+0.01
AW2_90m	24.2	<+0.1	**34.2**	<+0.01
AW2_100m	23.3	<+0.1	**34.1**	<+0.01
AW2_110m	22.5	<+0.1	**34.0**	<+0.01
AW2_120m	21.9	<+0.1	**33.9**	<+0.01
AW2_130m	21.3	<+0.1	**33.8**	<+0.01
AW2_140m	20.7	<+0.1	**33.7**	<+0.01
AW2_150m	20.3	<+0.1	**33.6**	<+0.01
AW2_160m	19.8	<+0.1	**33.5**	<+0.01
AW2_170m	19.5	<+0.1	**33.5**	<+0.01

AW2_180m	19.1	<+0.1	**33.4**	<+0.01
AW2_190m	18.8	<+0.1	**33.4**	<+0.01
AW2_200m	18.5	<+0.1	**33.3**	<+0.01
AW3_29.5m	**35.2**	+0.1	**35.2**	+0.01
AW3_30m	**35.0**	+0.1	**35.2**	+0.01
AW3_40m	**32.0**	+0.1	**34.7**	+0.01
AW3_50m	29.8	<+0.1	**34.4**	+0.01
AW3_60m	28.1	<+0.1	**34.1**	+0.01
AW3_70m	26.7	<+0.1	**33.9**	+0.01
AW3_80m	25.6	<+0.1	**33.7**	+0.01
AW3_90m	24.6	<+0.1	**33.6**	<+0.01
AW3_100m	23.8	<+0.1	**33.4**	<+0.01
AW3_110m	23.0	<+0.1	**33.3**	<+0.01
AW3_120m	22.4	<+0.1	**33.2**	<+0.01
AW3_130m	21.8	<+0.1	**33.1**	<+0.01
AW3_140m	21.3	<+0.1	**33.0**	<+0.01
AW3_150m	20.9	<+0.1	**33.0**	<+0.01
AW3_160m	20.5	<+0.1	**32.9**	<+0.01
AW3_170m	20.1	<+0.1	**32.8**	<+0.01
AW3_180m	19.8	<+0.1	**32.8**	<+0.01
AW3_190m	19.5	<+0.1	**32.7**	<+0.01
AW3_200m	19.2	<+0.1	**32.7**	<+0.01
Air Quality Standard	**30**		**10 – 20**[2,3] **15 – 20**[4]	

Notes:
[1] **Bold** values denote and exceedance of the relevant air quality objective and/or Critical Load.
[2] Broadleaved deciduous woodland. [3] Acid grassland. [4] Meso- and eutrophic Quercus woodland.

13A.7 Sensitivity Test

Introduction

13A.7.1 A sensitivity test has been undertaken on the assessment of operational phase offsite road traffic emissions impacts. The test follows the same approach described for the main assessment reported, but with a change in the assumption on future year vehicle emission rates for NO_X. Whilst the main assessment utilises the National Highways GAP analysis tool to precautionarily offset some of the anticipated improvement in future year vehicle emission rates, this sensitivity test goes further, by freezing emission rates at the baseline year 2019. This means that for the sensitivity test, it is assumed that that there is no evolution of the vehicle fleet and associated improvement in emissions between 2019 and 2025.

Sensitivity Test Results

13A.7.2 Predicted future baseline and future operational annual mean NO_2 results at the human health sensitive receptors are presented in **Table 13A.28**, along with the change in concentrations at each receptor considered.

Table 13A.28. Predicted operational pollutant statistics (human health senstive receptors) – sensitivty analysis

Receptor	Future Baseline NO_2 Conc. (µg/m^3)	Future Operational NO_2 Conc. (µg/m^3)	Change in NO_2 Conc.(µg/m^3)
R1	19.8	24.9	+5.0
R2	20.6	25.5	+4.9
R3	21.1	26.5	+5.4
R4	28.5	28.8	+0.4
R5	31.3	31.7	+0.4
R6	14.9	15.2	+0.3
R7	19.2	19.4	+0.2
R8	28.0	28.3	+0.3
R9	10.6	10.6	+0.1
R10	12.8	13.0	+0.2
R11	13.9	14.1	+0.2
R12	13.8	14.0	+0.2
R13	16.2	16.5	+0.3
R14	18.6	19.1	+0.6
R15	10.4	10.6	+0.1
R16	12.8	13.0	+0.2
R17	15.3	15.5	+0.2
R18	13.7	13.9	+0.2
R19	24.5	24.6	+0.1
R20	24.2	24.3	+0.1
R21	22.4	22.5	+0.1
R22	21.6	21.6	+0.1
R23	37.2	37.2	+0.1
R24	31.9	31.9	+0.1

R25	29.7	29.8	<+0.1
R26	36.9	36.9	<+0.1
R27	19.3	19.3	<+0.1
R28	19.9	20.0	<+0.1
R29	27.5	27.5	<+0.1
R30	30.1	30.1	<+0.1
R31	32.8	32.8	<+0.1
R32	30.5	30.5	<+0.1

13A.7.3 At receptors on Queens Road in Immingham (R1 to R3), the magnitude of change in annual mean NO_2 concentrations is larger (greater than 10% of the air quality objective). A change of this magnitude where annual mean concentrations with the IERRT project in operation are less than 75% of the air quality objective, equates to a moderate adverse impact.

13A.7.4 Elsewhere, the magnitude of change ranges from imperceptible to small, causing a negligible impact, including all locations within the AQMAs considered.

13A.7.5 The results of the sensitivity test are not used to determine the significance of effects that are reported in Chapter 13 of the ES. However, it should be noted that for air quality, a moderate adverse impact does not necessarily equate to a significant effect, particularly when such an impact occurs where total concentrations are so far below the air quality objective value, and a relatively low number of properties are affected to that extent.

13A.7.6 Predicted future baseline and future operational annual mean NO_X and nitrogen deposition results at the nature conservation sensitive receptors are presented in Table 13A.29, along with the change in concentrations at each receptor considered.

13A.7.7 The ultra-conservative assumption in emissions leads to new exceedances of the annual mean NO_X air quality objective in both future baseline and future operational scenarios, including at Potteric Carr SSSI (SSSI1) and LWS5. Impacts at the SSSI remain below 1% of the air quality objective at all locations across the site. Impacts at LWS5 exceed 1% of the air quality objective close to the road, but fall below 1% beyond 30m back from the road.

13A.7.8 Nitrogen deposition rates are unsurprisingly higher in this sensitivity scenario, but impacts remain below 1% of the Critical Load at all but one receptors. LWS5 experiences and increase of 1% or above up to 20m back from the road.

Table 13A.29. Predicted operational pollutant statistics (nature conservation receptors) – sensitivty analysis

Receptor	Future Baseline NO_X Conc. ($\mu g/m^3$)	Future Operational NO_X Conc. ($\mu g/m^3$)	Change in NO_X Conc. ($\mu g/m^3$)	Future Baseline Ndep rates ($\mu g/m^3$)	Future Operational Ndep rates ($\mu g/m^3$)	Change in Ndep rates ($\mu g/m^3$)
SSSI1_65.25m	**32.0**	**32.1**	+0.1	**35.8**	**35.8**	+0.02
SSSI_100.25m	26.8	26.9	+0.1	**36.0**	**36.0**	+0.02
SSSI_30.25m	**58.9**	**59.1**	+0.1	**40.5**	**40.6**	+0.02
LWS2_19.35m	23.5	24.0	+0.5	**24.2**	**24.3**	+0.04
LWS3_21.75m	27.7	28.3	+0.6	**45.8**	**45.9**	+0.09
LWS4_13.2m	25.7	26.2	+0.5	**54.7**	**54.8**	+0.09
LWS5_16.5m	**31.4**	**32.1**	+0.7	**55.5**	**55.7**	+0.11
LWS6_11m	22.0	22.5	+0.5	**40.5**	**40.5**	+0.07
LWS7_5m	**40.7**	**41.6**	+0.9	**23.4**	**23.5**	+0.05
LWS8_22.5m	**36.1**	**36.2**	+0.1	**38.6**	**38.6**	+0.01
LWS9_12.75m	**50.6**	**50.7**	+0.1	**40.7**	**40.7**	+0.01
LWS10_4.25m	**75.8**	**76.1**	+0.3	**23.7**	**23.7**	+0.01
LWS11_4.25m	**84.9**	**85.2**	+0.3	**24.2**	**24.2**	+0.01
LWS12_6.5m	**58.9**	**59.1**	+0.2	**38.8**	**38.8**	+0.04
LWS13_3m	**67.5**	**67.8**	+0.3	**39.9**	**40.0**	+0.04
LWS14_2.5m	**75.5**	**75.8**	+0.3	**40.9**	**41.0**	+0.04
AW1_29.75m	**39.7**	**39.9**	+0.2	**36.2**	**36.2**	+0.03
AW2_18.25m	**51.2**	**51.4**	+0.2	**38.5**	**38.5**	+0.03
AW3_29.5m	**40.8**	**41.0**	+0.2	**36.4**	**36.4**	+0.03
Air Quality Standard	**30**			**10 – 20**[2,3] **15 – 20**[4]		

Notes:
[1] **Bold** values denote and exceedance of the relevant air quality objective and/or Critical Load.
[2] Broadleaved deciduous woodland. [3] Acid grassland. [4] Meso- and eutrophic Quercus woodland.

Contact Us

ABPmer

Quayside Suite,
Medina Chambers
Town Quay, Southampton
SO14 2AQ

T +44 (0) 23 8071 1840
F +44 (0) 23 8071 1841
E enquiries@abpmer.co.uk

[redacted]