FICHTNER
Consulting Engineers Limited

Humber Gate Waste Treatment Facility

Humber Resources Group Ltd

Dispersion Modelling Assessment

ENGINEERING CONSULTING

Document approval

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Management Summary

Fichtner Consulting Engineers Ltd (Fichtner) has been engaged by Humber Resources Group Ltd to undertake a Dispersion Modelling Assessment to support the application for an Environmental Permit (EP) for the Humber Gate Waste Treatment Facility (the Facility). Full details of the Facility can be found in the Supporting Information document submitted with this application.

1) Dispersion Modelling of Emissions

The ADMS dispersion model is routinely used for air quality assessments to the satisfaction of the Environment Agency (EA). The model uses weather data from the local area to predict the spread and movement of the exhaust gases from the stack for each hour over a five-year period. The model takes account of wind speed, wind direction, temperature, humidity and the amount of cloud cover, as all of these factors influence the dispersion of emissions. The model also takes account of the effects of buildings and terrain on the movement of air.

To set up the model, it has been assumed that the Facility operates for the whole year and releases emissions at the emission limits compliant with the BAT-AELs set out in the Waste Incineration BREF for new plants. The model has been used to predict the ground level concentration of pollutants on a long-term and short-term basis across a grid of points. In addition, concentrations have been predicted at the identified sensitive receptors.

2) Approach and Assessment of Impact on Air Quality – Protection of Human Health

The air quality impact of the Facility on human health has been assessed using a standard approach based on guidance provided by the EA. Using this approach, in relation to the Air Quality Assessment Levels (AQALs) set for the protection of human health the following can be concluded from the assessment.

1. Emissions from the operation of the Facility will not cause a breach of any AQAL.
2. The overall impact of long-term and short-term process emissions associated with the operation of the Facility can be screened out as ‘insignificant’ or ‘not significant’ in accordance with the EA’s screening criteria at the point of maximum impact and at all identified human sensitive receptors.
3. There is no potential for a significant cumulative air quality effect on human health.

3) Approach and Assessment of Impact on Air Quality – Protection of Ecosystems

The impact of air quality on ecology has been assessed using a standard approach based on guidance provided by the EA. Using this approach, in relation to the Critical Level and Critical Loads set for the protection of ecology it can be concluded that all of the impacts at ecological features can be screened out as ‘insignificant’ or ‘not significant’ except for cumulative nitrogen deposition impacts on saltmarsh habitats at the Humber Estuary SPA/Ramsar site/SSSI. Further analysis undertaken by the project ecologist has concluded no significant effects are likely.

4) Summary and conclusions

The assessment has shown that emissions from the Facility would not result in any significant air quality effects. As such, there should be no air quality constraint in granting an EP to operate the Facility.

Contents

1 Introduction

1.1 Background

Fichtner Consulting Engineers Ltd (Fichtner) has been engaged by Humber Resources Group Ltd (the Client) to undertake a Dispersion Modelling Assessment to support the application for an Environmental Permit (EP) for the Humber Gate Waste Treatment Facility (the Facility). The Facility will comprise a single line waste treatment plant and associated infrastructure. The location of the Facility is shown on Figure 1.

When considering the impact on human health, the predicted atmospheric concentrations have been compared to the Air Quality Assessment Levels (AQALs) for the protection of human health. It is noted that for some pollutants such as metals and dioxins they have the potential to accumulate within the environment. A separate Dioxin Pathway Intake Assessment has been undertaken to assess the pathway intake of these pollutants and impacts compared to the Tolerable Daily Intakes (TDIs).

When considering the impact on ecosystems the predicted atmospheric concentrations have been compared to the Critical Levels for the protection of ecosystems. The deposition of emissions over a prolonged period can have nutrification and acidification impacts. An assessment of the long-term deposition of pollutants has been undertaken and the results compared to the habitat specific Critical Loads.

1.2 Structure of the report

This report has the following structure.

- Air quality legislation and guidance are considered in section 2.
- The assessment criteria used are described in section 3.
- The baseline levels of ambient air quality are described in section 4.
- The residential properties and ecological receptors which are sensitive to changes in air quality associated with the operation of the Facility and identified in section 5.
- The inputs used for the dispersion model are contained in section 6
- Details of the sensitivity analysis carried out is presented in section 7.
- The assessment methodology and results of the assessment of the impact of emissions on human health is presented in section 8.
- The assessment methodology and results of the assessment of the impact of emissions at ecological sites is presented in section 9.
- The assessment of cumulative schemes is presented in section 10.
- The conclusions of the assessment are set out in section 11.
- The Appendices include illustrative figures and detailed results tables.

2 Legislation Framework and Policy

2.1 Air quality assessment levels

In the UK, Ambient Air Directive (AAD) Limit Values, Targets, and air quality standards and objectives for major pollutants are described in The Air Quality Strategy (AQS). In addition, the Environment Agency include Environmental Assessment Levels (EALs) for other pollutants in the environmental management guidance 'Air Emissions Risk Assessment for your Environmental Permit'[1] ("Air Emissions Guidance"), which are also considered. The long-term and short-term EALs from these documents have been used when the AQS does not contain relevant objectives. Standards and objectives for the protection of sensitive ecosystems and habitats are also contained within the Air Emissions Guidance and the Air Pollution Information System (APIS).

AAD Target and Limit Values, AQS Objectives, and EALs are set at levels well below those at which significant adverse health effects have been observed in the general population and in particularly sensitive groups. For the remainder of this report these are collectively referred to as AQALs.

Table 1 to Table 3 summarise the AQALs used in this assessment.

Table 1: Air Quality Assessment Levels (AQALs)

Pollutant	AQAL (µg/m³)	Averaging Period	Frequency of Exceedances	Source
Nitrogen dioxide	200	1 hour	18 times per year (99.79th percentile)	AAD Limit Value
	40	Annual	-	AAD Limit Value
Sulphur dioxide	266	15 minutes	35 times per year (99.9th percentile)	AQS Objective
	350	1 hour	24 times per year (99.73rd percentile)	AAD Limit Value
	125	24 hours	3 times per year (99.18th percentile)	AAD Limit Value
Particulate matter (PM_{10})	50	24 hours	35 times per year (90.41st percentile)	AQS Objective
	40	Annual	-	AQS Objective
Particulate matter ($PM_{2.5}$)	20	Annual	-	AQS Target
	10	Annual		Environmental Targets (fine particulate matter) (England) regulations 2023

[1] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions

Pollutant	AQAL (µg/m³)	Averaging Period	Frequency of Exceedances	Source
Carbon monoxide	10,000	8 hours, running	-	AAD Limit Value
	30,000	1 hour	-	Air Emissions Guidance
Hydrogen chloride	750	1 hour		Air Emissions Guidance
Hydrogen fluoride	160	1 hour	-	Air Emissions Guidance
	16	Annual	-	Air Emissions Guidance
Ammonia	2,500	1 hour	-	Air Emissions Guidance
	180	Annual	-	Air Emissions Guidance
Benzene	5	Annual	-	Air Emissions Guidance
	30	24 hours	-	Air Emissions Guidance
PCBs	6	1-hour	-	Air Emissions Guidance
	0.2	Annual	-	Air Emissions Guidance
PAHs	0.00025	Annual	-	AQS Objective

Table 2: Air Quality Assessment Levels for Metals

Pollutant	AQAL (ng/m³)	Averaging Period	Source
Cadmium	30	24 hour	Air Emissions Guidance
	5	Annual	AAD Target Value
Mercury	600	1 hour	Air Emissions Guidance
	60	24 hour	Air Emissions Guidance
	-	Annual	-
Antimony	150,000	1 hour	Air Emissions Guidance
	5,000	Annual	Air Emissions Guidance
Arsenic	-	1 hour	-
	6	Annual	Air Emissions Guidance
Chromium (III)	2,000	24 hour	Air Emissions Guidance
	-	Annual	-
Chromium (VI)	-	1 hour	-
	0.25	Annual	Air Emissions Guidance
Copper	50	24 hour	Air Emissions Guidance
	-	Annual	-
Lead	-	1 hour	-
	250	Annual	AQS Target
Manganese	1,500,000	1 hour	Air Emissions Guidance
	150	Annual	Air Emissions Guidance
Nickel	700	1 hour	Air Emissions Guidance

Pollutant	AQAL (ng/m³)	Averaging Period	Source
	20	Annual	AAD Limit
Vanadium	1,000	24 hours	Air Emissions Guidance
	-	Annual	-

Table 3: Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m³)	Measured as	Source
Nitrogen oxides (as nitrogen dioxide)	75/200*	Daily mean	APIS
	30	Annual mean	AAD Critical Level
Sulphur dioxide	10	Annual mean where lichens and bryophytes are an important part of the ecosystem's integrity	Air Emissions Guidance / APIS
	20	Annual mean for all higher plants	AAD Critical Level
Hydrogen fluoride	5	Daily mean	Air Emissions Guidance / APIS
	0.5	Weekly mean	Air Emissions Guidance / APIS
Ammonia	1	where lichens and bryophytes are an important part of the ecosystem's integrity	APIS
	3	Annual mean for all higher plants	APIS

Note:
**only for detailed assessments where the ozone is below the AOT40 Critical Level and sulphur dioxide is below the lower Critical Level of 10 µg/m³.*
The *AOT40 for ozone is 3,000 ppb.h (6,000 µg/m³.h) calculated from accumulated hourly ozone concentrations – AOT40 means the sum of the difference between each hourly daytime (08:00 to 20:00 Central European Time, CET) ozone concentration greater than 80 µg/m³ (40 ppb) and 80 µg/m³, for the period between 01 May and 31 July.*

In the first instance the lower Critical Level for oxides of nitrogen of 75 µg/m³ will be applied as a conservative measure, and consideration will be given to the applicability of the higher Critical Level if it is considered that there is a risk of exceedance of the Lower Critical Level.

In addition to the Critical Levels set out in the table above, APIS provides habitat specific Critical Loads for nitrogen and acid deposition. Full details of the habitat specific Critical Loads can be found in Appendix B.

2.2 Areas of relevant exposure

The AQALs apply only at areas of exposure relevant to the assessment level. The following table extracted from Local Authority Air Quality Technical Guidance (2022) (LAQM.TG(22))[2] explains where the AQALs apply.

Table 4: Guidance on Where AQALs Apply

Averaging period	AQALs should apply at:	AQALs should generally not apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
24-hour mean and 8-hour mean	All locations where the annual mean AQAL would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean AQALs apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc., which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer.	Kerbside sites where the public would not be expected to have regular access.
15-min mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer	-

Source: Box 1-1, Local Air Quality Management Technical Guidance (TG22), Defra, August 2022

2 Department for Environment, Food and Rural Affairs, Local Air Quality Management Technical Guidance (TG22), August 2022, available at: https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

2.3 Industrial pollution regulation

The Industrial Emissions Directive (IED) (Directive 2010/75/EU), adopted on 7th January 2013, is the key European Directive which covers almost all regulation of industrial processes in the EU. Within the IED, the requirements of the relevant sector Best Available Techniques Reference Document (BREF) become binding as BAT guidance, as follows.

- Article 15, paragraph 2, of the IED requires that Emission Limit Values (ELVs) are based on best available techniques, referred to as BAT.
- Article 13 of the IED, requires that 'the Commission' develops BAT guidance documents (referred to as BREFs).
- Article 21, paragraph 3, of the IED, requires that when updated BAT conclusions are published, the Competent Authority (in England this is the EA) has up to four years to revise permits for facilities covered by that activity to comply with the requirements of the sector specific BREF.

The Waste incineration (WI) BREF was adopted by the European IPPC Bureau in December 2019, and implemented by the EA in December 2023. The WI BREF introduces BAT-Associated Emission Limits (BAT-AELs) which are more stringent than the ELVs currently set out in the IED. It has been assumed that emissions from the Facility will comply with the upper end of the BAT-AEL range for each pollutant, except where otherwise stated.

2.4 Local air quality management

In accordance with Section 82 of the Environment Act (1995) (Part IV), local authorities are required to periodically review and assess air quality within their area of jurisdiction, under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves assessing present and likely future ambient pollutant concentrations against AQALs. If it is predicted that levels at the façade of buildings where members of the public are regularly present (normally residential properties) are likely to be exceeded, then the local authority is required to declare an AQMA. For each AQMA, the local authority is required to produce an AQAP, the objective of which is to reduce pollutant levels in pursuit of the relevant AQALs.

3 Assessment Criteria

3.1 Human health

The Air Emissions Guidance states that to screen out 'insignificant' process contributions (PCs):

- *the long-term PC must be less than 1% of the long-term environmental standard; and*
- *the short-term PC must be less than 10% of the short-term environmental standard.*

As part of this assessment, predicted PCs have been compared to the AQALs detailed in section 2.1.

If the above criteria are achieved, it can be concluded that it is not likely that emissions would lead to significant environmental impacts and the PCs can be screened out.

The long-term 1% PC threshold is based on the judgement that:

- it is unlikely that an emission at this level will make a significant contribution to air quality; and
- the threshold provides a substantial safety margin to protect health and the environment.

The short-term 10% PC threshold is based on the judgement that:

- spatial and temporal conditions mean that short-term PCs are transient and limited in comparison with long-term PCs; and
- the threshold provides a substantial safety margin to protect health and the environment.

For the purpose of this assessment, if the impact can be screened out as 'insignificant' at the point of maximum impact, further assessment is not required. If PCs cannot be screened out, assessment will be undertaken for the following:

- the predicted environmental concentration (PEC, defined as the PC plus the background concentration) at the point of maximum impact; and
- the PC and PEC at areas of public exposure.

If the long-term PEC is below 70% of the AQAL, or the short-term PC is less than 20% of the headroom[3], it can be concluded that there is little risk of the PEC exceeding the AQAL, and the impact can be considered 'not significant'.

For the assessment of group 3 metals, guidance taken from the EA document 'Guidance on assessing group 3 metals stack emissions from incinerators – V.4 June 2016' ('EA metals guidance') has been used. The EA metals guidance states that where the PC for any metal exceeds 1% of the long term or 10% of the short term environmental standard (in this case the AQAL), this is considered to have potential for significant pollution. Where the PC exceeds these criteria, the PEC should be compared to the AQAL. The PEC can be screened out if is less than the AQAL. Where the impact is within these parameters it can be concluded that there is no significant risk of exceeding the AQAL.

3.2 Ecology

The Air Emissions Guidance states that to screen out impacts as 'insignificant' at European and UK statutory designated sites:

- the long-term PC must be less than 1% of the long-term environmental standard (i.e., the Critical Level or Load); and

[3] Calculated as the AQAL minus twice the long-term background concentration.

- the short-term PC must be less than 10% of the short-term environmental standard.

If the above criteria are met, no further assessment is required. If the long-term PC exceeds 1% of the long-term environmental standard, the PEC must be calculated and compared to the standard. If the resulting PEC is less than 70% of the long-term environmental standard, the Air Emissions Guidance states that the emissions are 'insignificant' and further assessment is not required. In accordance with the guidance, calculation of the PEC for short-term standards is not required.

The Air Emissions Guidance states further that to screen out impacts as 'insignificant' at local nature sites[4]:

- the long-term PC must be less than 100% of the long-term environmental standard; and
- the short-term PC must be less than 100% of the short-term environmental standard.

In accordance with the guidance, calculation of the PEC for local nature sites is not required.

[4] Ancient woodlands, local wildlife sites and national and local nature reserves.

4 Baseline Air Quality

This section presents a review of the baseline air quality and defines appropriate baseline concentrations to be used within this assessment.

The Facility is to be located approximately 4.5 km to the north-west of Grimsby town centre within the administrative area of North East Lincolnshire Council (NELC).

A number of point-source emitters are already operational in the local area, such as the South Humber Bank Power Station, which has been operational since 1997. The contribution to local air pollution from these operational sources is included in monitored and mapped baseline concentrations. As such, it is not considered necessary to explicitly model emissions from these sources. Point sources which have planning consent or an EP to operate but are not yet operational require consideration in a cumulative impact assessment; this analysis is presented in section 10.

4.1 Air quality review and assessment

There are no AQMAs in NELC's administrative areas. The closest AQMA to the Facility is in Hull located over 20 km to the north-west of the Facility. Due to the distance from the Facility the impact of process emissions from the Facility within this AQMA is expected to be imperceptible and no further consideration has been given to the impact in AQMAs.

4.2 National modelling – mapped background data

The Department for Environment Food and Rural Affairs (Defra) provides modelled background concentrations of pollutants across the UK on a 1 km by 1 km grid under the Modelling of Ambient Air Quality (MAAQ) contract. This model is based on known pollution sources and background measurements and provides a source of background concentrations in lieu of suitable monitoring data. Mapped background concentrations have been downloaded for the grid squares containing the proposed development and immediate surroundings. In addition, mapped atmospheric concentrations of ammonia are available from Defra via the National Environment Research Council (NERC) Centre for Ecology and Hydrology (CEH) throughout the UK.

The mapped background data is calibrated against monitoring data. The most recently available 2023 mapped background concentrations are based on 2023 meteorological data and are calibrated against monitoring undertaken in 2023.

Concentrations will vary over the modelling domain area. Therefore, the maximum mapped background concentration from within 3 km of the Facility has been calculated, as presented in Table 5, together with the concentration at the Facility.

Table 5: Mapped Background Data

Pollutant	Annual Mean AQAL	Annual mean concentration (µg/m³)		Dataset
		At Facility	Max within 3 km	
Nitrogen dioxide	40	21.77	21.77	Defra 2023 Dataset
Sulphur dioxide	-	2.12	3.71	Defra 2023 Dataset
Particulate matter (as PM_{10})	40	13.44	16.20	Defra 2023 Dataset
Particulate matter (as $PM_{2.5}$)	10[1]	7.00	7.95	Defra 2023 Dataset

Pollutant	Annual Mean AQAL	Annual mean concentration (µg/m³)		Dataset
		At Facility	Max within 3 km	
Carbon monoxide - annual	-	226	234	Defra 2010 Dataset[(2)]
Carbon monoxide – max 8 hr	-	1,593	1,647	Defra 2010 Dataset[(2)]
Benzene	5	0.43	0.61	Defra 2023 Dataset
Ammonia	180	1.40	1.40	CEH 2020 – 2022 average (via APIS)

Notes

[(1)] Target value for PM_{10} – to be achieved by 2040.

[(2)] CO mapping has not been updated since 2010. Mapping includes maximum 8 hour concentrations for comparison with the rolling 8-hour mean AQAL.

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As shown, the mapped background concentrations are well below the relevant Air Quality Assessment Levels (AQALs).

4.3 AURN and LAQM monitoring data

Monitoring locations are broadly classified into 'roadside' and 'background' locations. 'Background' locations are typically sited so that no single pollutant source is dominant and are intended to be representative of background concentrations over several square kilometres. 'Roadside' sites are dominated by road traffic emissions and only representative of concentrations in the immediate vicinity of the analyser. This analysis has considered background-type monitoring sites within 5 km of the Facility and roadside-type sites within 2 km of the Facility.

A review of the UK Automatic Urban and Rural Network (AURN) and monitoring undertaken by NELC shows that no monitoring is undertaken within these distances of the Facility.

4.4 National monitoring data

4.4.1 Hydrogen chloride

Hydrogen chloride was measured until the end of 2015 on behalf of Defra as part of the UK Eutrophying and Acidifying Atmospheric Pollutants (UKEAP) project. Monitoring of hydrogen chloride ceased at the end of 2015 and none of the historic sites were located within 10 km of the Facility. Prior to the cessation of the monitoring concentrations were fairly constant.

The maximum annual average concentration monitored within the UK between 2011 and 2015 was 0.76 µg/m³. In lieu of any recent representative monitoring this has been used as the baseline concentration for this assessment as a conservative estimate.

4.4.2 Hydrogen fluoride

Baseline concentrations of hydrogen fluoride are not measured locally or nationally, since these are not generally of concern in terms of local air quality. However, the Expert Panel on Air Quality Standards (EPAQS) report 'Guidelines for halogens and hydrogen halides in ambient air for protecting human health against acute irritancy effects' contains some estimates of baseline levels, reporting that measured concentrations have been in the range of 0.036 µg/m³ to 2.35 µg/m³.

In lieu of any local monitoring, the maximum measured baseline hydrogen fluoride concentration has been used for the purpose of this assessment as a conservative estimate.

4.4.3 Ammonia

Ammonia is also measured as part of the UK Eutrophying and Acidifying Atmospheric Pollutants (UKEAP) project at rural background locations. There are no UKEAP monitoring locations within 10 km of the Facility. In lieu of any local monitoring, the maximum mapped background concentration within the modelling domain (1.40 µg/m³, as presented in Table 5) has been used as the baseline concentration for the assessment of human health.

Location-specific baseline data for the assessment of effects on ecological habitats has been obtained from APIS where the impact cannot be screened out as 'insignificant'. This analysis is presented in section 9.2.

4.4.4 Volatile Organic Compounds

As part of the Automatic and Non-Automatic Hydrocarbon Network, benzene concentrations are measured at sites co-located with the AURN across the UK. There are no benzene monitoring locations within 10 km of the Site.

In lieu of any local monitoring of benzene, the maximum mapped background concentration within the modelling domain (0.61 µg/m³, as presented in Table 5) has been used as the baseline concentration.

4.4.5 Metals

Metals are measured as part of the Heavy Metals Network. The nearest monitoring sites are in Scunthorpe. Monitoring data from Scunthorpe is considered unlikely to be representative of conditions in the vicinity of the Facility due to heavy metals emissions from industry in Scunthorpe. In lieu of any representative local monitoring data, the maximum concentrations measured at any rural background site across the UK have been used. A summary of the most recent five years of monitoring data from UK rural background monitoring sites is presented in the following table.

Table 6: Metals Monitoring – Maximum at any UK Rural Background Site

Substance	Annual mean concentration (ng/m³)						Max (as % of AQAL)
	AQAL	2019	2020	2021	2022	2023	
Arsenic	6	0.81	0.76	0.81	0.67	0.66	13.50%
Cadmium	5	0.15	0.13	0.13	0.11	0.09	3.00%
Chromium	-	1.30	0.66	0.61	0.75	0.82	-
Cobalt	-	0.06	0.05	0.06	0.05	0.05	-
Copper	-	4.70	3.50	3.40	3.30	2.90	-
Lead	250	5.70	5.00	5.40	4.60	3.70	2.28%
Manganese	150	3.70	3.40	3.50	3.70	2.90	2.47%
Nickel	20	0.74	0.53	0.68	0.81	0.56	4.05%

Substance	Annual mean concentration (ng/m³)						Max (as % of AQAL)
	AQAL	2019	2020	2021	2022	2023	
Vanadium	-	0.96	1.00	1.20	1.20	1.00	-

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As shown, the concentrations monitored are significantly lower than the applicable annual mean AQALs.

There are also AQALs for antimony and mercury. However, these metals are not currently monitored as part of the heavy metals network. Monitoring of antimony across the UK ceased at the end of 2013. The maximum monitored concentration at a rural background site in 2013 was 1.30 ng/m³, which has been used as the baseline concentration for the assessment. This value is only 0.026% of the annual mean AQAL of 5,000 ng/m³.

Mercury was widely monitored across the UK until the end of 2013, and monitoring continued at London Westminster and Runcorn Weston Point until 2018. The maximum concentration at a rural background site in 2013 was 2.10 ng/m³, which has been used as the baseline concentration for the assessment.

4.4.6 Dioxins, furans and polychlorinated biphenyl (PCBs)

Dioxins, furans and PBCs are monitored on a quarterly basis at a number of urban and rural stations in the UK as part of the Toxic Organic Micro Pollutants (TOMPs) network. There are no monitoring locations within 10 km of the Facility.

A summary of dioxin and furan and PCB concentrations from all monitoring sites across the UK is presented in Table 7 and Table 8. Note that monitoring data for dioxins and furans is only available up to the end of 2016 from the UK-Air website. For PCBs data is only available up to the end of 2018 from the UK-Air website.

Table 7: TOMPS – Dioxin and Furans Monitoring

Site	Annual mean concentration (fgTEQ/m³)				
	2012	2013	2014	2015	2016
Auchencorth Moss	0.13	0.86	0.01	0.01	0.13
Hazelrigg	8.75	2.02	2.61	5.27	4.59
High Muffles	4.32	0.60	1.07	0.54	2.73
London Nobel House	15.42	3.47	2.89	4.34	21.27
Manchester Law Courts	32.99	10.19	16.52	5.94	12.23
Weybourne	9.30	2.34	1.61	1.42	16.32

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Table 8: TOMPS – PCB Monitoring

Site	Annual mean concentration (pg/m³)				
	2014	2015	2016	2017	2018
Auchencorth Moss	23.23	24.27	25.32	19.09	12.31
Hazelrigg	25.84	41.68	52.58	33.15	22.22
High Muffles	26.11	33.43	37.76	31.63	8.86

Site	Annual mean concentration (pg/m³)				
	2014	2015	2016	2017	2018
London Nobel House	107.49	121.39	110.46	121.87	46.63
Manchester Law Courts	128.93	97.99	92.60	97.27	40.10
Weybourne	17.00	20.95	38.61	32.26	11.23

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As shown, the concentrations vary significantly between sites and years. As there are no monitoring sites located within close proximity of the Facility, nor any mapped background datasets, the maximum monitored concentrations from the past five years have been used as the background concentration within this assessment. These values are 32.99 fg/TEQ/m³ for dioxins and furans and 128.93 pg/m³ for PCBs.

4.4.7 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) are monitored at a number of stations in the UK as part of the PAH network. There are no monitoring locations within 10 km of the Facility.

For the purpose of this assessment, benzo(a)pyrene is considered as this is the only PAH which an AQAL has been set. A summary of benzo(a)pyrene concentrations from all rural background monitoring sites within the UK is presented in Table 9.

Table 9: National Monitoring - Benzo(a)pyrene

Site type	Quantity	AQAL (ng/m³)	Annual mean concentration (ng/m³)				
			2020	2021	2022	2022	2023
All rural background	Min	0.25	0.01	0.01	0.02	0.02	0.01
	Max		0.30	0.26	0.39	0.11	0.10
	Average		0.09	0.08	0.11	0.06	0.04

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As shown, the maximum monitored concentration has exceed the AQAL in three out of the last five years. However, these exceedances were all recorded at a single site, Ruardean in Gloucestershire, which is not representative of the surroundings of the Facility. The average concentration at rural background sites is more likely to be representative of concentrations in the vicinity of the Facility. Therefore, in lieu of any local monitoring or mapped background data, the maximum annual average of all rural background sites (0.11 ng/m³ – 2020) has been used. The choice of background concentration will be considered further if the PC cannot be screened out as 'insignificant'.

4.5 Summary

The preceding sections have provided a review of the baseline local and national monitoring data and national modelled background concentrations. Table 10 presents the values for the annual baseline concentrations that will be used to evaluate the impact of the Facility. Further consideration will be given to the baseline concentrations at specific receptor locations if the predicted impact of emissions of a given pollutant from the Facility cannot be screened out as 'insignificant'.

Table 10: Summary of Baseline Concentrations

Pollutant	Concentration	Units	Justification
Nitrogen dioxide	21.77	µg/m^3	Maximum mapped background within modelling domain, Defra 2023 dataset.
Sulphur dioxide	3.71	µg/m^3	Maximum mapped background within modelling domain, Defra 2023 dataset
Particulate matter (as PM_{10})	16.20	µg/m^3	Maximum mapped background within modelling domain, Defra 2023 dataset
Particulate matter (as $PM_{2.5}$)	7.95	µg/m^3	Maximum mapped background within modelling domain, Defra 2023 dataset
Carbon monoxide (annual mean)	234	µg/m^3	Maximum mapped background within modelling domain, Defra 2010 dataset.
Carbon monoxide (8-hr rolling)	1,647	µg/m^3	Maximum mapped background within modelling domain, Defra 2010 dataset.
Benzene	0.61	µg/m^3	Maximum mapped background within modelling domain, Defra 2023 dataset.
Ammonia	1.40	µg/m^3	Maximum mapped background within modelling domain, APIS 2020-2022 dataset.
Hydrogen chloride	0.76	µg/m^3	Maximum monitored across the UK 2012 to 2015
Hydrogen fluoride	2.35	µg/m^3	Maximum measured from EPAQS report
Cadmium	0.15	ng/m^3	Maximum annual average from any UK rural background monitoring site, 2019 – 2023, except Mercury and Antimony, which are maximum from any UK rural background monitoring site in 2013. Chromium VI assumed to be 20% of total chromium.
Mercury	2.10	ng/m^3	
Antimony	1.30	ng/m^3	
Arsenic	0.66	ng/m^3	
Chromium	0.82	ng/m^3	
Chromium VI	0.16	ng/m^3	
Cobalt	0.06	ng/m^3	
Copper	4.70	ng/m^3	
Lead	5.70	ng/m^3	
Manganese	3.70	ng/m^3	
Nickel	0.81	ng/m^3	
Vanadium	1.20	ng/m^3	
Dioxins and Furans	32.99	fgTEQ/m^3	Maximum monitored across all UK sites 2012 to 2016
PCBs	128.93	pg/m^3	Maximum monitored across all UK sites 2014 to 2018
PaHs	0.11	ng/m^3	Highest average of annual concentrations across all rural background sites in UK 2019 – 2023.

5 Sensitive Receptors

5.1 Human sensitive receptors

The general approach to the assessment is to evaluate the highest predicted PC at a height of 1.5 m, to represent typical breathing height. In addition, the predicted PC at sensitive receptors has been evaluated, again at a height of 1.5 m. These sensitive receptors have been selected to represent the residential dwellings most likely to be impacted by emissions from the Facility. There are very few residences and no schools, hospitals or care homes within close proximity of the Facility. The human sensitive receptors identified for assessment are displayed in Figure 2 and listed in Table 11.

Table 11: Human Sensitive Receptors

ID	Name	Location		Distance from stack (km)
		X	Y	
R1	Primrose Cottage	522020	412070	1.86
R2	Meadows Farm	522065	411685	2.02

5.2 Ecological sensitive receptors

The EA has provided a Nature and Conservation Screening Report which identifies sites of ecological importance in accordance with the following screening distances, as laid out in the Air Emissions Guidance:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs), or Ramsar sites within 10 km of the Site;
- Sites of Special Scientific Interest (SSSIs) within 2 km of the Site; and
- National Nature Reserves (NNR), Local Nature Reserves (LNRs), local wildlife sites and ancient woodlands within 2 km of the Site. There are collectively referred to as local nature sites.

In addition, as requested in the Scoping Opinion issued by NELC, the impact at land functionally linked to SPAs (functionally linked land, FLL) within 2 km of the Facility has been assessed. FLL is land which supports bird species for which the SPAs are designated but is not included within the SPA designation. NELC also requested that the impact at North Killingholme Haven Pits SSSI be assessed. However this site is 9 km north-west of the Facility, well outside of the statutory screening distance for SSSIs listed above. Therefore, no significant air quality impacts are expected at the North Killingholme Haven Pits SSSI. Commentary has been provided as to the likely impact at this site in sections 9.2 and 9.3.

An assessment of the impact of emissions at land identified for mitigation has been undertaken. These mitigation areas are part of a strategic mitigation solution to compensate for the loss of FLL along this part of the Humber to development. They have been created to provide safe roosting and feeding sites for waders and waterfowl associated with the SPA which have been recorded using arable land for roosting or feeding.

The sensitive ecological receptors identified are displayed in Figure 3 and are listed in Table 12. A review of the citation and APIS website for each site has been undertaken to determine if lichens or bryophytes are an important part of the ecosystem's integrity. If lichens or bryophytes are an important part of the ecosystem's integrity, the more stringent Critical Level has been applied as part of the assessment.

Table 12: Ecological Sensitive Receptors

ID	Site	Designation	Closest point to Facility		Distance from stack (km)	Lichens/ Bryo-phytes
			X	Y		
E1	Humber Estuary	SAC/SPA/ Ramsar/SSSI	523805	413130	0.3	No
E2	Sweedale Croft Drain	LWS	523735	411830	1.1	No
E3	Healing Cress Beds	LWS	521980	412080	1.9	No
E4	Tioxide west fields	LWS	525200	411640	1.9	No
E5	Humber Estuary FLL	FLL	523560	412990	0.2	No
E6	Mitigation Areas	N/A	524250	412450	0.7	No

The Humber Estuary, associated FLL, and the mitigation areas are close to the Facility and each cover a wide area, so the maximum PC at ground level within each of these receptors has been assessed. For all other ecological receptors the PC at ground level has been assessed at the points listed in Table 12.

As the FLL is used by the species for which the Humber Estuary designated site has been designated, it is considered appropriate to use the screening criteria for European sites listed in section 3.2.

6 Dispersion Modelling Methodology

6.1 Selection of model

Detailed dispersion modelling was undertaken using the model ADMS 6, developed and supplied by Cambridge Environmental Research Consultants (CERC) This is a new generation dispersion model, which characterises the atmospheric boundary layer in terms of the atmospheric stability and the boundary layer height. In addition, the model uses a skewed Gaussian distribution for dispersion under convective conditions, to take into account the skewed nature of turbulence. The model also includes modules to take account of the effect of buildings and complex terrain.

ADMS is routinely used for modelling of emissions for planning and Environmental Permitting purposes to the satisfaction of the EL and local authorities. The maximum predicted concentration for each pollutant and averaging period has been used to determine the significance of any potential impacts.

6.2 Source and emissions data

The principal inputs to the model with respect to the emissions to air from the stack of the Facility are presented in Table 13 and Table 14. The source parameters have been provided by the technology supplier for the Facility, based on a thermal capacity of approximately 20 MWth. At the design fuel net calorific value (NCV) of 18 MJ/kg, this equates to an hourly throughput of approximately 4 tonnes per hour. It has been assumed that the Facility operates continually, which is conservative as the Facility will shut down periodically for planned maintenance.

The site level will be raised by approximately 2 m for flood mitigation. To account for this, both the stack height and building heights have been increased by 2 m in the model, which allows the model to accurately represent the additional 2 m vertical distance between the emission point and the receptors, while maintaining the correct vertical separation between the emission point and the top of the buildings. Therefore, the modelled stack height of 49 m is 47 m above the raised development platform.

Table 13: Stack Source Data

Item	Unit	Value
Stack Data		
Height	m	49
Internal diameter (each stack)	m	1.15
Centred location of stacks(1)	m, m	523691, 412877
Flue Gas Conditions		
Temperature	°C	56.35
Exit moisture content	% v/v	16.4%
	kg/kg	0.118
Exit oxygen content	% v/v dry	13.6%
Reference oxygen content	% v/v dry	11.0%
Exit pressure	kPa	101.8
Reference pressure	kPa	101.3

Item	Unit	Value
Volume at reference conditions (dry, ref O_2)	Nm^3/h	31,198
	Nm^3/s	8.67
Volume at actual conditions	Am^3/h	60,996
	Am^3/s	16.94
Flue gas exit velocity	m/s	16.31

Table 14: Stack Emissions Data

Pollutant	Daily or periodic	Half-hourly	Daily or periodic	Half-hourly
	Conc. (mg/Nm^3)		Release rate (g/s)	
Oxides of nitrogen (as NO_2)	120	400	1.040	3.466
Sulphur dioxide	30	200	0.260	1.733
Carbon monoxide	50	150(1)	0.433	1.300
Fine particulate matter (PM)(2)	5	30	0.0433	0.260
Hydrogen chloride	6	60	0.0520	0.520
Volatile organic compounds (as TOC)	10	20	0.0867	0.173
Ammonia	10	-	0.0867	-
Hydrogen fluoride	1	4	8.666 mg/s	0.0347
Cadmium and thallium	0.02	-	0.173 mg/s	-
Mercury	0.02	-	0.173 mg/s	-
Other metals(3)	0.3	-	2.600 mg/s	-
Benzo(a)pyrene (PAHs)(4)	0.2 µg/Nm³	-	1.733 µg/s	-
Dioxins, furans and dioxin-like PCBs	0.06 ng/Nm³	-	0.520 ng/s	-
PCBs(5)	5 µg/Nm³	-	43.33 µg/s	-

Notes:

All emissions are expressed at reference conditions of dry gas, 11% oxygen, 273.15K.

(1) Averaging period for carbon monoxide is 95% of all 10-minute averages in any 24-hour period.

(2) As a worst-case it has been assumed that the entire PM emissions consist of either PM_{10} or $PM_{2.5}$ for comparison with the relevant AQALs.

(3) Other metals consist of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V).

(4) Figure 8.121 of the 2019 Waste Incineration BREF shows that the maximum recorded at a UK plant was 0.2 µg/m³. This is assumed to be the emission concentration for the Facility.

(5) The 2006 Waste Incineration BREF provides a range of values for PCB emissions to air from European municipal waste incineration plants. This states that the annual average total PCBs is less than 0.005 mg/Nm³ (dry, 11% oxygen, 273K). In lieu of other available operational data, this has been assumed to be the emission concentration for the Facility.

The Facility is designed to operate at full capacity and is not anticipated to have significant changes in loading. Therefore, it is appropriate to base the assessment on the design point of the system.

If the Facility continually operated at the half-hourly limits, the daily limits would be exceeded. The Facility is designed to achieve the daily limits and as such will only operate at the shorter term limits for short periods on rare occasions.

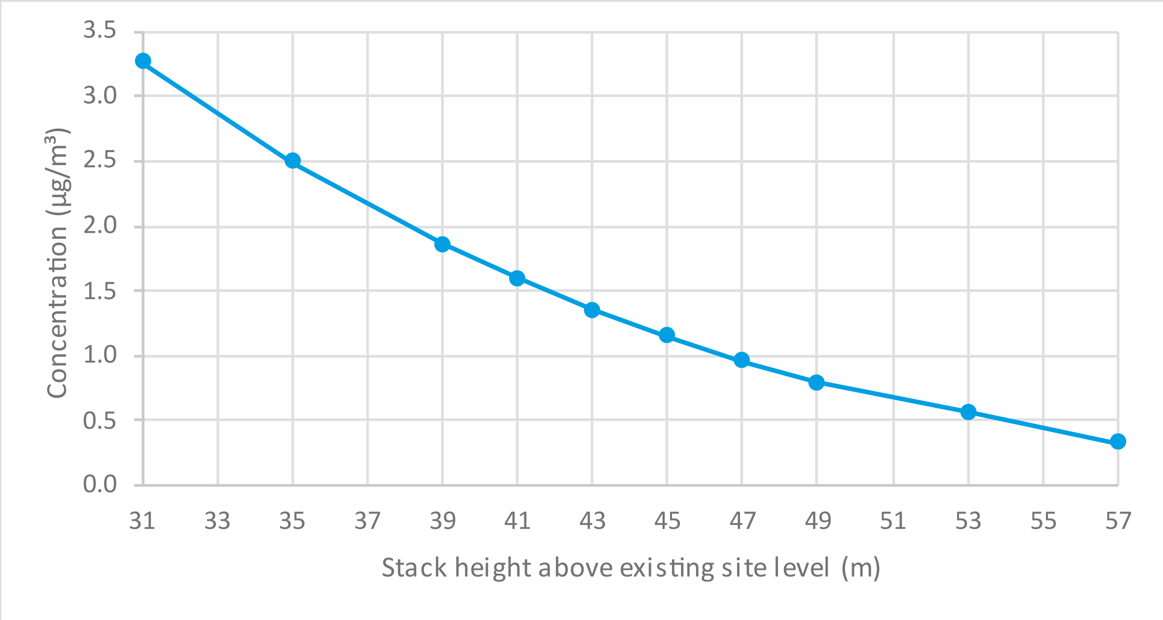
6.3 Stack height justification

When determining a suitable stack height, it is best practice to identify the stack height where the rate of reduction in maximum ground level concentration with increased height slows down. This can be identified on a graph as a step change in the slope. A range of stack heights from 31 m to 57 m has been considered (as measured above existing site level; subtract 2 m for height above development platform, as explained in section 6.2).

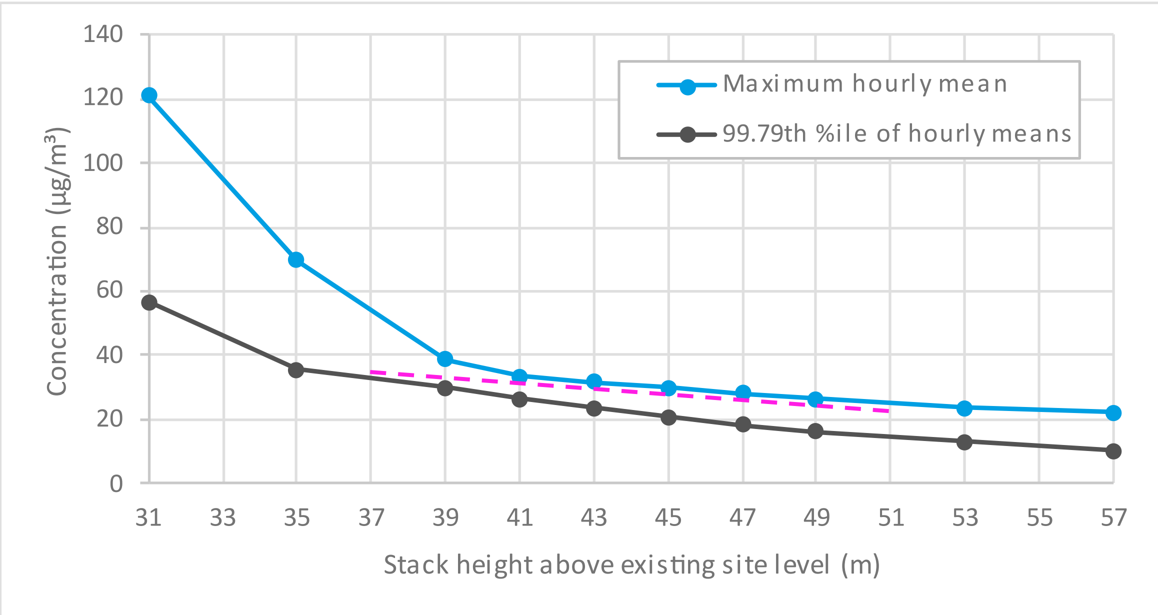
The following parameters were kept constant:

- Buildings – included;
- Dispersion site surface roughness value – varying at 64 x 64 resolution;
- Meteorological site surface roughness – 0.1 m;
- Dispersion site Monin-Obukhov length – 1 m;
- Meteorological site Monin-Obukhov length – 1 m; and
- Meteorological data used – Humberside Airport 2019 to 2023.

The following graphs show the ground level concentration at the point of maximum impact for a range of stack heights for the Facility, for a nominal 1 g/s release rate. The stack heights shown on the graphs are the height above the existing site level.



Graph 1 – Annual Mean Stack Height Analysis



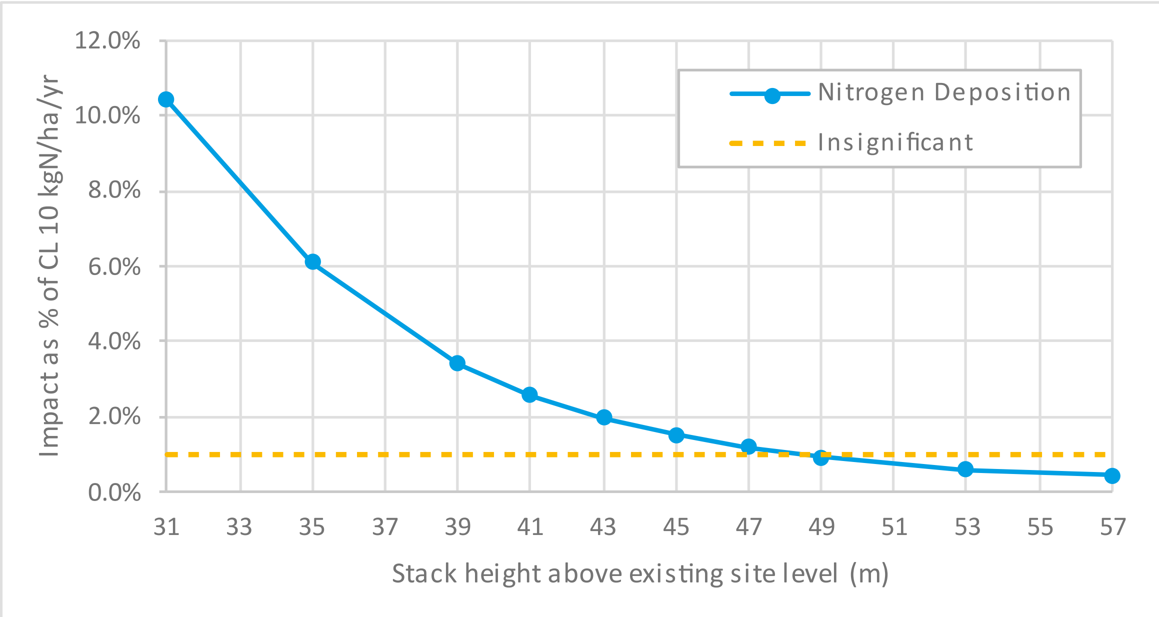
Graph 2 – Short-Term Stack Height Analysis

For annual mean concentrations there is no significant change in the angle of the slope, rather there is a general decrease in the angle of the slope as the stack height increases. For short-term concentrations there isa flattening of the slope for 99.79th percentile of hourly means at a stack height of 35 m, and a significant flattening of the slope for maximum hourly means for stack heights of 41 m and above (indicated by the magenta line).

Based on the shape of the graphs alone, there is some benefit to increasing the stack height to 57 m and potentially beyond due to the continuing decrease in annual mean impacts. However, considering the scale and throughput of the Facility and the maximum building height (27 m), it is not clear that a stack height of up to 57 m is appropriate for the Facility, nor whether a stack as tall as 57 m is required to provide adequate dispersion of emissions and avoid significant air quality impacts.

A review of the sensitivity of the local area to emissions has identified that there are no high sensitivity human receptors (e.g. residential dwellings, schools, hospitals, etc.) within the area of maximum impacts. However, the Humber Estuary ecological designated site is within this area. The distribution of sensitive habitats in the section of the Humber Estuary closest to the Facility shows that the most sensitive habitat in close proximity is a section of saltmarsh (the location of this habitat is shown on Figure 3). Saltmarsh is sensitive to nitrogen deposition (refer to Appendix B for the relevant Critical Loads).

The stack location has been selected to minimise potential impacts on the sensitive habitats in the Humber Estuary. The following graph shows the nitrogen deposition impact on the closest section of saltmarsh as a percentage of the lower Critical Load for the range of stack heights considered, averaged over the five years of weather data to account for interannual variability (refer to section 9.3 for further details on this approach). In accordance with the assessment criteria detailed in section 3.2, annual mean impacts of less than 1% of the Critical Load can be screened out as 'insignificant'.



Graph 3 –Stack Height Analysis – Nitrogen Deposition to Saltmarsh Habitats

As shown, at the closest saltmarsh habitat to the Facility there are no significant changes in the angle of the slope with increasing stack height, but rather a gradual decrease in the angle of the slope. A stack height of 49 m above the existing site level (47 m above the development platform) is required for the nitrogen deposition impact at the saltmarsh to be screened out as 'insignificant'.

Overall, it is considered that a stack height of 49 m above the existing site level (47 m above the development platform) is appropriate as it provides adequate dispersion of pollutants from the Facility to prevent a potentially significant impact on the closest sensitive receptor. The remainder of this assessment has been undertaken for a stack height of 49 m above the existing site level.

6.4 Other inputs

6.4.1 Modelling domain

Modelling has been undertaken using two grids: a fine 2.5 km x 2.5 km grid with a spatial resolution of 25 m, which has been used to calculate all tabulated results, and a wider 6 x 6 km grid with a spatial resolution of 60 m which has been used to produce contour plots of impacts that lie outside of the fine grid. Both grids have been modelled at 0 m and 1.5 m height. The fine grid has a resolution much less than the stack height and is considered sufficiently fine to accurate capture the maximum impact of emissions.

Reference to Figure 4 should be made to for a graphical representation of the modelling domain used. The extent of the modelling domain is detailed in Table 15.

Table 15: Modelling Domain

Grid quantity	Fine grid	Wide grid
Grid spacing (m)	25	60
Grid points	101	101
Grid Start X (m)	522500	520800
Grid Finish X (m)	525000	526800
Grid Start Y (m)	412000	410800
Grid Finish Y (m)	414500	416800

6.4.2 Meteorological data and surface characteristics

The dispersion modelling has been undertaken using weather data from the Humberside Airport meteorological recording station. Humberside Airport is approximately 14 km to the west of the Facility and is the most representative meteorological station available.

The EA recommends that five years of data are used to take into account inter-annual fluctuations in weather conditions. The period 2019 – 2023 has been used as this is the most recent five year period available. Wind roses for each year are presented in Figure 5.

The minimum Monin-Obukhov length can be selected in ADMS for both the dispersion site and the meteorological site. This is a measure of the minimum stability of the atmosphere and can be adjusted to account for urban heat island effects which prevent the atmosphere in urban areas from ever becoming completely stable. The minimum Monin-Obukhov length has been set to 1 m for the dispersion and meteorological sites, which is model default value recommended by CERC by rural areas. This value is considered appropriate for the mainly rural surroundings of the Facility and the meteorological site.

The surface roughness length utilised in ADMS can also be selected for both the dispersion site and meteorological site. There is considerable variation in surface roughness across the 6 x 6 km wider modelling domain, ranging from open water to built-up industrial areas. To account for the varying surface roughness length a spatially-varying surface roughness file has been used as a model input. The land-use class for each point in the file has been extracted from the CORINE Land Cover database[5] and cross-referenced with the most likely surface roughness length value[6].

A surface roughness length of 0.1 m has been selected for Humberside Airport. CERC recommends that this value is the maximum value suitable for “root crops” and is considered representative of the mainly open land around the meteorological station.

The parameters for the spatially-varying surface roughness file are shown in Table 16 and a visual representation provided in Figure 6.

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5 https://land.copernicus.eu/pan-european/corine-land-cover

6 Taken from “Roughness length classification of Corine Land Cover classes”, Megajoule Consultants, 2007.

Table 16: Spatially Varying Surface Roughness File Parameters

Parameter	Value
Grid spacing (m)	50
Grid points	150 x 150
Modelled resolution	64 x 64
Grid Start X (m)	520025
Grid Finish X (m)	527475
Grid Start Y (m)	410025
Grid Finish Y (m)	417475

Table 17: Surface Roughness Lengths Used for Different Land Use Classes

Land use classification	Corine 2018 land use codes	Surface roughness length (m)
Continuous urban fabric	111	1.2
Broad-leaved forest	311	0.75
Discontinuous urban fabric	112	0.5
Non-irrigated arable land, inland marshes, salt marshes	211, 411, 421	0.05
Natural grassland	323	0.03
Bare rock	332	0.005
Intertidal flats	423	0.0005
Water(1)	522, 523	0.0001
Note: *(1) The 'most likely' value for water is given as zero. ADMS cannot model a surface roughness length of zero, so areas of water have been assigned a roughness length of 0.0001 m which is the value recommended by CERC for 'sea'.*		

A summary of the meteorological parameters used in the dispersion modelling is shown in Table 18.

Table 18: Meteorological Parameters

Parameter	Dispersion site value (m)	Met site value (m)
Surface roughness length	Spatially varying	0.1
Minimum Monin-Obukhov length	1	1

The sensitivity of the modelling results to the choice of surface roughness has been considered in Section 7.1.

6.4.3 Terrain

It is recommended that, where gradients within 500 m of the modelling domain are greater than 1 in 10, the complex terrain module within ADMS (FLOWSTAR) should be used. A review of the local area shows mainly flat terrain, with no areas of gradients greater than 1 in 10 within the modelling domain. Therefore, terrain effects have not been considered further.

6.4.4 Buildings

The presence of adjacent buildings can significantly affect the dispersion of the atmospheric emissions in various ways:

- Wind blowing around a building distorts the flow and creates zones of turbulence. The increased turbulence can cause greater plume mixing.
- The rise and trajectory of the plume may be depressed slightly by the flow distortion. This downwash leads to higher ground level concentrations closer to the stack than those which would be present without the building.

The EA recommends that buildings should be included in the modelling if they are both:

- Within 5L of the stack (where L is the smaller of the building height and maximum projected width of the building); and
- Taller than 40% of the stack.

The ADMS 6 user guide also states that buildings less than one third of the stack height will not have any effect on the dispersion calculations in the model.

A review of the site layout has been undertaken and the details of the applicable buildings which may affect dispersion from the Facility are presented in Table 19. The buildings have been modelled at the height of the highest point of the structure. A site plan showing which buildings have been included in the model is presented in Figure 7.

Table 19: Building Details

Buildings	Centre point		Height (m)(2)	Length (m)	Width (m)	Angle (°)
	X (m)	Y (m)				
Process Bld 1(1)	523644.5	412872.7	29.0	64.0	32.0	43
Process Bld 2	523660.4	412848.4	18.5	77.5	24.0	43

Note:

(1) Selected as the main building in ADMS.

(2) Height above existing site level, as entered into the model. Subtract 2 m for height above development platform.

6.5 Chemistry

The Facility will release nitric oxide (NO) and nitrogen dioxide (NO_2) which are collectively referred to as NOx. In the atmosphere, nitric oxide will be converted to nitrogen dioxide in a reaction with ozone which is influenced by solar radiation. Since the air quality objectives are expressed in terms of nitrogen dioxide, it is important to be able to assess the conversion rate of nitric oxide to nitrogen dioxide.

Ground level NOx concentrations have been predicted through dispersion modelling. Nitrogen dioxide concentrations reported in the results section assume 70% conversion from NOx to nitrogen dioxide for annual means and a 35% conversion for short term (hourly) concentrations, based upon the worst-case scenario in the Environment Agency methodology. Given the short travel time to the areas of maximum concentrations, this approach is considered conservative.

6.6 Baseline concentrations

Background concentrations for the assessment have been derived from monitoring and national mapping as presented in section 4. For short term averaging periods, the background concentration has been assumed to be twice the long term ambient concentration following the Air Emissions Guidance methodology, with the exception of 8-hour rolling carbon monoxide for which a mapped background concentration is provided by Defra.

7 Sensitivity Analysis

7.1 Surface roughness

The sensitivity of the results to using spatially varying surface roughness length has been considered by running the model with a variety of surface roughness lengths for the dispersion site. For all sensitivity analyses the impact of changing model parameters on the maximum annual mean and short-term concentrations of oxides of nitrogen have been considered.

The following parameters were kept constant:

- Stack height – 49 m above existing site level;
- Grid – 2.5 x 2.5 km at 25 m resolution;
- Buildings – included;
- Meteorological site surface roughness – 0.1 m;
- Dispersion site Monin-Obukhov length – 1 m;
- Meteorological site Monin-Obukhov length – 1 m; and
- Meteorological data used – Humberside Airport 2023.

The contribution of the process emissions from the Facility to the ground level concentration of oxides of nitrogen at the point of maximum impact is presented in Table 20.

Table 20: Surface Roughness Sensitivity Analysis

Surface roughness (m)	Oxides of nitrogen PC					
	Annual mean		99.79%ile of 1-hour mean		Max 1-hour mean	
	Conc. (µg/m³)	% change from varying	Conc. (µg/m³)	% change from varying	Conc. (µg/m³)	% change from varying
Varying	**0.82**	-	**16.27**	-	**20.45**	-
0.02	0.87	5.93%	15.18	-6.74%	28.69	40.29%
0.05	0.94	13.67%	15.31	-5.94%	29.98	46.56%
0.1	0.98	18.53%	15.33	-5.80%	30.98	51.47%
0.2	1.03	24.89%	15.09	-7.28%	31.93	56.10%
0.3	1.05	27.98%	15.06	-7.49%	32.48	58.80%

Using any of the constant surface roughness values results in higher annual mean and maximum hourly concentrations compared to using the spatially varying surface roughness file. There is a slight decrease in the 99.79th percentile of hourly mean concentrations when using any of the constant surface roughness values compared to using the spatially varying surface roughness file.

Due to the sensitivity of the results to the choice of surface roughness length it is considered appropriate to use the spatially varying surface roughness file in the main model runs as this most accurately represents the variations in land use and surface roughness across the modelling domain.

7.2 Building parameters

The sensitivity of the results to the effect of buildings has been considered by running the model with and without the buildings presented in Table 19.

The following parameters were kept constant:

- Stack height – 49 m above existing site level;
- Grid – 2.5 x 2.5 km at 25 m resolution;
- Buildings – included;
- Dispersion site surface roughness – spatially varying at 64 x 64 resolution;
- Meteorological site surface roughness – 0.1 m;
- Dispersion site Monin-Obukhov length – 1 m;
- Meteorological site Monin-Obukhov length – 1 m; and
- Meteorological data used – Humberside Airport 2023.

The contribution of the process emissions from the Facility to the ground level concentration of oxides of nitrogen at the point of maximum impact is presented in Table 21 for each scenario.

Table 21: Effect of Buildings

Scenario used in model	Oxides of nitrogen PC (µg/m³)		
	Annual mean	99.79%ile of 1-hour mean	Max 1-hour mean
Including buildings	**0.82**	**16.27**	**20.45**
Excluding buildings	0.46	9.91	16.10
% change	-44.18%	-39.11%	-21.28%

Modelling the presence of buildings results in higher annual mean and maximum hourly mean concentrations at the point of maximum impact. Buildings have been included in the dispersion model as this is a realistic approach.

7.3 Operating below the design point

Dispersion modelling has been undertaken using the emission parameters based on the design point for the Facility. The Facility will be operated as a commercial plant, so it is beneficial to operate at full capacity. If loading does fall below the design point the volumetric flow rate and the exit velocity of the exhaust gases would reduce. The effect of this would be to decrease the quantity of pollutants emitted but also to reduce the buoyancy of the plume due to momentum. The reduction in buoyancy, which would lead to reduced dispersion, would be more than offset by the decrease in the amount of pollutants being emitted, so that the impact of the plant when running below the design point would be reduced.

8 Impact on Human Health

8.1 At the point of maximum impact

Table 22 and Table 23 present the results of the dispersion modelling of process emissions from the Facility at the point of maximum impact. This is the maximum predicted concentration based on the following:

- Modelling domain size – 2.5 km x 2.5 km grid with a spatial resolution of 25 m, and a wide grid of 6 km x 6 km with a spatial resolution of 60 m;
- Buildings – included;
- Stack height – 49 m above existing site level, 47 m above development platform;
- Five years of weather data 2019 to 2023 from Humberside Airport meteorological recording station;
- Operation at the long term ELVs for 100% of the year;
- Operation at the short term ELVs during the worst-case conditions for dispersion of emissions (Table 23 only);
- EA's worst case 70% conversion of oxides of nitrogen to nitrogen dioxide;
- The entire VOC emissions are assumed to consist of benzene; and
- Cadmium is released at the combined emission limit for cadmium and thallium.

The baseline concentration is taken from the review of baseline monitoring contained in section 4.

Impacts that cannot be screened out as 'insignificant' are highlighted. Where the impact cannot be screened out as 'insignificant', further analysis has been undertaken.

Table 22: Dispersion Modelling Results – Point of Maximum Impact - Operation at Daily ELVs

Pollutant	Quantity	Units	AQAL	Bg Conc.	PC at Point of Maximum Impact						Max as % of AQAL	PEC (PC +Bg)	PEC as % of AQAL
					2019	2020	2021	2022	2023	Max			
Nitrogen dioxide	Annual mean	µg/m³	40	21.77	0.49	0.56	0.43	0.48	0.58	0.58	**1.44%**	22.35	55.87%
	99.79th %ile of hourly means	µg/m³	200	43.54	5.62	5.61	5.87	5.91	5.70	5.91	2.96%	49.45	24.73%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	7.42	1.21	1.39	1.31	1.41	1.64	1.64	1.31%	9.06	7.25%
	99.73rd %ile of hourly means	µg/m³	350	7.42	3.91	3.93	4.07	4.14	3.94	4.14	1.18%	11.56	3.30%
	99.9th %ile of 15 min. means	µg/m³	266	7.42	4.65	4.54	4.81	4.83	4.71	4.83	1.82%	12.25	4.60%
PM_{10}	Annual mean	µg/m³	40	16.20	0.03	0.03	0.03	0.03	0.03	0.03	0.09%	16.23	40.59%
	90.41st %ile of daily means	µg/m³	50	32.40	0.11	0.12	0.09	0.11	0.12	0.12	0.25%	32.52	65.05%
$PM_{2.5}$	Annual mean	µg/m³	20	7.95	0.03	0.03	0.03	0.03	0.03	0.03	0.17%	7.98	39.92%
		µg/m³	10	7.95	0.03	0.03	0.03	0.03	0.03	0.03	0.34%	7.98	79.84%
Carbon monoxide	8 hour running mean	µg/m³	10,000	1,647	5.00	5.80	5.72	5.19	5.41	5.80	0.06%	1652.8	16.53%
	Hourly mean	µg/m³	30,000	468	10.35	11.49	9.81	8.05	8.52	11.49	0.04%	479.5	1.60%
Hydrogen chloride	Hourly mean	µg/m³	750	1.52	1.24	1.38	1.18	0.97	1.02	1.38	0.18%	2.90	0.39%
Hydrogen fluoride	Annual mean	µg/m³	16	2.35	0.01	0.01	0.01	0.01	0.01	0.01	0.04%	2.36	14.73%
	Hourly mean	µg/m³	160	4.70	0.21	0.23	0.20	0.16	0.17	0.23	0.14%	4.93	3.08%
Ammonia	Annual mean	µg/m³	180	1.40	0.06	0.07	0.05	0.06	0.07	0.07	0.04%	1.47	0.82%
	Hourly mean	µg/m³	2,500	2.80	2.07	2.30	1.96	1.61	1.70	2.30	0.09%	5.10	0.20%

Pollutant	Quantity	Units	AQAL	Bg Conc.	PC at Point of Maximum Impact						Max as % of AQAL	PEC (PC +Bg)	PEC as % of AQAL
					2019	2020	2021	2022	2023	Max			
VOCs (as benzene)	Annual mean	µg/m³	5	0.61	0.06	0.07	0.05	0.06	0.07	0.07	**1.37%**	0.68	13.57%
	Daily mean	µg/m³	30	1.22	0.53	0.61	0.70	0.53	0.70	0.70	2.33%	1.92	6.40%
Mercury	Daily mean	ng/m³	60	4.20	1.06	1.23	1.40	1.06	1.40	1.40	2.33%	5.60	9.33%
	Hourly mean	ng/m³	600	4.20	4.14	4.59	3.93	3.22	3.41	4.59	0.77%	8.79	1.47%
Cadmium	Annual mean	ng/m³	5	0.15	0.12	0.13	0.10	0.11	0.14	0.14	**2.75%**	0.29	5.75%
	Daily mean	ng/m³	30	0.30	1.06	1.23	1.40	1.06	1.40	1.40	4.66%	1.70	5.66%
PAHs	Annual mean	pg/m³	250	110	1.16	1.34	1.02	1.13	1.37	1.37	0.55%	111.4	44.55%
Dioxins, furans and dioxin-like PCBs	Annual mean	fg/m³	-	32.99	0.35	0.40	0.31	0.34	0.41	0.41	-	33.40	-
PCBs	Annual mean	ng/m³	200	0.129	0.03	0.03	0.03	0.03	0.03	0.03	0.02%	0.16	0.08%
	Hourly mean	ng/m³	6,000	0.258	1.03	1.15	0.98	0.80	0.85	1.15	0.02%	1.41	0.02%
Other metals	Annual mean	ng/m³	-	-	1.74	2.01	1.53	1.70	2.06	2.06	See metals assessment – Section 8.3		
	Daily mean	ng/m³	-	-	15.96	18.43	20.93	15.93	20.98	20.98			
	Hourly mean	ng/m³	-	-	62.08	68.92	58.89	48.29	51.14	68.92			

Note:
All assessment is based on the maximum PC using all five years of weather data.

Table 23: Dispersion Modelling Results – Point of Maximum Impact - Short-Term ELVs

Pollutant	Quantity	Units	AQAL	Bg Conc.	PC at Point of Maximum Impact						Max as % of AQAL	PEC (PC +Bg)	PEC as % of AQAL
					2014	2015	2016	2017	2018	Max			
Nitrogen dioxide	99.79th%ile of hourly means	µg/m³	200	43.54	18.73	18.70	19.58	19.70	18.99	19.70	9.85%	63.24	31.62%
Sulphur dioxide	99.73rd%ile of hourly means	µg/m³	350	7.42	26.08	26.18	27.15	27.63	26.29	27.63	7.89%	35.05	10.01%
	99.9th%ile of 15 min. means	µg/m³	266	7.42	30.98	30.25	32.06	32.20	31.41	32.20	**12.10%**	39.62	14.89%
Carbon monoxide	8 hour running mean	µg/m³	10,000	468	14.99	17.40	17.17	15.58	16.23	17.40	0.17%	485.40	4.85%
	Hourly mean	µg/m³	30,000	468	31.04	34.46	29.44	24.15	25.57	34.46	0.11%	502.46	1.67%
Hydrogen chloride	Hourly mean	µg/m³	750	1.52	12.43	13.79	11.79	9.67	10.24	13.79	1.84%	15.31	2.04%
Hydrogen fluoride	Hourly mean	µg/m³	160	4.70	0.83	0.92	0.79	0.64	0.68	0.92	0.57%	5.62	3.51%

Note:
All assessment is based on the maximum PC using all five years of weather data and operation at the short-term ELVs

As shown, at the point of maximum impact the contribution of the process emissions from the Facility is less than 10% of the short-term AQAL and less than 1% of the annual mean AQAL and can be screened out as 'insignificant', with the exception of the following:

- Annual mean nitrogen dioxide impacts;
- Annual mean VOC impacts (as benzene);
- Annual mean cadmium impacts; and
- 99.9th percentile of 15-minute mean sulphur dioxide impacts.

The design of the Facility includes a caustic wet scrubber stage in the flue gas treatment system which would be expected to remove almost all sulphur dioxide (along with other acid gases such as hydrogen chloride and hydrogen fluoride), such that residual emission concentrations will be well below the ELVs. Therefore, the predicted worst-case sulphur dioxide impacts would not occur in reality. Nonetheless, further assessment of these impacts has been undertaken assuming that the Facility operates at the half-hourly ELVs during the worst-case weather conditions for dispersion.

8.2 Further assessment

8.2.1 Annual mean impacts

The annual mean impacts at the identified human receptor locations are presented in Table 24.

Table 24: Annual Mean Impacts at Sensitive Receptors

Receptor	Nitrogen dioxide		VOCs (as benzene)		Cadmium	
	PC µg/m³	% AQAL	PC µg/m³	% AQAL	PC µg/m³	% AQAL
R1	0.04	0.11%	0.005	0.10%	0.010	0.21%
R2	0.04	0.09%	0.004	0.09%	0.009	0.18%

As shown, for all pollutants for which the annual mean impact at the point of maximum impact cannot be screened out as 'insignificant', the impacts at receptor locations are much less than 1% of the AQALs and are screened out as 'insignificant'. This is based on the conservative assumptions that all VOCs are emitted as benzene and that cadmium is emitted at the combined cadmium and thallium ELV.

The following plot files illustrate the spatial distribution of emissions, showing that there are no areas of relevant exposure where the impact exceeds 1% of the AQAL:

- Figure 8: Annual Mean Nitrogen Dioxide;
- Figure 9: Annual Mean VOCs as Benzene; and
- Figure 10: Annual Mean Cadmium.

8.2.2 Short-term impacts

The short-term impacts on 15 minute mean concentrations of sulphur dioxide are greater than 10% of the AQAL and cannot be screened out as 'insignificant'. Therefore, the maximum PC has been compared to the headroom. As detailed in section 3.1, where the PC is less than 20% of the headroom the impact can be considered 'not significant'. The results are presented in Table 25.

Table 25: 15-Min Mean Sulphur Dioxide Impacts as Percentage of Headroom

Pollutant and averaging period	Headroom (µg/m³)	PC µg/m³	PC as % of headroom
99.9th %ile of 15-min mean sulphur dioxide	258.6	32.20	12.45%

As shown, the PC is less than 20% of the headroom, so the impacts are described as 'not significant'. As noted in section 4.2 this is based on a conservative choice of baseline concentrations, along with the conservative assumption that the Facility operates at the half-hourly ELV during the worst-case weather conditions for dispersion (which is highly unlikely due to the caustic scrubber included in the design). Therefore, the impacts as a percentage of the headroom are anticipated to be even less in reality.

Figure 11 illustrates the spatial distribution for 15-minute mean sulphur dioxide emissions. This shows that there are no areas of relevant public exposure where the PC as the 99.9th percentile of 15-minute mean sulphur dioxide exceeds 10% of the AQAL. In addition, as noted in section 8.1 the design of the Facility includes a caustic scrubber which will ensure emissions of sulphur dioxide are well below the daily ELV. Therefore, it is anticipated that the emission concentration will not approach the half-hourly ELV. Even under the conservative assumption that emissions are at the half-hourly ELV during the worst-case weather conditions for dispersion, there are no areas of relevant exposure where the impact exceeds 10% of the AQAL; therefore, all impacts at areas of relevant exposure can be screened out as 'insignificant'.

8.3 Heavy metals – at the point of maximum impact

Table 26 and Table 27 detail the impact of process emissions from the Facility and the PEC assuming that each metal is released at the ELV for group 3 metals. If the PC is greater than 1% of the long-term or 10% of the short-term AQAL and the PEC exceeds the AQAL when it is assumed that each metal is emitted at the ELV, further analysis has been undertaken assuming the release of each metal is no greater than the maximum reported in the EA metals guidance[7].

[7] Guidance on Assessing group 3 metal stack emissions from incinerators, Environment Agency, 2016

Table 26: Long-Term Metals Results – Point of Maximum Impact

Metal	AQAL	Baseline conc.	Metals emitted at combined metal limit				Metal as % of ELV [1]	Each metal emitted at the maximum concentration from the EA metals guidance document			
			PC		PEC			PC		PEC	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	6	0.66	2.06	**34.34%**	2.72	45.34%	8.3%	0.17	**2.86%**	0.83	13.86%
Antimony	5,000	1.30	2.06	0.04%	3.36	0.07%	3.8%	0.08	0.00%	1.38	0.03%
Chromium	-	0.82	2.06	-	2.88	-	30.7%	0.63	-	1.45	-
Chromium (VI)	0.25	0.16	2.06	**824.1%**	2.22	**889.7%**	0.043%	0.00	0.36%	0.16	65.96%
Cobalt	-	0.06	2.06	-	2.12	-	1.9%	0.04	-	0.10	-
Copper	-	4.70	2.06	-	6.76	-	9.7%	0.20	-	4.90	-
Lead	250	5.70	2.06	0.82%	7.76	3.10%	16.8%	0.35	0.14%	6.05	2.42%
Manganese	150	3.70	2.06	**1.37%**	5.76	3.84%	20.0%	0.41	0.27%	4.11	2.74%
Nickel	20	0.81	2.06	**10.30%**	2.87	14.35%	73.3%	1.51	**7.55%**	2.32	11.60%
Vanadium	-	1.20	2.06	-	3.26	-	2.0%	0.04	-	1.24	-

Notes:

[1] *Metal as maximum percentage of the group 3 metals ELV, recalculated from the data presented in EA metals guidance document (V.4) Table A1.*

Table 27: Short-Term Metals Results – Point of Maximum Impact

Metal	AQAL	Baseline conc.	Metals emitted at combined metal limit				Metal as % of ELV [1]	Each metal emitted at the maximum concentration from the EA metals guidance document			
			PC		PEC			PC		PEC	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	-	1.32	68.92	-	70.24	-	8.3%	5.74	-	7.06	-
Antimony	150,000	2.60	68.92	0.05%	71.52	0.05%	3.8%	2.64	<0.01%	5.24	<0.01%
Chromium[2]	2,000	1.64	20.98	1.05%	22.62	1.13%	30.7%	6.44	0.32%	8.08	0.40%
Chromium (VI)	-	0.33	68.92	-	69.25	-	0.043%	0.03	-	0.36	-
Cobalt	-	0.12	68.92	-	69.04	-	1.9%	1.29	-	1.41	-
Copper[2]	50	9.40	20.98	**41.97%**	30.38	60.77%	9.7%	2.03	4.06%	11.43	22.86%
Lead	-	11.40	68.92	-	80.32	-	16.8%	11.56	-	22.96	-
Manganese	1,500,000	7.40	68.92	<0.01%	76.32	0.01%	20.0%	13.78	<0.01%	21.18	<0.01%
Nickel	700	1.62	68.92	9.85%	70.54	10.08%	73.3%	50.54	7.22%	52.16	7.45%
Vanadium[2]	1,000	2.40	20.98	2.10%	23.38	2.34%	2.0%	0.42	0.04%	2.82	0.28%

Notes:

[1] *Metal as maximum percentage of the group 3 metals ELV, recalculated from the data presented in EA metals guidance document (V.4) Table A1.*

[2] *All impacts maximum 1-hour PC with the exception of chromium, copper, and vanadium, which are the maximum 24-hour PC.*

As shown in Table 26 and Table 27, if it is assumed that the entire emissions of metals consist of only one metal, the impact of process emissions from the Facility is less than 1% of the long-term and less than 10% of the short-term AQAL, with the exception of annual mean impacts of arsenic, chromium (VI), manganese, and nickel, and short-term impact of copper. The PC is only predicted to exceed the long-term AQAL for chromium (VI) using this worst-case screening assumption. If it is assumed that process emissions from the Facility are the maximum values reported in the Environment Agency's metals guidance, the PC is below 1% of the long term and 10% of the short term AQAL for all pollutants except for annual mean arsenic and nickel. However, for all of these pollutants the PEC is well below the AQALs. Therefore, the impact of emissions of metals can be screened out and is considered to be 'insignificant'.

9. Impact at Ecological Receptors

This section provides an assessment of the impact of emissions at the ecological receptors identified in Section 5.2.

9.1 Methodology

9.1.1 Atmospheric emissions – Critical Levels

The impact of process emissions from the Facility has been compared to the Critical Levels listed in Table 3 and the results are presented in Section 9.2.

For the purpose of the ecological assessment, the mapped background dataset from APIS has been used. If the PC is than 1% of the long-term or 10% of the short-term Critical Level further consideration will be made to the baseline concentrations.

9.1.2 Deposition of emissions - Critical Loads

In addition to the Critical Levels for the protection of ecosystems, habitat specific Critical Loads for nature conservation sites at risk from acidification and nitrogen deposition (eutrophication) are outlined in APIS. The Critical Loads and background levels of deposition appropriate to each habitat are presented in Appendix B.

APIS includes Critical Loads for sand dune habitats for the Humber Estuary designated sites. The ecologist for the project, Artemis Ecological Consulting Limited, has advised that no sand dune priority habitat has been identified in the area where there may be a potentially significant effect due to emissions from the Facility, and all relevant coastal priority habitat for the Humber Estuary designations are saltmarsh and mudflats. However, as there are sand dune habitats within 10 km of the stack, the impact at the closest sand dune habitat to the Facility (8.5 km to the south-east in Cleethorpes) has been considered in this assessment for completeness. This point lies outside of the modelling domain so an additional model run has been undertaken without the spatially varying surface roughness file to obtain the predicted PC (a surface roughness of 0.02 m has been used).

If the impact of process emissions from the Facility upon nitrogen and acid deposition is greater than 1% of the Critical Load, further assessment has been undertaken.

9.1.3 Calculation methodology

9.1.3.1 Nitrogen deposition

The impact of deposition has been assessed using the methodology detailed within the Habitats Directive AQTAG06[8] (March 2014). The steps to this method are as follows.

1. Determine the annual mean ground level concentrations of nitrogen dioxide and ammonia at each site.
2. Calculate the dry deposition flux (µg/m^2/s) at each site by multiplying the annual mean ground level concentration by the relevant deposition velocity presented in Table 28.

[8] Air Quality Advisory Group, AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air, March 2014

3. Convert the dry deposition flux into units of kgN/ha/yr using the conversion factors presented in Table 28.
4. Compare this result to the nitrogen deposition Critical Load.

Table 28: Deposition Factors

Pollutant	Deposition Velocity (m/s)		Conversion Factor ($\mu g/m^2/s$ to kg/ha/year)
	Grassland	Woodland	
Nitrogen dioxide	0.0015	0.003	96.0
Ammonia	0.0200	0.030	259.7

9.2 Results – atmospheric emissions - Critical Levels

The impact of process emissions from the Facility has been compared to the Critical Levels and the results are presented in Table 29 and Table 30. If the PC of a particular pollutant is greater than 1% of the long-term or 10% of the short-term Critical Level at a European or UK designated site, or 100% of the long- or short-term Critical Level at a local nature site, further assessment would be undertaken. The PC has been calculated based on the maximum predicted in each designated site using all five years of weather data. This assumes operation at the daily ELVs as set out in Table 14.

Table 29: Process Contribution at Designated Ecological Sites – µg/m³

ID	Site	NOx		SO_2	HF		NH_3
		Annual Mean	Daily Mean	Annual Mean	Weekly Mean	Daily Mean	Annual Mean
E1	Humber Estuary SAC/SPA/Ramsar/SSSI (max within site)	0.72	7.144	0.179	0.026	0.059	0.060
	Humber Estuary SAC/SPA/Ramsar/SSSI (sand dune habitat)	0.01	0.129	0.002	<0.001	0.001	0.001
E2	Sweedale Croft Drain LWS	0.05	1.185	0.012	0.003	0.010	0.004
E3	Healing Cress Beds LWS	0.06	0.916	0.015	0.004	0.008	0.005
E4	Tioxide west fields LWS	0.03	0.887	0.009	0.002	0.007	0.003
E5	Humber Estuary FLL	0.25	5.137	0.062	0.019	0.043	0.021
E6	Mitigation Areas	0.20	2.862	0.050	0.008	0.024	0.017

Table 30: Process Contribution at Designated Ecological Sites – as % of Critical Level

ID	Site	NOx		SO_2	HF		NH_3
		Annual Mean	Daily Mean	Annual Mean	Weekly Mean	Daily Mean	Annual Mean
E1	Humber Estuary SAC/SPA/Ramsar/SSSI (max within site)	**2.39%**	9.53%	0.90%	5.14%	1.19%	**1.99%**
	Humber Estuary SAC/SPA/Ramsar/SSSI (sand dune habitat)	0.02%	0.17%	0.02%(1)	0.07%	0.02%	0.06%(1)
E2	Sweedale Croft Drain LWS	0.16%	1.58%	0.06%	0.54%	0.20%	0.14%
E3	Healing Cress Beds LWS	0.20%	1.22%	0.08%	0.84%	0.15%	0.17%
E4	Tioxide west fields LWS	0.12%	1.18%	0.04%	0.39%	0.15%	0.10%
E5	Humber Estuary FLL	0.83%	6.85%	0.31%	3.88%	0.86%	0.69%
E6	Mitigation Areas	0.66%	3.82%	0.25%	1.52%	0.48%	0.55%

Note: Assessed against lower Critical Levels of 10 µg/m³ for SO_2 and 1 µg/m³ for NH_3 for lichens/bryophytes in sand dune habitat.

As shown, at all designated sites the PC from the Facility is less than the screening criteria and can be screened out as 'insignificant' for all pollutants considered, with the exception of annual mean NOx and ammonia at the maximum impacted location in the Humber Estuary designated site.

For those pollutants where the impact cannot be screened out consideration has been given to the PEC, taking the maximum baseline concentration from APIS for the area of maximum impact. The results are presented in Table 31.

Table 31: Further Assessment of Ecological Impacts

Pollutant	Background		PC		PEC	
	µg/m³	% CL	µg/m³	% CL	µg/m³	% CL
Humber Estuary designated site						
Annual mean NOx	16.9	56.33%	0.72	2.39%	17.62	58.72%
Annual mean NH_3	1.4	46.67%	0.060	1.99%	1.46	48.65%

As shown, for annual mean oxides of nitrogen and ammonia, the PEC remains below 70% of the Critical Level and can be screened out as 'not significant'.

Given the very small PCs at the receptors within 2 km of the Facility, it is considered that the PCs at the North Killingholme Haven Pits SSSI (which has not been included as a receptor) will be imperceptible.

The following plot files show impacts that cannot be screened out as 'insignificant':

- Figure 12: Annual Mean Oxides of Nitrogen; and
- Figure 13: Annual Mean Ammonia.

9.3 Results - deposition of emissions - Critical Loads

Appendix C presents the results at each of the identified statutory designated ecological receptors. As shown, at all designated sites the contribution from process emissions from the Facility is less than the screening criteria and can be screened out as 'insignificant' at all designated sites considered, with the exception of nitrogen deposition on saltmarsh habitat at the Humber Estuary Designated Site, which slightly exceeds 1% of the Critical Load in the worst-case year of weather data. However, as nitrogen deposition has long-term multi-year effects, it is appropriate to consider nitrogen impacts averaged over the five years of weather data. This analysis is shown in Table 32.

Table 32: Nitrogen Deposition Impact in Worst-Case and Average of Weather Years

Site	Nitrogen Deposition Impact as % of Critical Load	
	Max met year	Average over five years
Humber Estuary	1.08%	0.93%

As shown, when interannual variability is taken into account, the nitrogen deposition impact less than 1% of the Critical Load and can be screened out as 'insignificant'. A plot file of nitrogen deposition based on the average of the five years of weather data is provided as Figure 14.

Given the very small PCs at the receptors within 2 km of the Facility, it is considered that the PCs at the North Killingholme Haven Pits SSSI (which has not been included as a receptor) will be imperceptible.

10 Cumulative Assessment

10.1 Identification of cumulative point source emissions

As noted in section 4, the impact of operational point sources close to the Facility will be included in the mapped background concentrations which have been used to inform the analysis of baseline pollutant concentrations, so do not need to be considered explicitly in the dispersion modelling assessment.

A number of additional point sources in the local area have planning consent and/or an EP to operate but are not yet operational; these have the potential to have a cumulative impact with emissions from the Facility. The consultation response issued by the EA and Scoping Opinion issued by NELC included lists of cumulative schemes to consider for inclusion in the cumulative assessment. These are presented in Appendix D, along with a justification as to whether the development has been included or excluded from the cumulative assessment.

Taking the pattern of the dispersion of emissions from the Facility into account, it is considered that there is no risk of a significant cumulative impact from point source emitters located more than 3 km from the Facility, as the plumes from more distant point sources would not overlap with that of the Facility. Should any significant cumulative impacts be identified from such distant sources, the contribution from the Facility to those cumulative impacts would be imperceptible. The exception would be if a large point source were located more than 3 km south-west (upwind) of the Facility, the plume from which may overlap the plume from the Facility. However, no projects meeting this description have been identified. In addition, it is considered that there is minimal risk of significant short-term cumulative impacts as the instantaneous plumes from multiple sources would not significantly overlap, and the short-term PECs resulting from the operation of the Facility are all well below the relevant AQALs and Critical Levels.

As detailed in Appendix D the following point sources have been identified for inclusion in the cumulative assessment:

1. EP Waste Management Ltd, Stallingborough EfW (EPR/QP3300LN, planning ref DCO EN010107), also referred to as the South Humber Bank Energy Centre, (SHBEC)
2. Fluid Ice Tyre Pyrolysis Facility (planning ref DM1103/22/FUL);
3. Velocys Waste to Jet Fuel (DM 0664/19/FUL);
4. Great Coates Energy Ltd - Waste to Energy (DM/0329/18/FUL); and
5. Carbon fibre manufacturing (DM/0579/24/FUL).

Model inputs for each of these cumulative developments are detailed in Appendix E and the location of each source shown on Figure 15.

The assessment detailed in section 8 shows that the impacts of the Facility on human health can be screened out as 'insignificant' at all areas of relevant exposure, irrespective of the PEC. Therefore, it is considered that there is no potential for a significant cumulative impact on human health or a significant short-term cumulative impact on ecology. Therefore, this assessment has considered long-term impacts on ecology only. In addition, the impacts of the Facility on the sand dune habitat (<0.1% of the long-term Critical Level or Load) are so small as to be considered inconsequential either alone or in-combination, so impacts on the sand dune habitat have been excluded from the cumulative assessment.

Cumulative impacts due to emissions of dioxins and furans has been considered separately in the Dioxin Pathway Intake Assessment submitted with the application. The emissions of dioxins from each source are detailed in Appendix E.

10.2 Results

10.2.1 Atmospheric emissions - Critical Levels

The cumulative impact of process emissions from the Facility and the identified cumulative schemes has been compared to the Critical Levels and the results are presented in Appendix F. The PC has been calculated based on the maximum predicted impact in each designated site using all five years of weather data. This assumes all sources operate continually at the daily ELVs or emissions concentrations.

The results have been presented for the overall point of maximum cumulative impact and at the point of maximum impact of emissions from the Facility. As shown, although the cumulative impacts exceed the 1% screening criteria at the Humber Estuary designated site and FLL, the cumulative PC does not exceed 70% of the Critical Level for any pollutant. Therefore, no significant effects are predicted.

10.2.2 Deposition of emissions - Critical Loads

The cumulative impact of process emissions from the Facility and the identified cumulative schemes has been compared to the Critical Levels and the results are presented in Appendix G. The PC has been calculated based on the maximum predicted impact in each designated site using all five years of weather data. This assumes all sources operate continually at the daily ELVs or emissions concentrations.

The results have been presented for the overall point of maximum cumulative impact. For the Humber Estuary designated site the results are presented for the sensitive saltmarsh habitat closest to the Facility. The FLL is arable and not sensitive to nitrogen deposition. Each of the local wildlife sites have been assessed using a single point, and the maximum cumulative impact in the mitigation areas occurs at the same point as the maximum impact of the Facility. Therefore, the maximum deposition impact of the Facility coincides with the maximum cumulative impact for all receptors considered.

As shown, the cumulative nitrogen deposition impact for saltmarsh at the Humber Estuary designated site 8.31% of the Critical Load, so exceeds the screening criteria. The PEC exceeds the Critical Load. However, only 1.08% of this is due to emissions from the Facility, falling to 0.93% when interannual variability is considered (as discussed in section 9.3). The remainder of the impact is due to emissions from the Stallingborough EfW (SHBEC), Great Coates Waste to Energy, and carbon fibre manufacturing projects. The significance of this effect has been assessed by the project ecologist as ‘not significant’.

11 Conclusions

This Dispersion Modelling Assessment has been undertaken to support an application for an EP for the Facility. This has been undertaken based on the assumption that the Facility will operate continually at the emission limits compliant with the BAT-AELs set out in the WI BREF for new plants.

This assessment has included a review of baseline pollution levels, dispersion modelling of emissions and quantification of the impact of these emissions on local air quality.

The primary conclusions of the assessment are presented below.

1. In relation to the impact on human health:
    a. Emissions from the operation of the Facility will not cause a breach of any AQAL.
    b. The overall impact of long-term process emissions associated with the operation of the Facility can be considered 'insignificant' or 'not significant' in accordance with EA screening criteria at the point of maximum impact and at all identified human sensitive receptors.
    c. The overall impact of short-term process emissions associated with the operation of the Facility can be screened out as 'insignificant' in accordance with EA screening criteria at the point of maximum impact, except for 15-minute mean sulphur dioxide. However, this impact does not occur in an area of relevant exposure; in addition, as the PC is less than 20% of the headroom, there is little risk of exceedance of the AQAL so the impact is 'not significant'.
2. In relation to the impact on ecologically sensitive sites, all impacts can be screened out as 'insignificant' or 'not significant'.
3. Emissions from the identified cumulative sources which have planning consent or an EP to operate but are not yet operational would not result in a significant cumulative impact on human health.
4. Cumulative impacts on ecological receptors can be screened out as 'insignificant' or 'not significant' except for nitrogen deposition impacts at the Humber Estuary SPA/Ramsar Site/SSSI. Further analysis undertaken by the project ecologist has concluded no significant effects are likely.

In summary, the assessment has shown that the operation of the Facility will not result in any significant air quality effects. As such, there should be no air quality constraint in granting an EP to operate the Facility.

Appendices

A Figures

Legend

Site location

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 1. Site Location

Drawn by: SMN | Date: 21/01/2025

0 0.5 1 2 km

Scale: 1:50,000

FICHTNER
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Kingsgate, Wellington Road North,
Stockport, Cheshire, SK4 1LW
Tel: 0161 476 0032
Fax: 0161 474 0618

Legend

- Site boundary
- Stack
- Human sensitive receptors

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 2. Human receptors

Drawn by: SMN	Date: 21/01/2025

0 0.1 0.2 0.4 km

Scale: 1:10,000

N

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Stockport, Cheshire, SK4 1LW
Tel: 0161 476 0032
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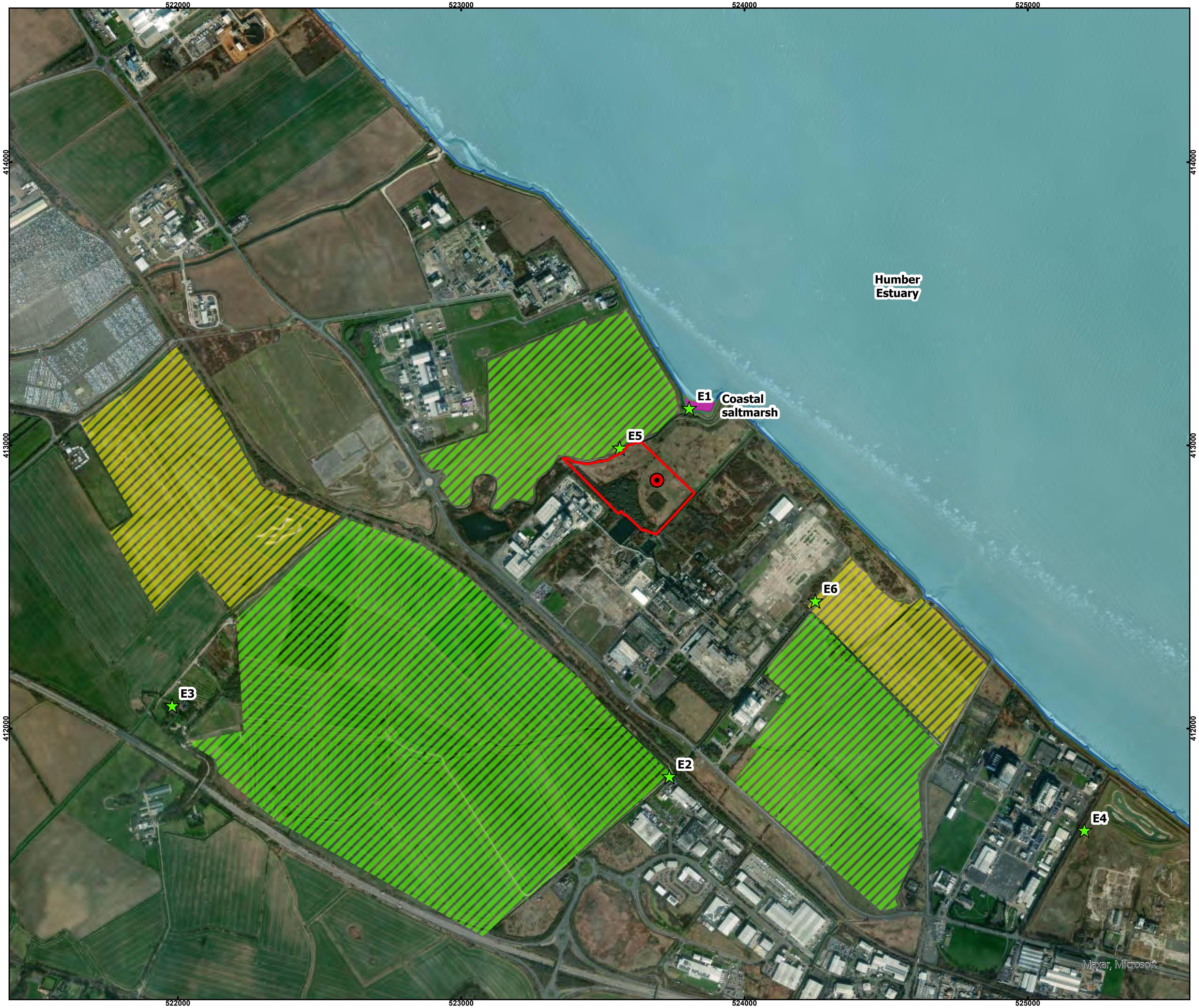

Legend

- Site boundary
- Stack
- Ecological sensitive receptors
- Coastal saltmarsh
- Humber Estuary SPA
- Functionally linked land
- Mitigation areas

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 3. Ecological receptors

Drawn by: SMN	Date: 21/01/2025

0 0.13 0.25 0.5 km

N

Scale: 1:12,500

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Legend

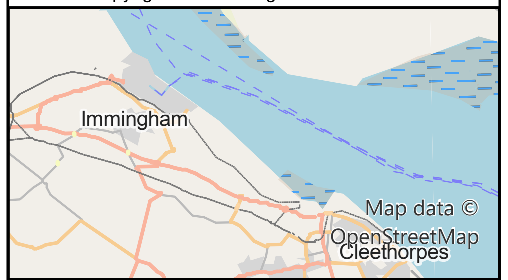
- Stack
- Site boundary
- Wide grid extent
- Fine grid extent

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 4. Modelling domain

Drawn by: SMN	Date: 21/01/2025



0 0.23 0.45 0.9 km

Scale: 1:24,000

N

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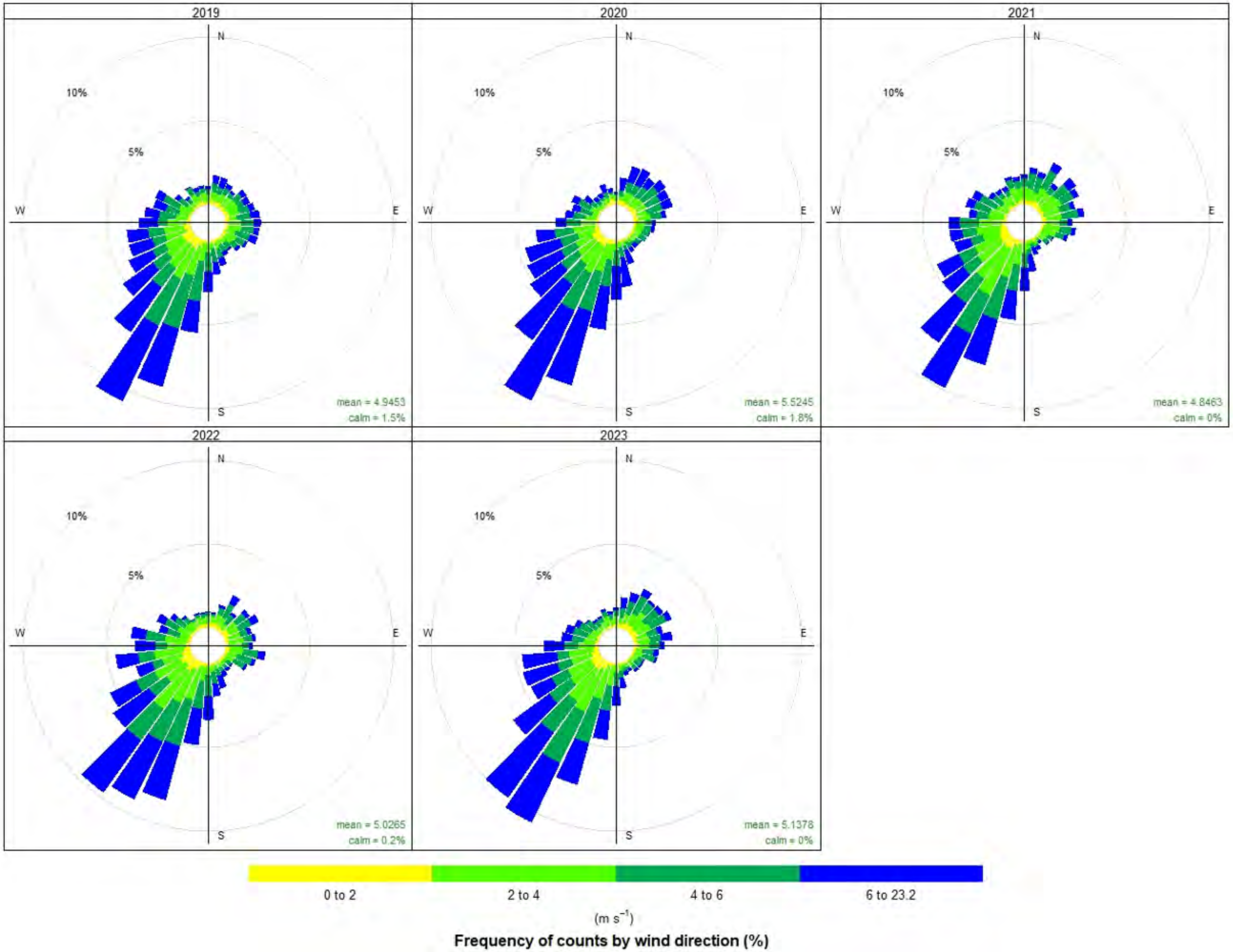
Stockport, Cheshire, SK4 1LW
Tel: 0161 476 0032
Fax: 0161 474 0618



Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 5. Wind roses - Humberside Airport 2019 - 2023

Drawn by: SMN	Date: 21/01/2025

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Legend

Site boundary

Stack

Surface roughness (m)

- 0.0001
- 0.0005
- 0.005
- 0.03
- 0.05
- 0.5
- 0.75
- 1.2

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment
Title:	

Figure 6. Surface roughness file

Drawn by: SMN | Date: 21/01/2025

Scale: 1:30,000

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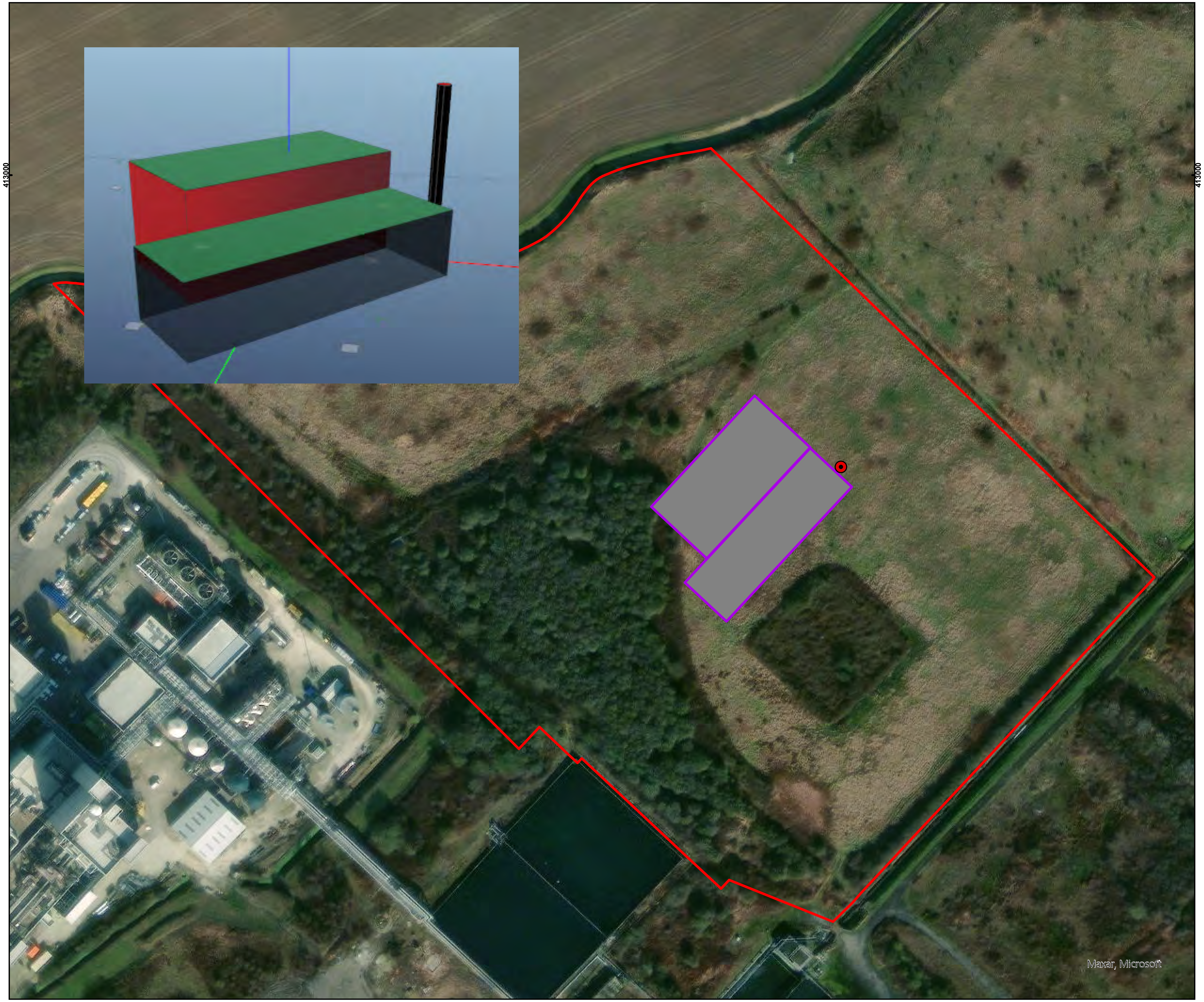
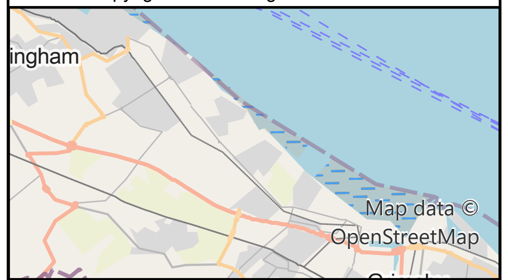


Legend

- Stack
- Site boundary
- Buildings modelled

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment
Title:	Figure 7. Buildings modelled

Drawn by: SMN	Date: 21/01/2025



0 0.01 0.03 0.06 km

Scale: 1:1,500

N

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Legend

- Site boundary
- Stack
- Human sensitive receptors
- Annual mean nitrogen dioxide as % of AQAL

Notes:
Assumes 70% NOx to NO2 conversion rate

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 8. Annual mean nitrogen dioxide

Drawn by: SMN	Date: 21/01/2025

0 0.13 0.25 0.5 km

Scale: 1:12,500

N

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Tel: 0161 476 0032
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Legend

- Site boundary
- Stack
- Human sensitive receptors
- Annual mean benzene as % of AQAL

Notes:
Assumes all VOCs are emitted as benzene

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 9. Annual mean VOCs as benzene

Drawn by: SMN	Date: 21/01/2025

0 0.13 0.25 0.5 km

Scale: 1:12,500

N

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Legend

- Site boundary
- Stack
- Human sensitive receptors
- Annual mean cadmium as % of AQAL

Notes:
Assumes cadmium emitted at the combined cadmium and thallium ELV

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 10. Annual mean cadmium

Drawn by: SMN | Date: 21/01/2025

0 0.17 0.35 0.7 km
N

Scale: 1:17,500

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Legend

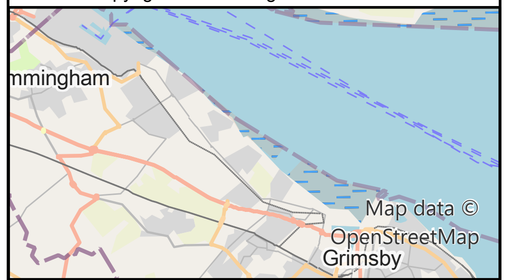
- Site boundary
- Stack
- Human sensitive receptors
- 99.9th percentile of 15 min mean SO2 as % of AQAL

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 11. 15-minute mean sulphur dioxide

Drawn by: SMN	Date: 21/01/2025



0 0.05 0.1 0.2 km

N

Scale: 1:7,000

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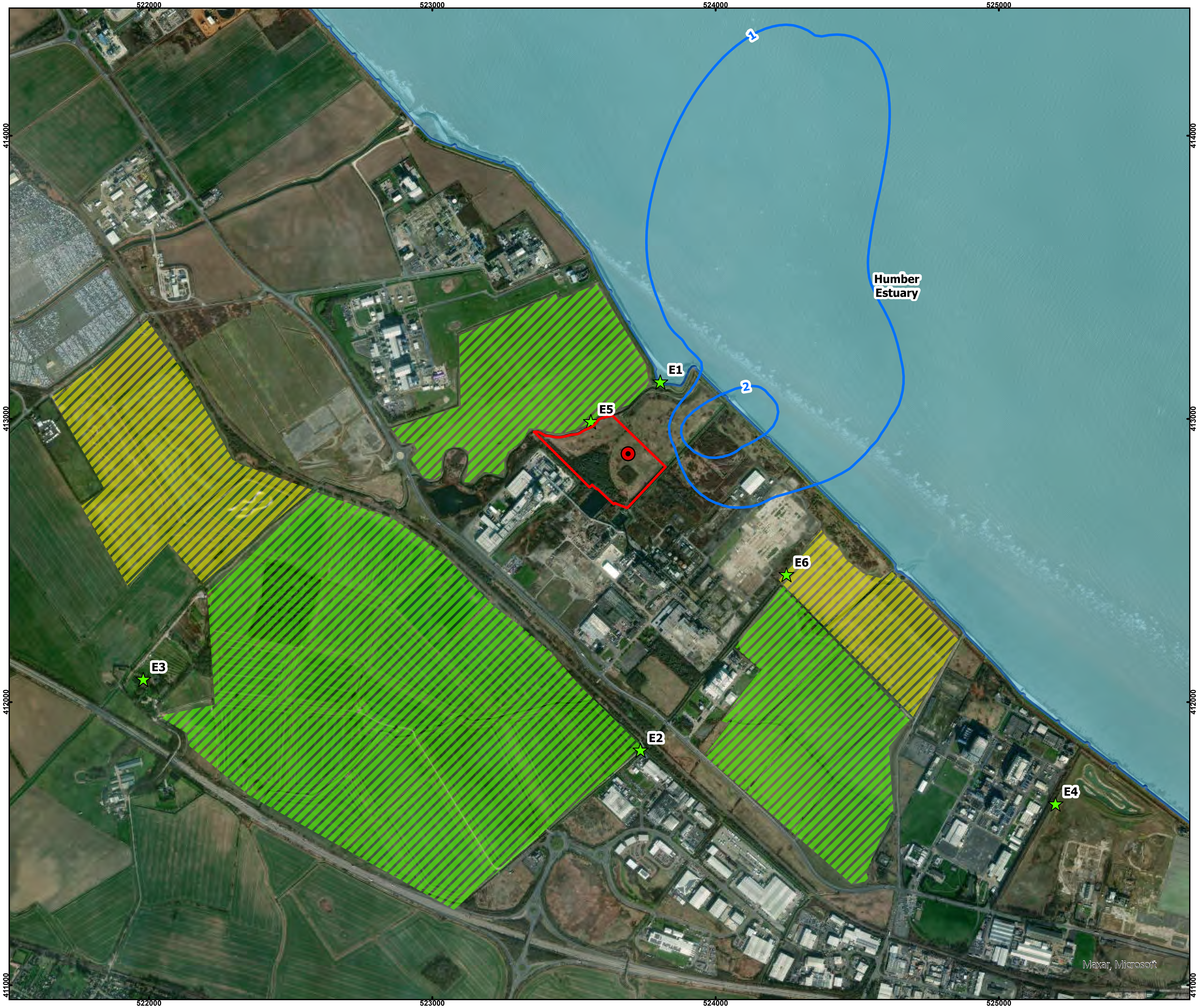

Legend

- Site boundary
- Stack
- Ecological sensitive receptors
- Annual mean NOx as % of CL
- Humber Estuary SPA
- Functionally linked land
- Mitigation areas

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 12. Annual mean oxides of nitrogen

Drawn by: SMN	Date: 21/01/2025

0 0.13 0.25 0.5 km

N

Scale: 1:12,500

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Tel: 0161 476 0032
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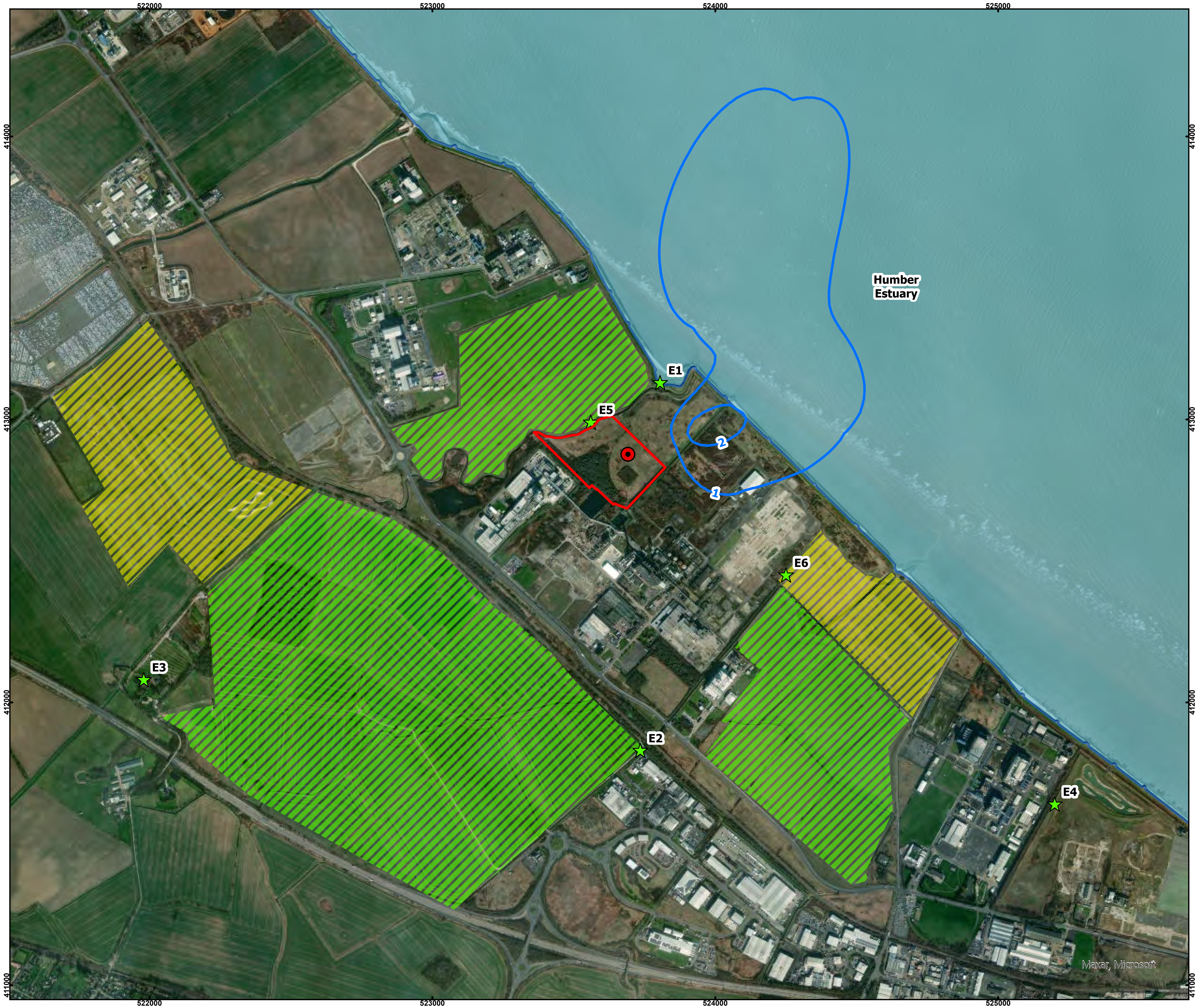

Legend

- Site boundary
- Stack
- Ecological sensitive receptors
- Annual mean ammonia as % of CL
- Humber Estuary SPA
- Functionally linked land
- Mitigation areas

Notes:
Ammonia as % of Critical Level of 3 μg/m³

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment
Title:	Figure 13. Annual mean ammonia

Drawn by: SMN | Date: 21/01/2025

0 0.13 0.25 0.5 km

Scale: 1:12,500

N

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Tel: 0161 476 0032
Fax: 0161 474 0618

Legend

- Site boundary
- Stack
- Ecological sensitive receptors
- Nitrogen deposition as % of CL - average of met years
- Coastal saltmarsh
- Humber Estuary SPA
- Functionally linked land
- Mitigation areas

Notes:
Average over five years of weather data

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment

Title:

Figure 14. Nitrogen deposition - average of met years

Drawn by: SMN	Date: 21/01/2025

0 0.15 0.3 0.6 km

Scale: 1:15,000

N

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Legend

- Site boundary
- Stack
- Cumulative sources

Client:	Humber Resources Group Ltd
Site:	Humber Gate Waste Treatment Facility
Project:	Air Quality Assessment
Title:	Figure 15. Cumulative sources modelled

Drawn by: SMN | Date: 12/03/2025

0 0.07 0.15 0.3 km

Scale: 1:8,000

N

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Fax: 0161 474 0618

B APIS Critical Loads

Table 33: Nitrogen Deposition Critical Loads

ID	Site	Species/Habitat Type	NCL Class	Lower Critical Load (kgN/ha/yr)	Upper Critical Load (kgN/ha/yr)	Background (kgN/ha/yr)
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	Saltmarsh	Atlantic upper-mid & mid-low salt marshes	10	20	14.5
		Fixed coastal dunes with herbaceous vegetation (grey dunes)	Coastal dune grasslands (grey dunes)	5	15	13.1
E2	Sweedale Croft Drain LWS	Coastal and floodplain grazing marsh	Low and medium altitude hay meadows	10	20	14.4
E3	Healing Cress Beds LWS	Fen, marsh and swamp	Rich fens	15	25	14.7
E4	Tioxide west fields LWS	Coastal and floodplain grazing marsh	Low and medium altitude hay meadows	10	20	14.1
E5	Humber Estuary FLL	Arable land	Arable and horticultural	Not sensitive		
E6	Mitigation Areas	Coastal and floodplain grazing marsh	Low and medium altitude hay meadows	10	20	14.3

Table 34: Nitrogen Deposition Critical Loads

ID	Site	Species/Habitat Type	Acidity Class	CLminN	CLmaxS	CLmaxN	Background N (keq/ha/yr)	Background S (keq/ha/yr)
E1	Humber Estuary SAC/SPA/Ramsar/ SSSI	Fixed coastal dunes with herbaceous vegetation (grey dunes)	Coastal dune grasslands (grey dunes)	0.856	4.856	4	0.96	0.15
Note: *No other habitats sensitive to acidity have been identified. The Critical Loads are the lowest reported on APIS for the Humber Estuary designated site. The maximum background deposition across the Humber Estuary designated site has been used. These are worst-case screening assumptions.*								

C Deposition Analysis at Ecological Sites

Table 35: Deposition Analysis

ID	Site	Annual Mean PC (ng/m³)				Nitrogen deposition (kgN/ha/yr)	Acid deposition (keq/ha/yr)	
		Nitrogen Dioxide	Sulphur dioxide	Hydrogen chloride	Ammonia		N	S
E1	Humber Estuary SAC/SPA/Ramsar/SSSI (saltmarsh[(1)])	142.1	N/A	N/A	16.9	0.11	N/A – not sensitive	
	Humber Estuary SAC/SPA/Ramsar/SSSI (sand dunes [(2)])	4.9	1.8	0.4	0.6	0.004	0.0003	0.0004
E2	Sweedale Croft Drain LWS	34.2	N/A	N/A	4.1	0.03	N/A – not sensitive	
E3	Healing Cress Beds LWS	42.4	N/A	N/A	5.0	0.03	N/A – not sensitive	
E4	Tioxide west fields LWS	24.4	N/A	N/A	2.9	0.02	N/A – not sensitive	
E5	Humber Estuary FLL	N/A – not sensitive						
E6	Mitigation Areas	138.9	N/A	N/A	16.5	0.11	N/A – not sensitive	

Note:

[(1)] *Maximum PC at saltmarsh habitat.*

[(1)] *Maximum PC at sand dune habitat.*

Table 36: Detailed Results – Nitrogen Deposition

ID	Site	NCL Class	Deposition Velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	Atlantic upper-mid & mid-low salt marshes	Grassland	0.11	**1.08%**	0.54%	14.61	146.1%	73.0%
		Coastal dune grasslands (grey dunes)	Grassland	0.004	0.08%	0.03%	13.10	262.1%	87.4%
E2	Sweedale Croft Drain LWS	Low and medium altitude hay meadows	Grassland	0.03	0.26%	0.13%	14.43	144.3%	72.1%
E3	Healing Cress Beds LWS	Rich fens	Grassland	0.03	0.22%	0.22%	14.73	98.2%	98.2%
E4	Tioxide west fields LWS	Low and medium altitude hay meadows	Grassland	0.02	0.19%	0.09%	14.12	141.2%	70.6%
E5	Humber Estuary FLL	Arable and horticultural	Grassland	Not sensitive					
E6	Mitigation Areas	Low and medium altitude hay meadows	Grassland	0.11	1.06%	0.53%	14.41	144.1%	72.0%

Table 37: Detailed Results – Nitrogen Deposition

ID	Site	NCL Class	Deposition Velocity	PC			PEC		
				PC N dep keq/ha/yr	PC S dep keq/ha/yr	% of CL	PEC N dep keq/ha/yr	PEC S dep keq/ha/yr	% of CL
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	Coastal dune grasslands (grey dunes)	Grassland	0.0003	0.0004	0.01%	0.96	0.15	22.9%
Note: *No other habitats sensitive to acidity have been identified.*									

D Cumulative Schemes Considered

Table 38: Cumulative Schemes

Project name/description	Planning ref	Permit ref	Scope in/out	Justification
Immingham eastern Ro Ro Terminal	DCO - TR030007	-	Out	Point sources and affected roads >3 km away
Immingham Green Energy Terminal	DCO - TR030008	-	Out	Point sources and affected roads >3 km away
SHBEC - WtE	**DCO - EN010107**	**EPR/QP3300LN**	**In**	**Point sources <3 km away**
Stallingborough CCGT CCP - EIA	DCO - EN010161	-	Out	At pre-app stage; insufficient information to assess
Carbon fibre manufacturing	**DM/0579/24/FUL**	**-**	**In**	**Point sources <3 km away**
Fluid Ice tyre pyrolysis	**DM/1103/22/FUL**	**-**	**In**	**Point source <3 km away**
TEGCO waste to energy	DM/0898/22/FUL	EPR/RP3628SJ	Out	Point source >3 km away
Velocys waste to jet fuel	**DM/0664/19/FUL**	**-**	**In**	**Point sources <3 km away**
South Humber Bank Energy Centre	DM/1070/18/FUL	-	Out	Replaced by DCO – EN010107
Immingham Railfreight waste to energy	DM/0628/18/FUL	-	Out	Varied by DM/0898/22/FUL
Great Coates Energy Ltd - waste to energy	**DM/0329/18/FUL**	**-**	**In**	**Point source <3 km away**
Stallingborough Interchange commercial site	DM/0105/18/FUL	-	Out	No point sources, affected roads >3 km away
North Beck waste to energy	DM/0026/18/FUL	EPR/BP3739QT	Out	Point source >3 km away
South Humber Bank Power station	-	EPR/QP3535LG	Out	Operational since 1997 – included in baseline
Newlincs Stallingborough EfW	-	EPR/BT4249IB	Out	Operational since 2004 – included in baseline
Note: Cumulative schemes scoped into the cumulative assessment are highlighted bold.				

E Model Inputs – Cumulative Point Sources

Table 39: Cumulative Schemes Stack Source Data

Item	Unit	SHBEC - WtE[1]	Fluid Ice Tyre Pyrolysis	Velocys Waste to Jet Fuel		Great Coates Energy[2]	Carbon fibre manu-facturing[3]
				Pulse combustion heaters	Other stacks and vents		
Stack Height	m	100	33	75	5	65	40
Internal diameter	m	2.75	1.0	1.6	4.0	2.4	1.8
Stack location(s)	m, m	523169, 413484 523175, 413447	523983, 412764	522597, 413003	522516, 413069	523550, 412401	See table below
Temperature	°C	120	150	319	245	143	136
Flue gas exit velocity	m/s	15	8.13	15	1	4.9	18.3
NOx release rate	g/s	7.985	0.2444	0.820	0.160	6.010	2.5275
SO_2 release rate	g/s	1.996	0.0244	-	0.110	1.502	-
NH_3 release rate	g/s	0.665	-	-	-	0.501	0.1262
Dioxin release rate	ng I-TEQ/s	2.660[4]	0.489[5]	-	-	2.002[4]	-

Note:

(1) Data are for each of the two flues.

(2) Pollutant release rates revised to upper end of BAT-AEL ranges, as this waste incineration facility will be classified as a “new plant” for the implementation of the BAT conclusions for the waste incineration BREF.

(3) Inputs taken from Appendix 12 of the Shadow Habitats Regulations Assessment submitted with application DM/0579/24/FUL.

(4) Assuming emissions at the BAT-AEL for dioxins and furans for new plants of 0.04 ng I-TEQ/Nm³. See Dioxin Pathway Intake Assessment Table 6 for information on the approach taken to modelling dioxin emissions.

(5) Assuming emissions at the ELV of 0.1 ng I-TEQ/Nm³; as the pyrolysis facility will be regulated as a Small Waste Incineration Plant (SWIP) and will not be subject to the Waste Incineration BREF (except where the applicant chooses to apply the BAT-AELs), this ELV is appropriate.

Table 40: Carbon Fibre Manufacturing Stack Locations

Stack	Location	
	X (m)	Y (m)
A1	524215	412592
A2	524182	412621
B1	524171	412631
B2	524138	412658

Table 41: Cumulative Schemes Building Details

Buildings	Centre Point		Height (m)	Width (m)	Length (m)	Angle (°)
	X (m)	Y (m)				
SHBEC Boiler Hall	523083.0	413456.0	55.0	68.0	169.0	82
Fluid Ice ATT – 1	523942.0	412758.0	12.0	36.4	92.7	45
Fluid Ice ATT – 2	523969.0	412756.0	12.0	6.9	59.1	45
Fluid Ice ATT – 3	523981.0	412756.0	12.0	10.3	18.6	45
Velocys	522648.0	413015.0	66.0	53.3	88.1	56
Great Coates 1	523515.0	412467.0	32.4	22.0	95.0	317
Great Coates 2	523534.0	412474.0	25.6	14.0	80.0	317
CF - L1	524199	412609	15.2	39.0	311.0	43.0
CF - L2	524155	412644	15.2	39.0	311.0	43.0
CF - U3A	524160	412462	25.0	63.0	33.0	43.0
CF - U3B	524236	412541	15.0	63.0	190.0	43.0
Note: Only buildings >1/3 of the stack height of each development have been included.						

F Results - Cumulative Assessment – Critical Levels

Table 42: NOx Process Contribution at Designated Ecological Sites – µg/m³ - Point of Maximum Cumulative Impact

ID	Site	NOx PC (µg/m³)			NOx PEC (µg/m³)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	0.38	5.73	6.11	14.20	20.31
E2	Sweedale Croft Drain LWS	0.05	0.85	0.90	17.10	18.00
E3	Healing Cress Beds LWS	0.06	0.65	0.71	12.80	13.51
E4	Tioxide west fields LWS	0.03	0.55	0.58	16.90	17.48
E5	Humber Estuary FLL	0.14	1.46	1.61	16.40	18.01
E6	Mitigation Areas	0.13	1.66	1.79	15.40	17.19

Table 43: NOx Process Contribution at Designated Ecological Sites – % of Critical Level - Point of Maximum Cumulative Impact

ID	Site	NOx PC (% of Critical Level)			NOx PEC (% of Critical Level)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	**1.27%**	**19.09%**	**20.36%**	47.33%	67.69%
E2	Sweedale Croft Drain LWS	0.16%	2.83%	2.99%	57.00%	59.99%
E3	Healing Cress Beds LWS	0.20%	2.16%	2.36%	42.67%	45.03%
E4	Tioxide west fields LWS	0.12%	1.82%	1.93%	56.33%	58.27%
E5	Humber Estuary FLL	0.48%	**4.88%**	**5.36%**	54.67%	60.03%
E6	Mitigation Areas	0.45%	5.53%	5.97%	51.33%	57.31%

Table 44: NOx Process Contribution at Designated Ecological Sites – µg/m³ - Point of Maximum Impact of Facility

ID	Site	NOx PC (µg/m³)			NOx PEC (µg/m³)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	0.72	2.66	3.37	14.20	17.57
E2	Sweedale Croft Drain LWS	0.05	0.85	0.90	17.10	18.00
E3	Healing Cress Beds LWS	0.06	0.65	0.71	12.80	13.51
E4	Tioxide west fields LWS	0.03	0.55	0.58	16.90	17.48
E5	Humber Estuary FLL	0.25	0.96	1.21	16.40	17.61
E6	Mitigation Areas	0.20	1.34	1.54	15.40	16.94

Table 45: NOx Process Contribution at Designated Ecological Sites – % of Critical Level - Point of Maximum Impact of Facility

ID	Site	NOx PC (% of Critical Level)			NOx PEC (% of Critical Level)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	**2.39%**	**8.86%**	**11.24%**	47.33%	58.58%
E2	Sweedale Croft Drain LWS	0.16%	2.83%	2.99%	57.00%	58.17%
E3	Healing Cress Beds LWS	0.20%	2.16%	2.36%	42.67%	44.30%
E4	Tioxide west fields LWS	0.12%	1.82%	1.93%	56.33%	57.39%
E5	Humber Estuary FLL	0.83%	**3.20%**	**4.02%**	54.67%	58.69%
E6	Mitigation Areas	0.66%	4.47%	5.13%	51.33%	56.46%

Table 46: Sulphur Dioxide Process Contribution at Designated Ecological Sites – µg/m³ - Point of Maximum Cumulative Impact

ID	Site	SO_2 PC (µg/m³)			SO_2 PEC (µg/m³)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	0.04	0.61	0.65	2.80	3.45
E2	Sweedale Croft Drain LWS	0.01	0.07	0.08	3.60	3.68
E3	Healing Cress Beds LWS	0.02	0.11	0.12	1.70	1.82
E4	Tioxide west fields LWS	0.01	0.07	0.08	3.00	3.08
E5	Humber Estuary FLL	0.04	0.27	0.31	6.10	6.41
E6	Mitigation Areas	0.05	0.20	0.25	3.20	3.45

Table 47: Sulphur Dioxide Process Contribution at Designated Ecological Sites – % of Critical Level - Point of Maximum Cumulative Impact

ID	Site	SO_2 PC (% of Critical Level)			SO_2 PEC (% of Critical Level)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	0.22%	**3.05%**	**3.27%**	14.00%	17.27%
E2	Sweedale Croft Drain LWS	0.06%	0.36%	0.42%	18.00%	18.42%
E3	Healing Cress Beds LWS	0.08%	0.53%	0.61%	8.50%	9.11%
E4	Tioxide west fields LWS	0.04%	0.34%	0.38%	15.00%	15.38%
E5	Humber Estuary FLL	0.20%	**1.34%**	**1.54%**	30.50%	32.04%
E6	Mitigation Areas	0.25%	1.01%	1.26%	16.00%	17.26%

Table 48: Sulphur Dioxide Process Contribution at Designated Ecological Sites – µg/m³ - Point of Maximum Impact of Facility

ID	Site	SO_2 PC (µg/m³)			SO_2 PEC (µg/m³)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	0.18	0.43	0.61	2.80	3.41
E2	Sweedale Croft Drain LWS	0.01	0.07	0.08	3.60	3.68
E3	Healing Cress Beds LWS	0.02	0.11	0.12	1.70	1.82
E4	Tioxide west fields LWS	0.01	0.07	0.08	3.00	3.08
E5	Humber Estuary FLL	0.06	0.11	0.17	3.50	3.67
E6	Mitigation Areas	0.05	0.20	0.25	3.20	3.45

Table 49: Sulphur Dioxide Process Contribution at Designated Ecological Sites – % of Critical Level - Point of Maximum Impact of Facility

ID	Site	SO_2 PC (% of Critical Level)			SO_2 PEC (% of Critical Level)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	0.90%	**2.17%**	**3.07%**	14.00%	17.07%
E2	Sweedale Croft Drain LWS	0.06%	0.36%	0.42%	18.00%	18.42%
E3	Healing Cress Beds LWS	0.08%	0.53%	0.61%	8.50%	9.11%
E4	Tioxide west fields LWS	0.04%	0.34%	0.38%	15.00%	15.38%
E5	Humber Estuary FLL	0.31%	0.56%	0.87%	17.50%	18.37%
E6	Mitigation Areas	0.25%	1.01%	1.26%	16.00%	17.26%

Table 50: Ammonia Process Contribution at Designated Ecological Sites – µg/m³ - Point of Maximum Cumulative Impact

ID	Site	NH_3 PC (µg/m³)			NH_3 PEC (µg/m³)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	0.032	0.288	0.320	1.40	1.72
E2	Sweedale Croft Drain LWS	0.004	0.047	0.051	1.40	1.45
E3	Healing Cress Beds LWS	0.005	0.039	0.044	1.40	1.44
E4	Tioxide west fields LWS	0.003	0.033	0.036	1.40	1.44
E5	Humber Estuary FLL	0.012	0.094	0.106	1.40	1.51
E6	Mitigation Areas	0.011	0.090	0.101	1.40	1.50

Table 51: Ammonia Process Contribution at Designated Ecological Sites – % of Critical Level - Point of Maximum Cumulative Impact

ID	Site	NH_3 PC (% of Critical Level)			NH_3 PEC (% of Critical Level)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	**1.06%**	**9.60%**	**10.66%**	46.67%	57.33%
E2	Sweedale Croft Drain LWS	0.14%	1.57%	1.71%	46.67%	48.38%
E3	Healing Cress Beds LWS	0.17%	1.31%	1.48%	46.67%	48.15%
E4	Tioxide west fields LWS	0.10%	1.11%	1.21%	46.67%	47.88%
E5	Humber Estuary FLL	0.40%	**3.14%**	**3.54%**	46.67%	50.20%
E6	Mitigation Areas	0.37%	3.01%	3.38%	46.67%	50.05%

Table 52: Ammonia Process Contribution at Designated Ecological Sites – µg/m³ - Point of Maximum Impact of Facility

ID	Site	NH_3 PC (µg/m³)			NH_3 PEC (µg/m³)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	0.060	0.115	0.175	1.40	1.57
E2	Sweedale Croft Drain LWS	0.004	0.047	0.051	1.40	1.45
E3	Healing Cress Beds LWS	0.005	0.039	0.044	1.40	1.44
E4	Tioxide west fields LWS	0.003	0.033	0.036	1.40	1.44
E5	Humber Estuary FLL	0.021	0.040	0.060	1.30	1.36
E6	Mitigation Areas	0.017	0.073	0.089	1.40	1.49

Table 53: Ammonia Process Contribution at Designated Ecological Sites – % of Critical Level - Point of Maximum Impact of Facility

ID	Site	NH_3 PC (% of Critical Level)			NH_3 PEC (% of Critical Level)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI	**1.99%**	**3.84%**	**5.82%**	46.67%	52.49%
E2	Sweedale Croft Drain LWS	0.14%	1.57%	1.71%	46.67%	48.38%
E3	Healing Cress Beds LWS	0.17%	1.31%	1.48%	46.67%	48.15%
E4	Tioxide west fields LWS	0.10%	1.11%	1.21%	46.67%	47.88%
E5	Humber Estuary FLL	0.69%	**1.32%**	**2.01%**	43.33%	45.35%
E6	Mitigation Areas	0.55%	2.42%	2.97%	46.67%	49.64%

G Results - Cumulative Assessment – Deposition Critical Loads

Table 54: Nitrogen Deposition Process Contribution at Designated Ecological Sites - Point of Maximum Cumulative Impact

ID	Site	NDep PC (kgN/ha/yr)			NDep PEC (kgN/ha/yr)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI (saltmarsh[1])	0.108	0.722	0.831	14.50	15.33
E2	Sweedale Croft Drain LWS	0.026	0.331	0.357	14.40	14.76
E3	Healing Cress Beds LWS	0.032	0.270	0.302	14.70	15.00
E4	Tioxide west fields LWS	0.019	0.228	0.247	14.10	14.35
E5	Humber Estuary FLL	Not sensitive				
E6	Mitigation Areas	0.072	0.636	0.707	14.30	15.01

Note:
[1] *Maximum PC at saltmarsh habitat.*

Table 55: Nitrogen Deposition Process Contribution at Designated Ecological Sites - Point of Maximum Cumulative Impact

ID	Site	NDep PC (% of Critical Load)			NDep PEC (% of Critical Load)	
		Facility	Cumulative Schemes	Total Cumulative	Background	PEC
E1	Humber Estuary SAC/SPA/Ramsar/SSSI (saltmarsh[1])	**1.08%**	**7.22%**	**8.31%**	145.0%	**153.31%**
E2	Sweedale Croft Drain LWS	0.26%	3.31%	3.57%	144.0%	147.57%
E3	Healing Cress Beds LWS	0.22%	1.80%	2.01%	98.0%	100.01%
E4	Tioxide west fields LWS	0.19%	2.28%	2.47%	141.0%	143.47%
E5	Humber Estuary FLL	Not sensitive				
E6	Mitigation Areas	0.72%	6.36%	7.07%	143.0%	150.07%

Note:
[1] Maximum PC at saltmarsh habitat.

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