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Project No: 315528

Air Quality Assessment

For the Site located at:

Saltend Power Station
Hull
HU12 8GA

Prepared for:

Saltend Cogeneration Company Limited

Saltend Cogeneration Plant
Saltend Power Station
Hedon Road
Hull
HU12 8GA

Contents Amendment Record

This report has been issued and amended as follows:

Revision	Description	Date	Signed
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2.0	Second Issue	26 June 2024	J Jones

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Acknowledgement

This report has been prepared for the sole and exclusive use of Saltend Cogeneration Company Limited in accordance with the scope of the Crestwood Environmental Ltd (Crestwood Environmental) Letter Agreement (ref: Q5945), dated 13 July 2023. Crestwood Environmental Ltd is now part of Mabbett & Associates Ltd (Mabbett). This report is based on information and data collected by Mabbett. Should any of the information be incorrect, incomplete or subject to change, Mabbett may wish to revise the report accordingly.

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Section 1.0: Introduction

1.1 Background

Saltend Cogeneration Company Limited is submitting an Environmental Permit Variation Application for the Saltend Power Station, Hull (hereafter referred to as 'the site').

The site operates three gas turbines fired on natural gas with a capacity of 400MW each. The gas turbines currently have an annual average Emissions Limit Value (ELV) for oxides of nitrogen (NO_x) of 40mg/m^3. The permit variation seeks to temporarily increase the annual average ELV for NO_x to 50mg/m^3 until the plant can be upgraded to reduce overall emissions.

Pre-application discussions with the Environmental Agency (EA) indicated that a detailed air quality dispersion modelling assessment is required to support the application.

Following submission of a first draft of the air quality dispersion modelling assessment, a revised assessment has been prepared to include:

- Corrections to applied deposition velocity for assessment of nitrogen deposition. Previously, the factor for woodland was applied (0.003 m/s) rather than grassland (0.0015 m/s).
- Corrections to the habitat for nitrogen deposition following a review of the Priority Habitat Inventory for England and Google Satellite Imagery.
- A reduction in operational run hours to 5930 hours per gas turbine per annum for the NO_x 50 mg/m^3 limit scenario. This totals 17,790 hours for the gas turbines combined on an annual basis.

The revised results of the detailed air quality dispersion modelling are presented in this report.

1.2 Site

The site is located in an industrial estate in Salt End, Hull. The site is bounded by industrial developments to the north, east and west and by the River Humber to the south. The Saltend Power Station is a Combined Heat and Power (CHP) and Combined Cycle Gas Turnbine (CCGT) cogeneration plant. The site includes the following emission to air sources that have been considered in this assessment (i.e. normal operation):

- Three gas turbines;
- One start-up boiler.

A Site location plan is show in Figure 1.1.

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Figure 1.1: Site Location

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Section 2.0: Environmental Standards

2.1 Ambient Air Directive (AAD) Limit Values

Table 2.1 summarises the relevant AAD limit values[1] which have been used in this assessment. Emissions from the site must not lead to an exceedance of these legally binding limit values.

Table 2.1: AAD Limit Values

Pollutant	Limit Value	Reference Period	Additional Information
Nitrogen Dioxide (NO_2)	200 µg/m^3	1-Hour Mean	Not to be exceeded more than 35 times a year (99.79th percentile)
	40 µg/m^3	Annual Mean	-
Nitrogen Oxides (NO_x as NO_2)	30 µg/m^3	Annual Mean	Objective for the protection of vegetation and ecosystems

These limits apply at relevant receptors. See Appendix A for example receptors.

2.2 Environmental Assessment Levels (EALs)

EALs are used to help regulators assess the acceptability of an operator's emissions to air and their relative contribution to the environment. They represent a pollutant concentration in ambient air at which no significant risks to public health are expected. Relevant EALs are summarised below.

The Environment Agency (EA) also provides a short term EAL for NO_x, which is shown in Table 2.2 below.

Table 2.2: EALs

Pollutant	EAL	Reference Period	Additional Information
NO_x as NO_2	75 µg/m^3	24-Hour Mean	Objective for the protection of vegetation and ecosystems

2.3 Guidance

A summary of some of the key guidance documents referred to in the undertaking of this assessment is provided below. Others which have been used are referenced throughout the report, as appropriate.

2.3.1 Local Air Quality Management Review and Assessment Technical Guidance

Defra has published technical guidance for use by local authorities in their review and assessment work. This guidance, referred to in this document as LAQM.TG22, has been used where appropriate in the assessment presented herein.

2.3.2 Air Emissions Risk Assessment for your Environmental Permit

The EA's Air Emissions Risk Assessment (AERA) Guidance for Environmental Permitting provides guidance on determining the impacts of emissions to air and the standards that are required to be met. The AERA guidance provides information on EALs against which the impacts of emissions to air can be assessed to evaluate whether the impacts represent 'significant pollution'.

[1] https://uk-air.defra.gov.uk/assets/documents/Air_Quality_Objectives_Update.pdf

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Section 3.0: Baseline Air Quality at Sensitive Receptors

3.1 Introduction

The existing air quality in the vicinity of the site was reviewed in order to provide a baseline for the air quality assessment. The findings are summarised below.

3.2 Air Quality Management Areas

Where a local authority identifies an area of non-compliance with the limit values set out in Table 2.1, and there is relevant public exposure, there remains a statutory need for the authority to declare the geographic extent of non-compliance as an Air Quality Management Area (AQMA) and to draw up an air quality action plan (AQAP) detailing remedial measures to address the problem.

The closest AQMA to the site is Hull AQMA No.1 which is located approximately 5.7km west of the site within the boundaries of the Kingston-Upon-Hull City Council (KHCC). The AQMA was declared in 2005 for exceedances of the annual mean NO_2 objective and covers an area encompassing Hull City Centre. Given the distance between the site and the AQMA, the likely impacts are considered negligible and have been scoped out of further assessment.

3.3 Sensitive Receptors (Human Health)

A review of the surrounding area was undertaken to identify potentially sensitive receptors. This focused on identifying the high sensitivity receptors nearest to the site in all directions. All of the averaging periods set out in LAQM.TG22 apply at high sensitivity receptors (reproduced in Appendix A).

In accordance with LAQM.TG22, there are other sensitive receptors in the vicinity of the site where the annual average environmental standards do not apply. These include the gardens and garages of residential properties as well as the site itself where workers could be exposed to unacceptable air quality conditions. In order to adequately assess these receptors, a grid was included in the dispersion modelling assessment.

The modelled grid domain was from easting 511005 – 422854 and northing 521005 – 432854, with a grid spacing of 10 m. The grid was modelled at a breathable height of 1.5m. The extent of the grid is shown in Figure 3.1.

In addition to the modelled gird, discrete receptors were included in the model. Two Air Quality Assessments, which included dispersion modelling, have been completed for previous permitting application in 2005[2] and variation in 2019[3]. For consistency, the discrete human receptors from this assessment, have been retained. This allows direct comparison between the results of this assessment and the 2005 permit application.

Table 3.1 and Figure 3.1 summarises the discrete sensitive receptors which were modelled. All receptors were modelled at a breathable height of 1.5m (ground floor).

Table 3.1: Modelled Human Health Sensitive Receptors

Ref.	Receptor	X Coordinate (m)	Y Coordinate (m)	Z Coordinate (m)
R1	Hull	515650	430000	1.5
R2	Saltend	516800	428950	1.5
R3	West End	517450	430150	1.5
R4	Hedon	517900	428750	1.5
R5	Paull	516750	426300	1.5
R6	Goxhill Haven	512000	425400	1.5

[2] Gair Consulting. Air Quality Assessment To Support Ppc Permitting Of The Congeneration Plant, Saltend Power Station. 2005
[3] RAS Environmental Permit Variation Detailed Dispersion Modelling. Triton Power, Saltend Power Station. 2019

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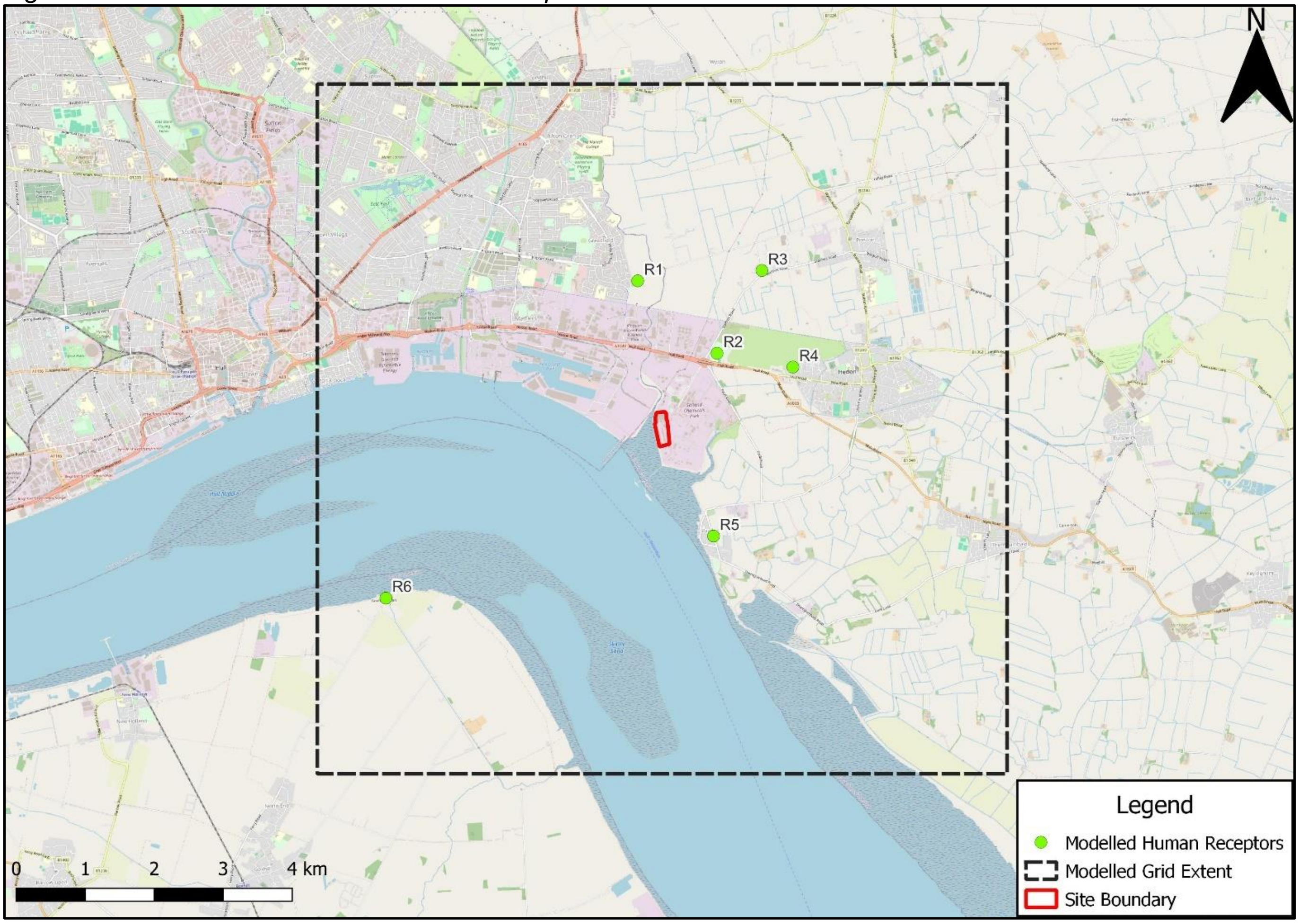
Figure 3.1: Modelled Sensitive Human Receptors



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3.4 Background Air Quality (Human Health Receptors)

Background concentration data was initially considered from three sources: local monitoring stations, Defra background concentration maps, and local diffusion tubes. It was identified that background concentration maps provide the most representative data for the site and have thus been utilised for modelling background pollutant concentrations.

Data for NO_2 are presented below.

3.4.1 NO_2

Defra background concentration data was obtained for the human health sensitive receptors as identified in Table 3.1. The highest background concentration from these receptors was selected for use within the modelled grid as a conservative approach. The annual mean data is provided (and presented below) in Table 3.2.

Table 3.2: NO_2 Background Concentration Data for Discrete Receptors

Receptor	Year	NO_2 (µg/m^3) Annual Mean
R1	2018	15.1
R2		21.5
R3		13.1
R4		14.3
R5		13.8
R6		11.4

The year-on-year data provided by the background maps is based on a modelling assessment with 2018 as the reference year, and this predicted a decreasing trend in concentration. However, this decrease is not always apparent in reality. Therefore, 2018 data have been used within this assessment as a conservative assumption.

3.4.2 Summary

The background concentrations considered within this assessment for the modelled gird and discrete receptors are summarised in Table 3.3 below. The short-term background concentrations are taken as twice the annual mean concentrations as per modelling good practice. As a conservative approach, worst-case background has been applied to modelled grid results.

Table 3.3: Summary of NO_2 Background Concentrations for Human Health Receptors

Receptor	Background Concentration (µg/m^3)	
	Long Term	Short Term
R1	15.1	30.2
R2	21.5	43
R3	13.1	26.2
R4	14.3	28.6
R5	13.8	27.6
R6	11.4	22.8
Modelled Grid	21.5	43

3.5 Sensitive Receptors (Ecological)

An assessment of impacts on designated ecological receptors was carried out as part of the previous permit variation[3]. Following a receptor review and at the request of the EA, the following receptors were identified for inclusion within the 2019 air quality assessment:

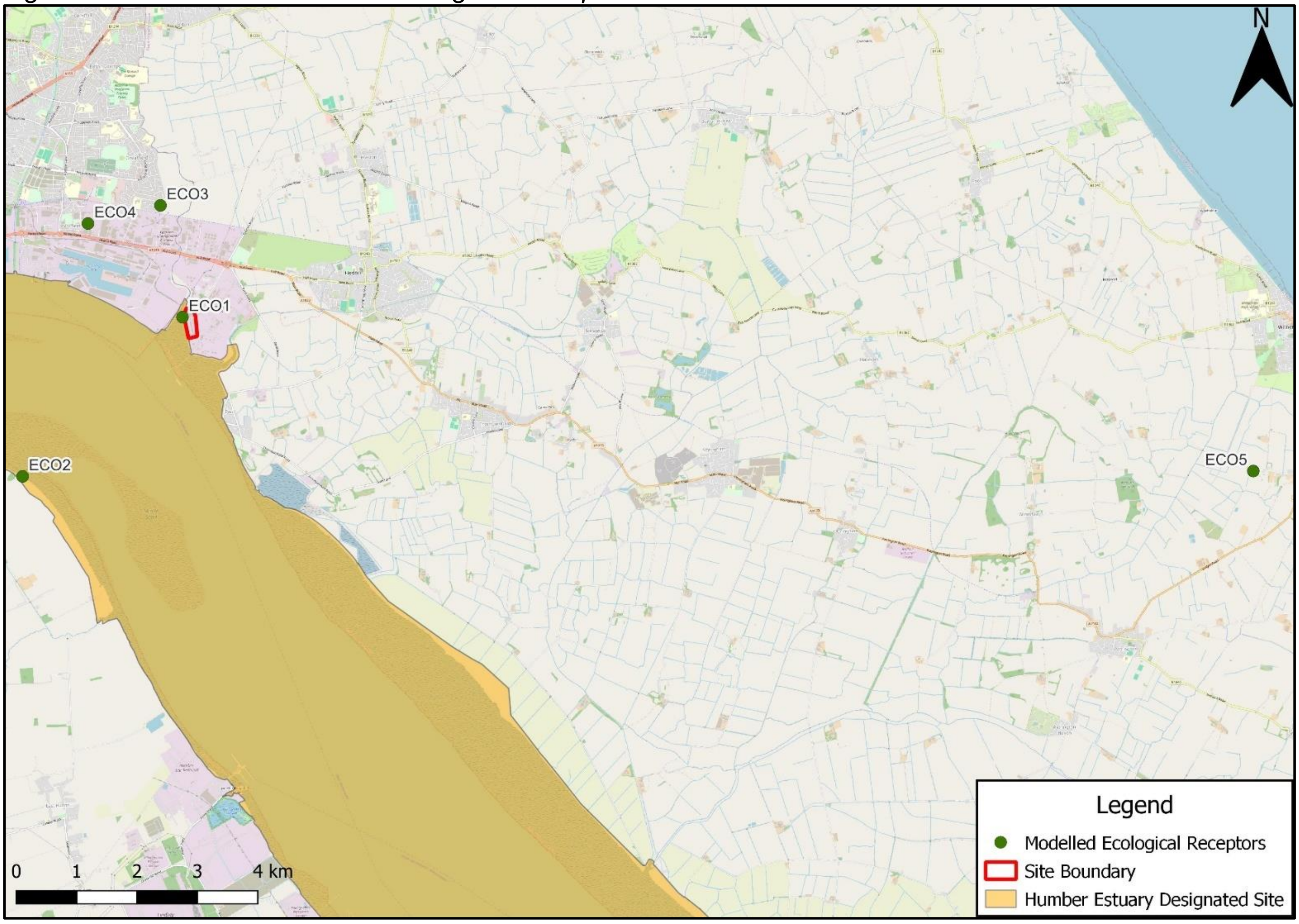
- Humber Estuary Site of Special Scientific Interest (SSSI)/Special Area of Conservation (SAC)/Special Protection Area/Ramsar;
- Land East of Falkland Road Local Wildlife Site (LWS);
- St Giles Bural Ground LWS; and
- Former Withernsea Railway Line LWS.

For consistency, the discrete receptors identified within the 2019 assessment have been retained for this modelling assessment. The modelled ecological receptors are summarised in Table 3.4 and are shown in Figure 3.2. All ecological receptors were modelled at a height of 0m.

Table 3.4: Modelled Ecological Sensitive Receptors

Ref.	Receptor	X Coordinate (m)	Y Coordinate (m)	Z Coordinate (m)
ECO1	Humber Estuary SSSI/SAC/SPA/Ramsar - 1	515865	427950	0
ECO2	Humber Estuary SSSI/SAC/SPA/Ramsar – 2	513217	425311	0
ECO3	Land East of Falkland Road LWS	515500	429800	0
ECO4	St Giles Bural Ground LWS	514300	429500	0
ECO5	Former Withernsea Railway Line LWS	533600	425400	0

Figure 3.2: Modelled Sensitive Ecological Receptors



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3.6 Background Air Quality & Deposition (Ecological Receptors)

Air Pollution Information System (APIS) is a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology.

Ambient background concentrations for annual mean NO_x and deposition rates and critical loads for nitrogen deposition and acid deposition were sourced from APIS and are provided in Table 3.5 and Table 3.6 below.

For the Humber Estuary, backgrounds, deposition rates and critical loads were derived using the 'Site Relevant Critical Loads' page on the APIS website to provide specific data for the designated site. A review of the Priority Habitat Inventory for England and Google Satellite Imagery was undertaken to identify the relevant habitats within the assessment area. Coastal saltmarsh / mudflats were identified as the habitat in this section of the Humber Estuary and relevant critical loads were applied for nitrogen deposition. There is no corresponding critical load for acid deposition for coastal saltmarsh. APIS[4] comments '*The likely contribution of acidification to this breakdown is not understood but the risks from acid deposition compared with eutrophication are probably small, based on available evidence*.'

APIS does not have any site-specific data for LWS. As such, backgrounds, deposition rates and critical load ranges for the three LWS were derived using the 'Location Search' on the APIS website. The Living England Habitat map was used to identify the closest appropriate habitat for each LWS. As a conservative approach, the lowest critical load range was applied when multiple classes were available.

4 https://www.apis.ac.uk/acid-deposition-coastal-saltmarsh

Table 3.5: APIS Nitrogen Deposition Rates and Critical Loads

Ref.	APIS Nitrogen Critical Load Class	APIS Annual Mean NO_x ($\mu g/m^3$)	Nitrogen Deposition (kg/N/ha/yr)	
			Deposition Rate	Critical Load Range
ECO1	Coastal Saltmarsh	22.6	16.7	10-20
ECO2		13.1	16.9	10-20
ECO3	Valley Mires, Poor Fens and Transition Mires	25.9	17.0	5-15
ECO4		35.4	17.1	5-15
ECO5		10.0	14.5	5-15

Table 3.6: APIS Acid Deposition Rates and Critical Loads

Ref.	APIS Acid Critical Load Class	Acid Deposition (kg_{eq}/ha/yr)		
		Deposition Rate	Critical Load Range	
			CLMinN	CLmaxN
ECO1	Critical load not available - the risks from acid deposition for coastal saltmarsh compared with eutrophication are probably small, based on available evidence as per APIS guidance			
ECO2	Critical load not available - the risks from acid deposition for coastal saltmarsh compared with eutrophication are probably small, based on available evidence as per APIS guidance			
ECO3	Habitat not sensitive to acidity			
ECO4	Broadleaved/Coniferous Unmanaged Woodland	1.2	0.357	8.69
ECO5	Habitat not sensitive to acidity			

Section 4.0: Methodology

4.1 Dispersion Model

ADMS 6.0, the model used to undertake this exercise, is a new generation Gaussian plume air dispersion model, which means that the atmospheric boundary layer properties are characterised by two parameters (the boundary layer depth and the Monin-Obukhov length) rather than in terms of the single parameter Pasquill-Gifford class. Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution (shown by validation studies to be a better representation than a symmetrical Gaussian expression).

4.2 Emission Parameters

The assessment has focussed on the three gas turbines and the start-up boiler. It is understood that emergency diesel generators are used as an emergency plant to facilitate start-up of the gas turbines. As these are not likely to run concurrently with the gas turbines for a substantial duration of the year, they have not been included in the modelling assessment.

As a worst-case approach, the model has been set up to assume that all three gas turbines will be running concurrently for 100% of the year. As the start-up boiler will only be used for short time periods, it was deemed that emissions from the boiler should only be included for assessment against short-term objectives. The plant emissions considered in the assessment are detailed below:

- Long-term (e.g. annual mean) objectives: three gas turbines running 100% of the time.
- Short-term (e.g. 1-hour mean) objectives: three gas turbines and one start-up boiler.

For assessment of long-term objectives for the for the NO_x 50 mg/m^3 limit scenario, the modelled results have been post-processed using Excel to account for the actual number of proposed run hours, 5930 hours per gas turbine per annum. This totals 17,790 hours for the gas turbines combined on an annual basis. This is standard practice in air quality assessment and is considered to be robust.

The modelled emission parameters for the plant is summarised in Table 4.1 and Table 4.2. Modelling was undertaken for two scenarios: existing (40mg/m^3 limit value) and proposed (50mg/m^3 limit value).

For the gas turbines, stack temperature and normalised volume flow rate data were provided by Saltend Cogeneration Company Limited. This enabled derivation of actual volume flow rate data (via temperature correction of normalised flow rate), efflux velocity and NO_x emission rate. The derived data was compared with modelled data for the 2005 air quality assessment for Saltend Power Station. The flow rate data used in this assessment is higher than the 2005 air quality assessment (527 Nm^3/s). The stack temperature is also higher than the 2005 air quality assessment (108 °C). The NO_x concentration used in the 2005 air quality assessment was 46 mg/Nm^3 compared to the existing and proposed ELVs used in this assessment. The stack velocity used in this assessment (30.5 m/s) is marginally higher than that used in the 2005 assessment (28 m/s).

For the start-up boiler, data from the 2005 air quality assessment has been utilised in this assessment.

Table 4.1: Modelled Emission Parameters – Existing Scenario

Parameter	A1 – Gas Turbine	A2 – Gas Turbine	A3 – Gas Turbine	A4 – Start-up Boiler
Stack Location X(m), Y(m)	515953, 427981	515992, 427983	516033, 427983	515961, 427938
Stack Height (m)	65	65	65	45
Stack Diameter (m)	6	6	6	1.5
Exit Temperature (°C)	120	120	120	175
Efflux Velocity - actual (m/s)	30.5	30.5	30.5	8
Volumetric Flow Rate - actual (m^3/hour)	863.7	863.7	863.7	14
Volumetric Flow Rate - normalised (m^3/hour)	600	600	600	8.6
Existing NO_x ELV (mg/Nm^3), yearly average	40			-
NO_x Emission Concentration (mg/Nm^3)	-			69
NO_x Emission Rate (g/s)	24.0	24.0	24.0	0.593

Table 4.2: Modelled Emission Parameters – Proposed Scenario

Parameter	A1 – Gas Turbine	A2 – Gas Turbine	A3 – Gas Turbine	A4 – Start-up Boiler
Stack Location X(m), Y(m)	515953, 427981	515992, 427983	516033, 427983	515961, 427938
Stack Height (m)	65	65	65	45
Stack Diameter (m)	6	6	6	1.5
Exit Temperature (°C)	120	120	120	175
Efflux Velocity - actual (m/s)	30.5	30.5	30.5	8
Volumetric Flow Rate - actual (m^3/hour)	863.7	863.7	863.7	14
Volumetric Flow Rate - normalised (m^3/hour)	600	600	600	8.6
Proposed NO_x ELV (mg/Nm^3), yearly average	50			-
NO_x Emission Concentration (mg/Nm^3)	-			69
NO_x Emission Rate (g/s)	30.0	30.0	30.0	0.593

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4.3 Modelled Buildings

Turbulence can be induced by nearby buildings and structures, causing pollutants emitted from an elevated source to be displaced and dispersed rapidly towards the ground, resulting in elevated ground level concentrations.

The on-site buildings deemed to have the biggest potential to impact on emissions were reviewed and included in the dispersion model. The parameters for the selected modelling buildings are detailed in Table 4.3 below. Building heights lengths and widths were derived from the previous air quality assessments at the site[2,3].

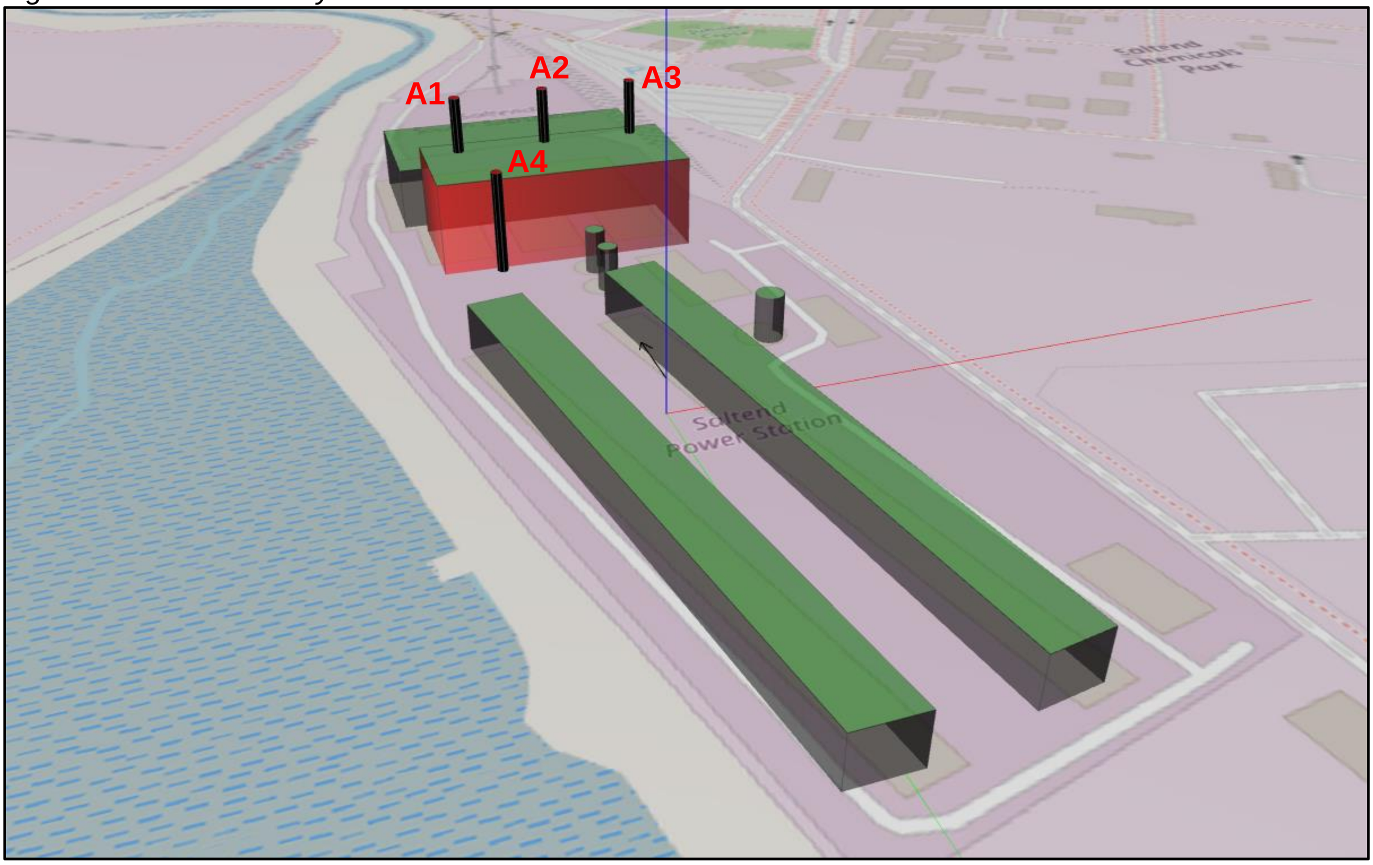
For the purpose of the dispersion modelling assessment, the buildings have been simplified. This results in a set up as shown in Figure 4.1.

Table 4.3: Modelled Buildings

Building ID	Building Centre		Modelled Height (m)	Length (m)	Width (m)
	X Coordinate (m)	Y Coordinate (m)			
HRSG 3[1]	515992	427966	40.5	110	50
Turbine Hall	515989	428029	27.7	120	60
Cooling Tower West	515964	427749	19.1	22	250
Cooling Tower East	516021	427761	19.1	22	250
Demineralisation Tank - 1	515999	427926	19	8	-
Demineralisation Tank - 2	515999	427907	19	8	-
Raw Water Tank	516045	427844	19	11	-

Note: [1] Considered most likely to impact the dispersion of the pollutants based on its proximity to the stacks. Thus, it was entered into the model as the 'main' building.

Figure 4.1: 3D Model Layout



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4.4 Modelled Terrain

The site is located in an area of relatively flat terrain and therefore dispersion is unlikely to be influenced by terrain. As such, no terrain file has been included in the dispersion model. This is consistent with the approach taken in the previous modelling assessments at Saltend Power Station[2,3].

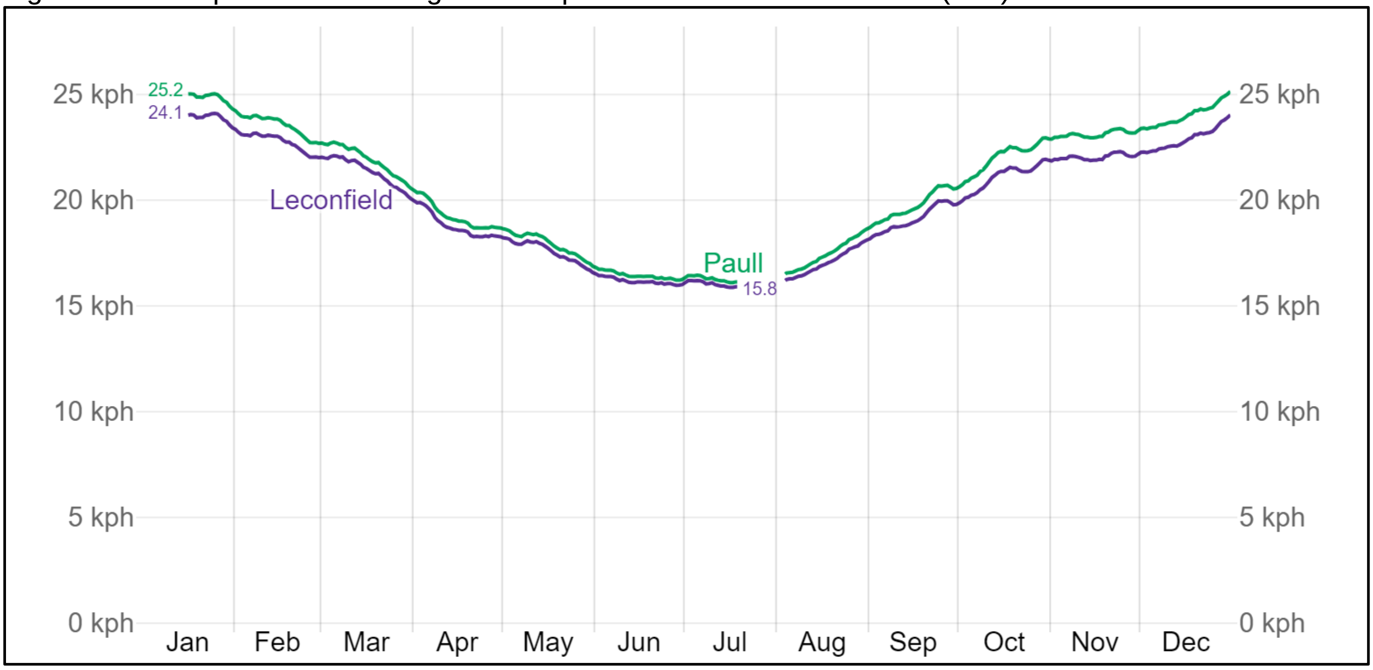
4.5 Meteorology

Leconfield weather station (around 19 km to the north-west of the site) was used to provide hourly sequential meteorological data for the dispersion model. The choice of met data site is consistent with the approach taken in the previous modelling assessments at Saltend Power Station[2,3].

A study by the UK Atmospheric Dispersion Modelling Liaison Committee (ADMLC) into the portability of weather data for dispersion calculations[5] found that the most important factor in the selection of a meteorological station was the annual mean wind speed. A desk study was undertaken to compare the wind speeds from Leconfield with the closest estimate for the site (Paull) as shown in Figure 4.2. The results showed that average wind speeds are very similar. As such, data from Leconfield weather station are considered to be appropriate for use in this assessment.

Five full years of Leconfield meteorological data from years 2019 - 2023 were used in the dispersion modelling; the wind rose for each year is shown in Figure 4.3. The model results presented in Section 5.0 represented the maximum predicted concentrations from these five modelled years.

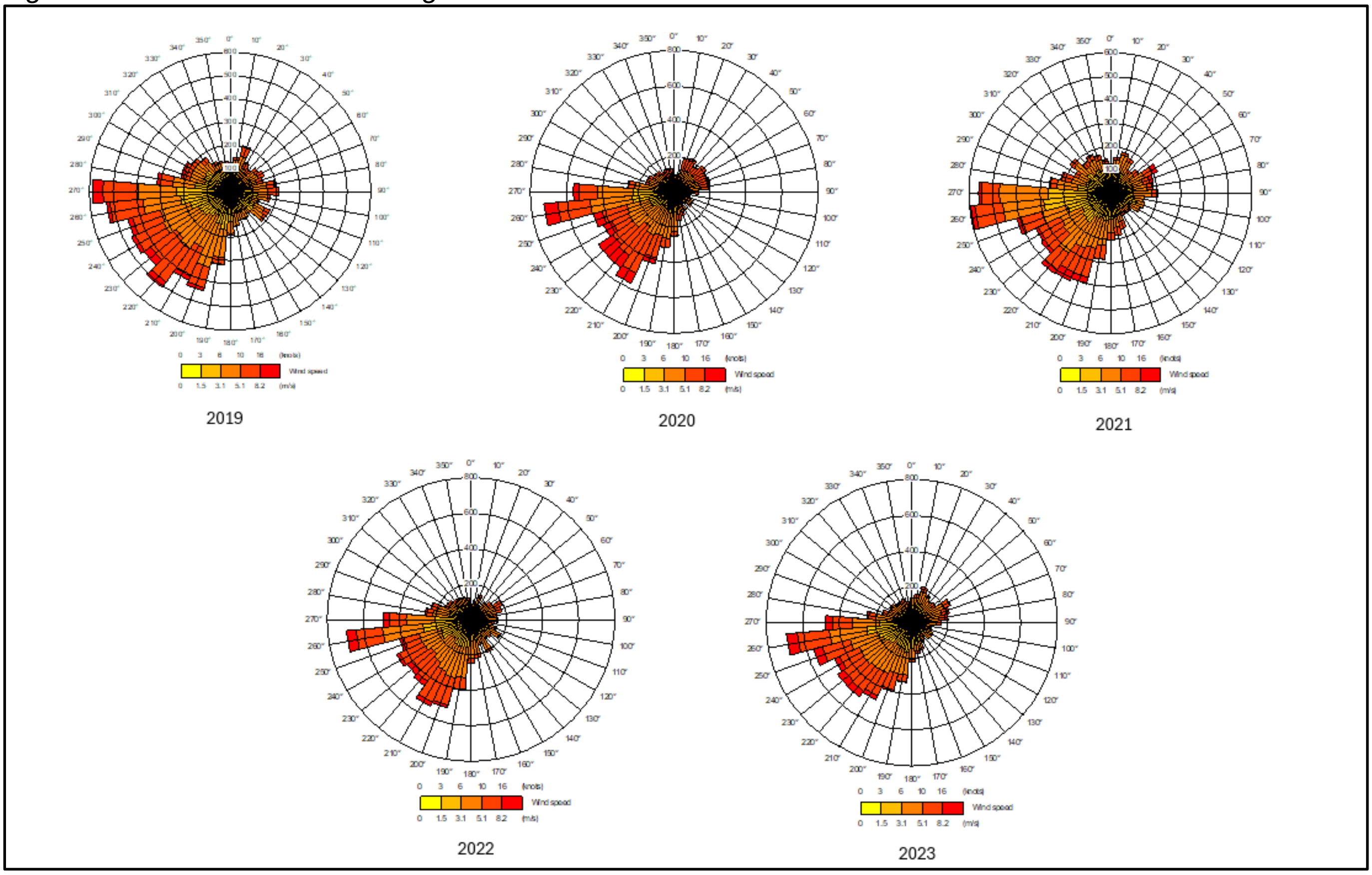
Figure 4.2: Comparison of Average Wind Speed at Leconfield and Paull (Site)



Contains Weatherspark.com Data © 2024

5 https://admlc.files.wordpress.com/2014/09/r316.pdf

Figure 4.3: Leconfield Meteorological Station 2019 - 2023 Wind Rose Data



4.6 Surface Characteristics

A surface roughness length is used to characterise the texture of land as this can impact dispersion of pollutants. With respect to the modelled domain, a length of 1.0 m (cities, woodlands) has been used for the site and 0.3 m (Agricultural areas, max) for the weather station.

4.7 Minimum Monin-Obukhov Length

A minimum Monin-Obukhov length of 30 m (mixed urban/industrial) was used at the development site and a length of 10m (small towns) for the meteorological site to account for the effects of buoyancy on turbulent flows.

4.8 Special Treatments

No special treatment (such as: dry or wet deposition; short-term releases; fluctuations; or chemistry) were deemed appropriate for use within the dispersion model.

4.9 Modelling Uncertainty

There are a variety of factors which can lead to potential uncertainty in dispersion modelling predictions. In the model results, potential uncertainties were minimised as far as is considered practicable and worst-case inputs used to provide a robust assessment. This included:

- The atmospheric dispersion model ADMS-6 has been verified by CERC through a number of studies to ensure predictions are suitably robust;
- Background pollutant concentrations and loads were obtained from Defra as an estimate of baseline conditions at human receptors;
- To account for inter-year variability in meteorological conditions, five years of meteorological data was used in the assessment; and,
- Surface roughness and the Monin-Obukhov length for the dispersion site and meteorological site were evaluated based on the land use guidance provided by CERC.

4.10 Model Output

Predicted pollutant concentrations were summarised in the following formats:

- Process contribution (PC) - Predicted pollutant level due to emissions from the facility only.
- Predicted environmental concentration (PEC) - Total predicted pollutant level due to emissions from the facility and existing baseline conditions.
- Net PC – net change to pollutant level associated with the change in ELV proposed at this facility.

Given the nature of this permit variation, assessment has reviewed the net PC.

4.11 NO_X to NO_2 Conversion

Emissions of NO_x arising from combustion processes are mainly in the form of nitric oxide (NO) at the point of release. NO_2 forms where the NO is oxidised due to excess oxygen in the combustion gases or other atmospheric reactions. In accordance with EA guidance, the NO_x to NO_2 conversions (at the point of impact) were assumed to be 70% for long-term average concentrations and 35% for short-term average concentrations.

4.12 Calculation of Contribution to Critical Loads

Deposition rates were calculated using empirical methods recommended by the EA AQTAG06. Dry deposition flux was calculated using the following equation:

Dry deposition flux (µg/m^2/s) = ground level concentration (µg/m^3) x deposition velocity (m/s)

Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow and is not considered significant over short distances (AQTAG06) compared with dry deposition and therefore for the purposes of this assessment, wet deposition has not been considered consistent with AQTAG06. The applied deposition velocities are as shown in Table 4.4.

Table 4.4: Deposition Velocities

Pollutant	Deposition Velocity (m/s)	
NO_2	Grassland	0.0015
	Woodland	0.0030

The predicted deposition rates were converted from µg/m^2/s to units of nitrogen deposition and acid equivalent deposition as detailed in Table 4.5.

Table 4.5: Applied Deposition Conversion Factors

Pollutant	Conversion	Factor
NO_2 to Nitrogen Deposition	µg/m^2/s to kg/ha/year	95.9
NO_2 to Acid Deposition	µg/m^2/s to kg_{eq}/ha/year	6.84

4.13 Calculation of PC as a percentage of Acid C_{Lo} Function

The calculation of the process contribution of N to the acid C_{Lo} function has been carried out according to the guidance on APIS, which is as follows:

The potential impacts of additional sulphur and/or nitrogen deposition from a source are partly determined by PEC, because only if PEC of nitrogen deposition is greater than CLminN will the additional nitrogen deposition from the source contribute to acidity. Consequently, if PEC is less that CLminN only the acidifying affects of sulphur from the process need to be considered:

Where PEC N Deposition < CLminN

*PC as % CL function = (PC S deposition/CLmaxS)*100*

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Where PEC is greater than CLminN (the majority of cases), the combined inputs of sulphur and nitrogen need to be considered. In such cases, the total acidity input should be calculated as a proportion of the CLmaxN.

Where PEC N Deposition > CLminN

*PC as %CL function = ((PC of S+N deposition)/CLmaxN)*100*

4.14 Assessment Significance

4.14.1 Human Receptors

In accordance with the EA's AERA guidance, a PC for any substance can be considered 'insignificant' if the PC meets the following criteria:

- The long-term PC is less than 1% of the long-term environmental standard.
- The short-term PC is less than 10% of the short-term environmental standard.

Initially, the maximum predicted PC across the modelled grid has been assessed against these criteria. If the above criteria are achieved at the point of maximum impact, then it can be concluded that impacts are 'insignificant' at all locations and that no further assessment is required.

If these criteria are exceeded, the predicted environmental concentration (PEC - defined as the PC plus the background concentration) is then calculated and consideration given to predicted impacts at discrete receptor locations.

Further action is not required, and impacts are considered to be acceptable and not to constitute 'significant pollution', if both of the following criteria are met:

- The proposed emissions comply with Best Available Techniques Associated Emission Levels (BAT AEL) or equivalent where there is no BAT AEL; and
- The resulting PECs are predicted not to exceed environmental standards.

4.14.2 Ecological Receptors

In addition to the AERA guidance, the EA's Operational Instruction 66_12 specifically details how the air quality impacts on ecological sites can be assessed. This guidance provides risk-based screening criteria to determine whether impacts will have 'no likely significant effects (alone and in-combination)' for European sites, 'no likely damage' for SSSIs, as follows:

- PC <1% long-term critical level and/or critical load for European sites and SSSIs.
- PC <10% short-term critical level for NO_x and hydrogen fluoride (if applicable) for European sites and SSSIs.
- PC <100% long-term critical level and/or critical load other conservation sites.
- PC <100% short-term critical level for NO_x for other conservation sites.

Where impacts cannot be classified as resulting in 'no likely significant effect', more detailed assessment may be required depending on the sensitivity of the feature in accordance with EAs Operational Instruction 67_12. This can require the consideration of the potential for in-combination effects, the actual distribution of sensitive features within the site and local factors (such as the water table).

The guidance provides the following further criteria:

- If the PEC<100% of the appropriate critical level and/or critical load it can be assumed there will be no adverse effect.
- If the background is below the critical level and/or critical load, but a small PC leads to an exceedance – decision based on local considerations.
- If the background is currently above the critical level and/or critical load and the additional PC will cause a small increase – decision based on local considerations.
- If the background is below the critical level and/or critical load, but a significant PC leads to an exceedance – cannot conclude no adverse effect.
- If the background is currently above the critical level and/or critical load and the additional PC is large - cannot conclude no adverse effect.

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Section 5.0: Results

5.1 Introduction

Table 5.1 summarises the various impact assessments which were undertaken.

Table 5.1: Impact Assessment Summary

Assessment Type	Section	Relevant Tables/Figures	Comment
Prediction of maximum concentrations (µg/m^3) across modelled grid[6] for human receptors	5.2	Tables 5.2 – 5.3	Assessment of pollutant impact relative to the environmental standards outlined in Section 2.0 and Section 3.6
Prediction of maximum concentrations (µg/m^3) at discrete sensitive human receptors	5.3	Tables 5.4 – 5.5	
Prediction of maximum concentrations (µg/m^3) across modelled grid[7] for ecological receptors[8]	5.4	Tables 5.7 – 5.8	
Prediction of maximum concentrations (µg/m^3) at discrete sensitive ecological receptors	5.5	Tables 5.8 – 5.11	

In each instance a screening exercise using only the PC value relative to the applicable environmental standard was undertaken i.e. not considering background concentrations. Where screening occurs, the associated impact is considered negligible. The screening criteria are as follows:

- For long term (i.e. annual mean) assessment, screening occurred where the PC value was <1% of the relevant environmental standard, and
- For short term (i.e. 1-hour mean) assessment, screening occurred where the PC value was <10% of the relevant environmental standard.

5.2 Gridded Human Receptors

As summarised in Section 4.5, five years of weather data have been run to help account for the variation in weather conditions which will be experienced at site. Initial model runs indicated that meteorological data from 2020 produced the highest concentrations at discrete receptor locations. As such, grid models have been run using a meteorological year of 2020. Contour plots for long and short-term NO_2 are included in Appendix B.

5.2.1 Annual Mean NO_2

As shown in Table 5.2, the annual mean NO2 PCs are above 1% of the limit value at worst case locations across the modelled grid in both the existing and proposed scenario.

However, the increasing of the limit value to 50 mg/m^3 alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to human health receptors within the assessed grid in the long-term. This is highlighted in Figure B.1 and B.2 which shows that the area of exceedance of the 1% limit value reduces as a result of the proposed changes.

The corresponding NO_2 PECs are below the 40 µg/m^3 limit value across the modelled grid in both modelled scenarios. A maximum PEC of 23.9 µg/m^3 is predicted across the grid (existing scenario) which is 40% below the limit value.

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[6] The grid is modelled at 1.5m representative of human breathing height at ground level but the point of maximum impact which is reported will, where applicable, include any sensitive receptors which have been modelled at height

[7] The grid is modelled at 0m representative of ground level for ecological receptors

[8] Not all of grid is located within a designated ecological site.

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The proposed increase of the NO_x ELV alongside reduced operational hours to a combined 17,790 hours does not amount to significant pollution with regard to annual mean NO_2 concentrations.

5.2.2 1-Hour Mean NO_2

As shown in Table 5.3 the 1-hour mean NO_2 PCs are above 10% of the limit value at worst case locations across the modelled grid in both the existing and proposed scenario. This is highlighted in Figure B.3 and B.4 which shows that exceedances of the 10% significance threshold are predicted, however this is largely constrained to a small area north-east of the site boundary. This area is not a location where members of the public are reasonably expected to spend up to 1 hour. Concentrations are expected to drop below 10% of the limit value approximately 1km form the site boundary. The increasing of the limit value to 50 mg/m^3 results in a maximum net PC increase of 8.0 µg/m^3 at the worst-case grid location, which corresponds to 4% of the limit value.

The corresponding NO_2 PECs are below the 40 µg/m^3 limit value across the modelled grid in both modelled scenarios. A maximum PEC of 83.3 µg/m^3 is predicted across the grid (proposed scenario) which is 58% below the limit value. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to 1-hour mean NO_2 concentrations.

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Table 5.2: 2020 Maximum Predicted Concentration of Annual Mean NO_2 Across Modelled Grid (Long Term)

Scenario	Reference Period	Limit Value (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z)			Net PC Change Between Scenarios	Net PC Change as % of Limit
Existing	Annual Mean	40	**2.4**	**6%**	21.5	23.9	60%	516405	428454	1.5	-0.4	-0.9%
Proposed			**2.0**	**5%**		23.5	59%	516405	428454	1.5		

Table 5.3: 2020 Maximum Predicted Concentration of 1-Hour Mean NO_2 Across Modelled Grid (Short Term)

Scenario	Reference Period	Limit Value (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z)			Net PC Change Between Scenarios	Net PC Change as % of Limit
Existing	1 Hour (99.79th percentile)	200	**32.3**	**16%**	43.0	75.3	38%	516405	428454	1.5	+8	4%
Proposed			**40.3**	**20%**		83.3	42%	516405	428454	1.5		

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5.3 Discrete Human Receptors

5.3.1 Annual Mean NO_2

The maximum predicted annual mean NO_2 concentrations at the human receptor locations are summarised in Table 5.4.

Table 5.4: Maximum Predicted Annual Mean NO_2 Impacts at Discrete Human Receptors

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
Existing Scenario				
R1	0.2	<1%	SCREENED	
R2	**1.7**	**4%**	23.2	58%
R3	**0.8**	**2%**	13.9	35%
R4	**0.9**	**2%**	15.2	38%
R5	0.2	<1%	SCREENED	
R6	0.2	<1%	SCREENED	
Proposed Scenario				
R1	0.2	<1%	SCREENED	
R2	**1.4**	**4%**	22.9	57%
R3	**0.7**	**2%**	13.8	34%
R4	**0.7**	**2%**	15.0	38%
R5	0.1	<1%	SCREENED	
R6	0.2	<1%	SCREENED	
Limit Value (µg/m³)	**40**			

*Exceedances of screening criteria, where applicable, are highlighted in **bold**.

The annual mean NO_2 PCs are above 1% of the limit value at three of the six modelled receptors in both the existing and proposed scenario.

A maximum PC of 1.7 µg/m³ is predicted at receptor R2 (existing scenario) which is located approximately 1km north of the site. This corresponds to 4% of the limit value. However, the increasing of the limit value to 50 mg/m³ alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to human health receptors within the assessed grid in the long-term.

The corresponding NO_2 PECs are well below the 40 µg/m³ limit value at all modelled receptors, in both modelled scenarios. A maximum PEC of 23.2 µg/m³ is predicted at receptor R2 (existing scenario), which is below the limit value by 42%.

The proposed increase of the NO_x ELV alongside reduced operational hours to a combined 17,790 hours does not amount to significant pollution with regard to annual mean NO_2 concentrations.

5.3.2 1-Hour Mean NO_2

The maximum predicted 99.79th percentile 1-hour mean NO_2 concentrations at the receptor locations are summarised in Table 5.5.

Table 5.5: Maximum Predicted 99.79th Percentile 1-hour Mean NO_2 Impacts at Discrete Human Receptors

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
Existing Scenario				
R1	6.1	3%	SCREENED	
R2	14.5	7%	SCREENED	
R3	6.3	3%	SCREENED	

Receptor	PC ($\mu g/m^3$)	PC % of Limit	PEC	PEC % of Limit
R4	7.9	4%	SCREENED	
R5	7.7	4%	SCREENED	
R6	4.9	2%	SCREENED	
Proposed Scenario				
R1	7.6	4%	SCREENED	
R2	18.1	9%	SCREENED	
R3	7.8	4%	SCREENED	
R4	9.9	5%	SCREENED	
R5	9.6	5%	SCREENED	
R6	6.1	3%	SCREENED	
Limit Value ($\mu g/m^3$)	**200**			

The 99.79th percentile 1-hour mean PCs are below 10% of the limit value at all modelled receptors in both the existing and proposed scenario. A maximum PC of 18.1 $\mu g/m^3$ is predicted at receptor R2 (proposed scenario) which corresponds to 9% of the limit value. The increasing of the limit value to 50 mg/m^3 results in a maximum net PC increase of 3.6 $\mu g/m^3$ at discrete sensitive human receptors which corresponds to 1.8% of the limit value.

Furthermore, the corresponding NO_2 PECs are well below the 200 $\mu g/m^3$ limit value at all modelled receptors, in both modelled scenarios. A maximum PEC of 48.3 $\mu g/m^3$ is predicted at receptor R2, which is below the limit value by 76%. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to 1-hour mean NO_2 concentrations at modelled discrete sensitive human receptors.

5.4 Gridded Ecological Receptors

As summarised in Section 4.5, five years of weather data have been run to help account for the variation in weather conditions which will be experienced at site. Initial model runs indicated that meteorological data from 2020 produced the highest concentrations at discrete receptor locations. As such, grid models have been run using a meteorological year of 2020.

As shown in Table 5.6, the increasing of the limit value to 50 mg/m^3 alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to ecological receptors within the assessed grid in the long-term.

A contour plot for nitrogen deposition is included in Appendix B which demonstrates that the PC for the proposed site is below 1% of the lower critical load for saltmarsh within the Humber Estuary ecological area. This further illustrates the benefit to ecological receptors within the ecological area.

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Table 5.6: 2020 Maximum Predicted Concentration of Annual Mean NO_x Across Modelled Grid (Long Term)

Scenario	Reference Period	Limit Value (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z) [9]			Net PC Change Between Scenarios	Net PC Change as % of Limit
Existing	Annual Mean	30	**3.5**	**12%**	35.4	38.9	130%	516405	428454	1.5	-0.5	-1.8%
Proposed			**2.9**	**8%**		38.3	128%	516405	428454	1.5		

Table 5.7: 2020 Maximum Predicted Concentration of 24-Hour Mean NO_x Across Modelled Grid (Short Term)

Scenario	Reference Period	Limit Value (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z) [10]			Net PC Change Between Scenarios	Net PC Change as % of Limit
Existing	24-Hour Mean	75	**79.4**	**106%**	70.8	150.2	200%	516505	428154	1.5	+19.5	26.1%
Proposed			**99.0**	**132%**		169.8	226%	516505	428154	1.5		

[9] Not all of grid is located within a designated ecological site.

[10] Not all of grid is located within a designated ecological site.

5.5 Discrete Ecological Receptors

5.5.1 Annual Mean NO_x

The maximum predicted annual mean NO_x concentrations at the discrete ecological receptor locations are summarised in Table 5.8.

Table 5.8: Maximum Predicted Annual Mean NO_x Impacts at Discrete Ecological Receptors

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
Existing Scenario				
ECO1	0.017	<1%	SCREENED	
ECO2	0.296	<1%	SCREENED	
ECO3	0.226	<100%	SCREENED	
ECO4	0.193	<100%	SCREENED	
ECO5	0.161	<100%	SCREENED	
Proposed Scenario				
ECO1	0.014	<1%	SCREENED	
ECO2	0.251	<1%	SCREENED	
ECO3	0.191	<100%	SCREENED	
ECO4	0.163	<100%	SCREENED	
ECO5	0.136	<100%	SCREENED	
Limit Value (µg/m³)	**30**			

*Exceedances of screening criteria, where applicable, are highlighted in **bold**.

The annual mean NO_X impacts at modelled receptors ECO1-2 and ECO3-5 are screened below their respective criteria for both existing and proposed scenarios such that ‘no likely significant effects (alone and in-combination)’ for European sites and ‘no likely damage’ for LWS sites is determined.

The increasing of the limit value to 50 mg/m³ alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to the assessed receptors.

5.5.2 24-Hour Mean NO_x

The maximum predicted 24-hour mean NO_x concentrations at the discrete ecological receptor locations are summarised in Table 5.9.

Table 5.9: Maximum Predicted 24-Hour Mean NO_x Impacts at Discrete Ecological Receptors

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
Existing Scenario				
ECO1	6.4	<10%	SCREENED	
ECO2	5.2	<10%	SCREENED	
ECO3	5.5	<100%	SCREENED	
ECO4	6.2	<100%	SCREENED	
ECO5	1.6	<100%	SCREENED	
Proposed Scenario				
ECO1	6.6	<10%	SCREENED	
ECO2	6.4	<10%	SCREENED	
ECO3	6.9	<100%	SCREENED	
ECO4	7.7	<100%	SCREENED	
ECO5	2.0	<100%	SCREENED	
Limit Value (µg/m³)	**75**			

*Exceedances of screening criteria, where applicable, are highlighted in **bold**.

The daily mean NO_X impacts at modelled receptors ECO1-2 and ECO3-5 are screened below their respective criteria for both existing and proposed scenarios such that 'no likely significant effects (alone and in-combination)' for European sites and 'no likely damage' for LWS is determined.

5.6 Nitrogen Deposition

The predicted annual nitrogen deposition rates at the receptor locations are summarised in Table 5.10.

Table 5.10: Maximum Predicted Annual Mean Nitrogen Deposition Rates at Discrete Ecological Receptors

Receptor	PC (kgN/ha/yr)	PC % of Lower Critical Load	PC % of Upper Critical Load	PEC (kgN/ha/yr)	PEC % of Lower Critical Load	PEC % of Upper Critical Load
Existing Scenario						
ECO1	0.002	<0.1%	<0.1%	SCREENED		
ECO2	0.043	0.4%	0.2%	SCREENED		
ECO3	0.032	0.6%	0.2%	SCREENED		
ECO4	0.028	0.6%	0.2%	SCREENED		
ECO5	0.023	0.5%	0.2%	SCREENED		
Proposed Scenario						
ECO1	0.002	<0.1%	<0.1%	SCREENED		
ECO2	0.036	0.4%	0.2%	SCREENED		
ECO3	0.027	0.5%	0.2%	SCREENED		
ECO4	0.023	0.5%	0.2%	SCREENED		
ECO5	0.020	0.4%	0.1%	SCREENED		

*Exceedances of screening criteria, where applicable, are highlighted in **bold**.

The annual mean nitrogen deposition PC impacts at modelled receptors ECO1-2 and ECO3-5 are screened below their respective criteria for both existing and proposed scenarios such that 'no likely significant effects (alone and in-combination)' for European sites and 'no likely damage' for LWS sites is determined.

The increasing of the limit value to 50 mg/m^3 alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to the assessed receptors.

5.7 Acid Deposition

The predicted annual acid deposition rates at the receptor locations are summarised in Table 5.11.

Table 5.11: Maximum Predicted Annual Mean Acid Deposition Rates at Discrete Ecological Receptors

Receptor	Nitrogen PC (keq/ha/yr)	CLmaxN (keq/ha/yr)	PC % of CLmaxN	Nitrogen PEC (keq/ha/yr)	PEC: % of CLmaxN
Existing Scenario					
ECO4	0.0040	8.69	<100%	SCREENED	
Proposed Scenario					
ECO4	0.0034	8.69	<100%	SCREENED	

The annual mean acid deposition PC impacts at modelled receptor ECO4 are screened below their respective criteria for both existing and proposed scenarios such that 'no likely damage' for LWS sites is determined.

The increasing of the limit value to 50 mg/m^3 alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to the assessed receptors.

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Section 6.0: Conclusions

Crestwood Environmental, now part of Mabbett, was appointed by Saltend Cogeneration Company Limited to undertake a detailed air quality dispersion modelling assessment assessing the impacts of increasing the Emissions Limit Value (ELV) at three gas turbines at the Saltend Power Station, Hull.

Dispersion modelling was undertaken using ADMS-6. For the purposes of assessing impacts on sensitive human and ecological receptors, NO_x and NO_2 were including in the dispersion modelling.

The dispersion model results were compared against the relevant limits, as summarised below:

- The annual mean NO_2 PCs are above 1% of the limit value at three of the six discrete modelled receptors and at hypothetical receptor locations in the modelled grid area, in both the existing and proposed scenarios. However, the increasing of the limit value to 50 mg/m^3 alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to human health receptors within the assessed grid in the long-term. The proposed increase of the NOx ELV alongside reduced operational hours to a combined 17,790 hours does not amount to significant pollution with regard to annual mean NO2 concentrations.
- The 1-hour mean NO_2 PCs are below 10% of the limit value at all discrete modelled receptors but above 10% of the limit value at hypothetical receptor locations in the modelled grid area, in both the existing and proposed scenarios. Furthermore, the corresponding NO_2 PECs are below the 200 µg/m^3 limit value at all modelled receptors and grid locations. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to 1-hour mean NO_2 concentrations.
- The annual mean NO_x PCs are below their respective screening criteria at all discrete modelled ecological receptors in both existing and proposed scenarios. The increasing of the limit value to 50 mg/m^3 alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to the assessed receptors.
- The 24-hour mean NO_x PCs are below their respective screening criteria at all discrete modelled ecological receptors. As such, 'no likely significant effects (alone and in-combination)' for European sites and 'no likely damage' for LWS is determined.
- The annual mean nitrogen deposition PCs are below their respective screening criteria at all discrete modelled ecological receptors in both existing and proposed scenarios. The increasing of the limit value to 50 mg/m^3 alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to the assessed receptors.
- The annual mean acid deposition PCs are below their respective screening criteria at all modelled receptors. The increasing of the limit value to 50 mg/m^3 alongside reduced operational hours to a combined 17,790 hours reduces the total PC from the Saltend plant. This therefore provides a benefit to the assessed receptors.

The overall impacts of emissions, from increasing the NO_x ELV to 50 mg/m^3 alongside reduced operational hours to a combined 17,790 hours, are considered to provide a benefit to receptors where the long-term air quality objectives and limits apply. For short-term air quality objectives and limits, it is considered that the impact on existing sensitive humans is not significant pollution whilst 'no likely significant effects (alone and in-combination)' for European sites and 'no likely damage' for modelled local wildlife sites is determined.

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Appendix A: Examples of Where Environmental Standards Apply

Averaging Period	Objectives should apply at:	Objectives 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	▪ All locations where the annual mean objectives 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 objectives would apply. ▪ Kerbside sites (e.g. pavements of busy shopping streets). ▪ Those parts of car parks, bus stations and railway stations, etc. which are not fully enclosed, where the public might reasonably be expected to spend one hour or more. ▪ Any outdoor locations at which the public may be expected to spend on hour or longer.	▪ Kerbside sites where the public would not be expected to have regular access.
15 Minute Mean	▪ All locations where members of the public might reasonably be expected to spend a period of 15 minutes or longer.	

Appendix B: Contour Plots

Figure B.1 2020 Annual Mean NO_2 Process Contribution as Percentage of the Limit Value (Limit Value 40 µg/m^3) – Existing

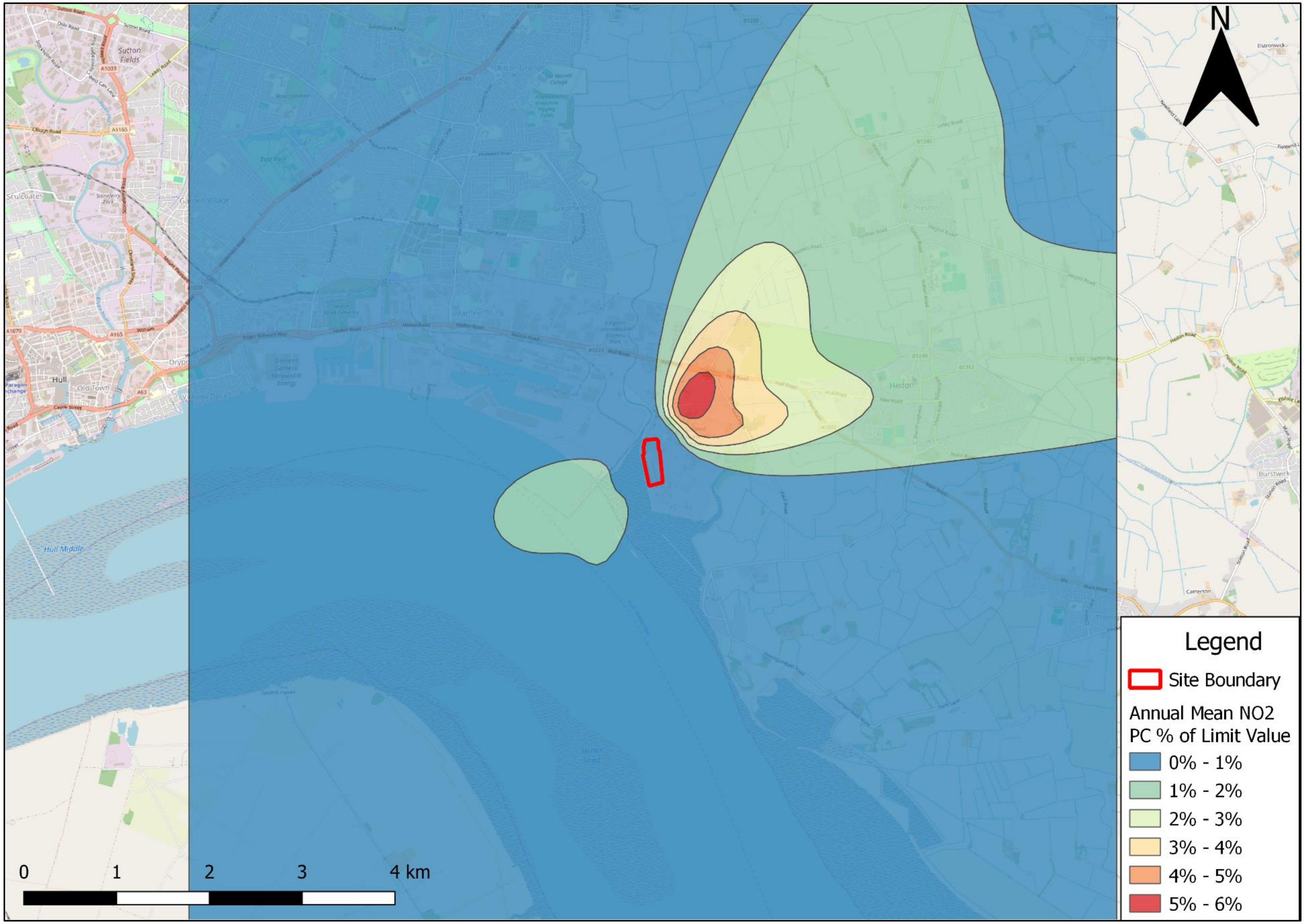

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Figure B.2 2020 Annual Mean NO_2 Process Contribution as Percentage of the Limit Value (Limit Value 40 µg/m^3) – Proposed

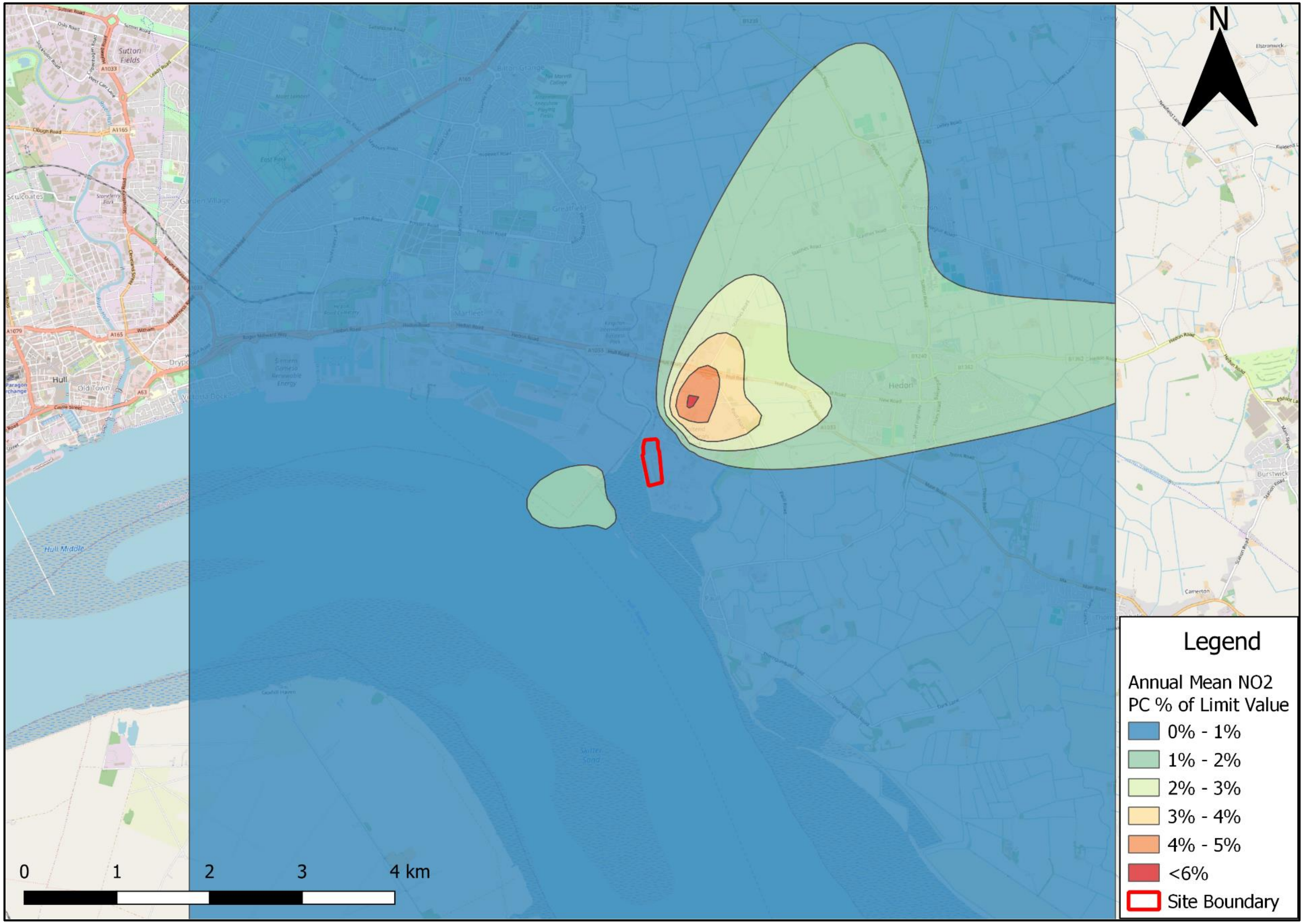

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Figure B.3 2020 1-Hour Mean NO_2 Process Contribution as Percentage of the Limit Value (Limit Value 200 µg/m^3) – Existing

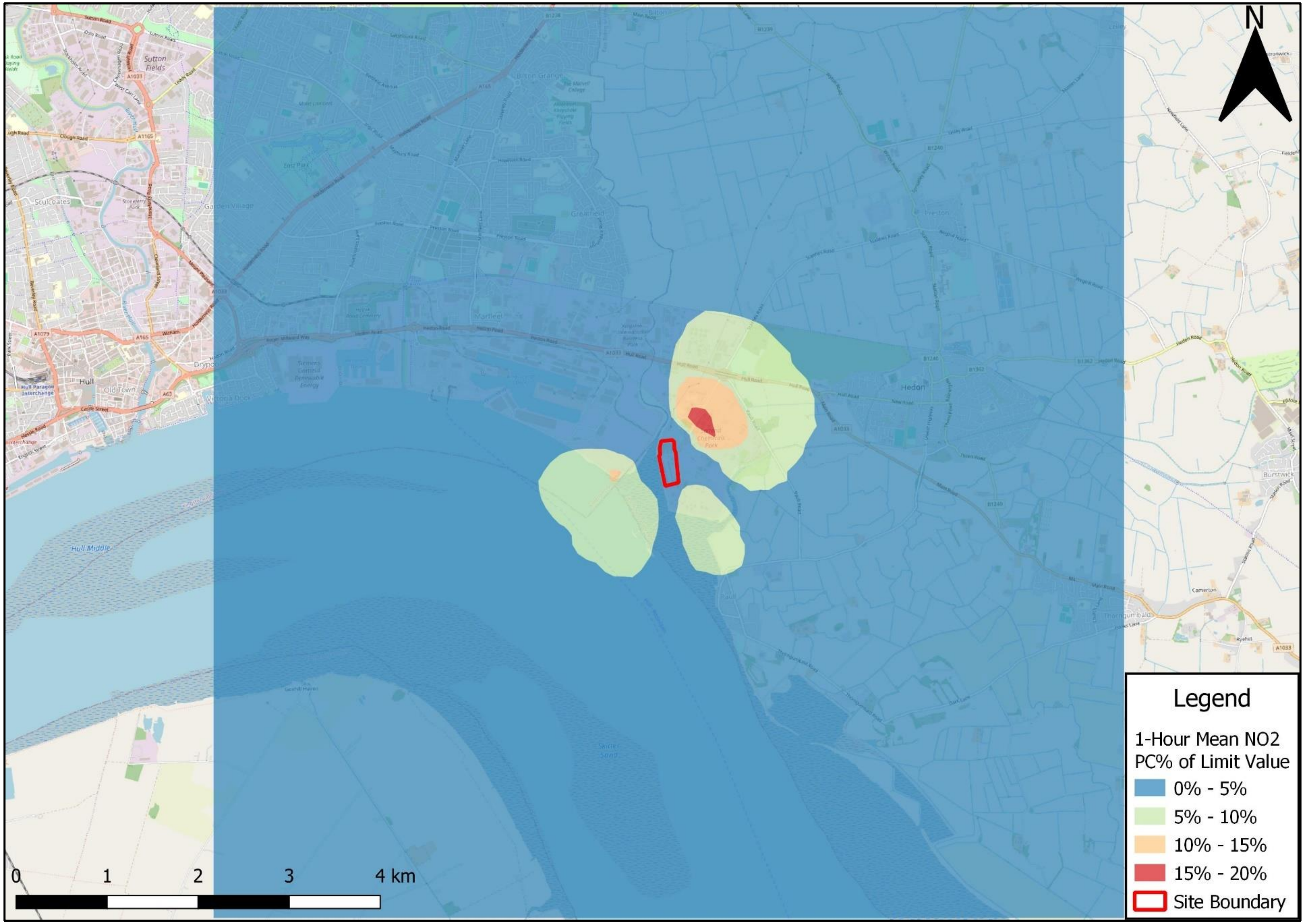

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Figure B.4 2020 1-Hour Mean NO_2 Process Contribution as Percentage of the Limit Value (Limit Value 200 µg/m^3) – Existing

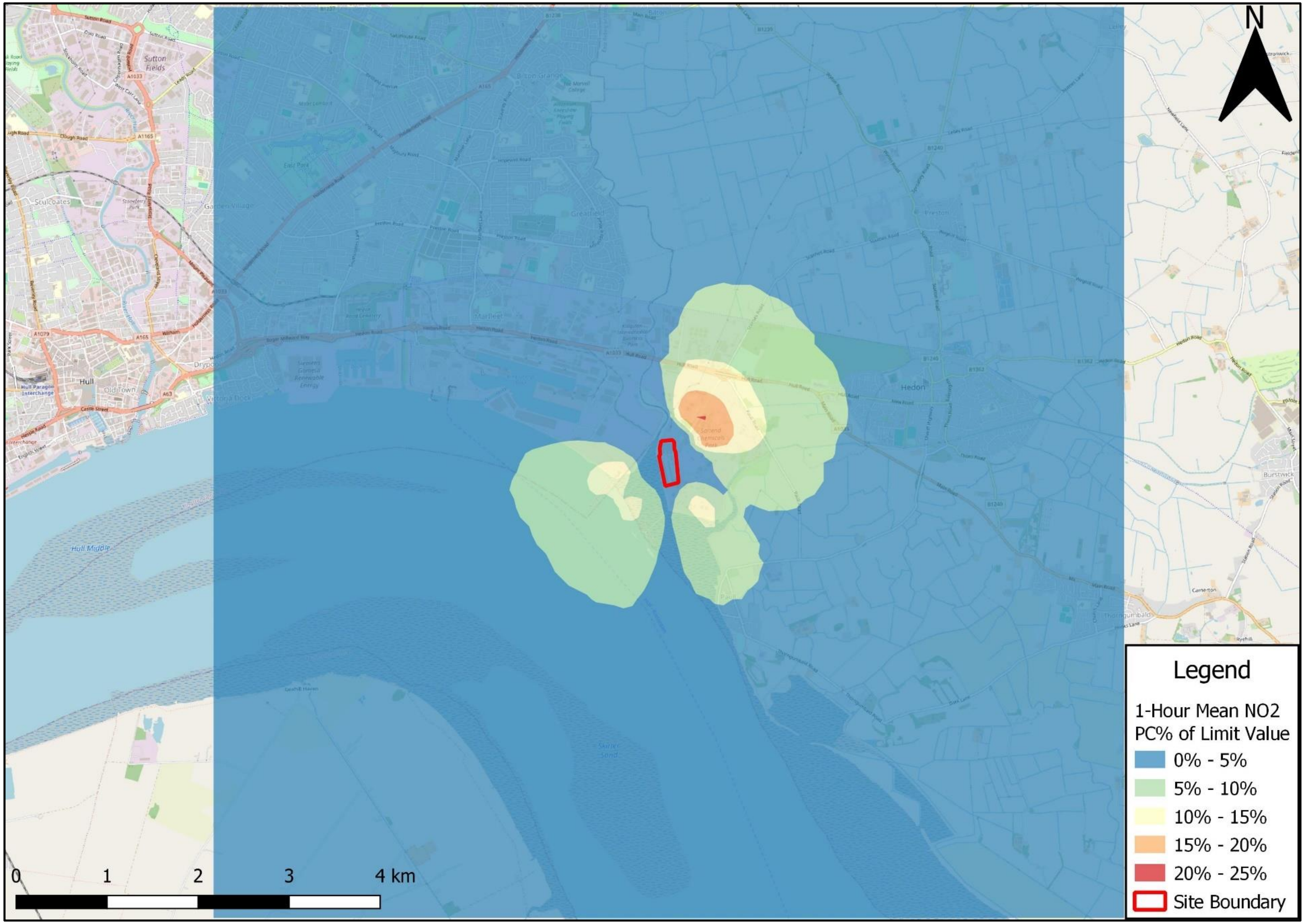

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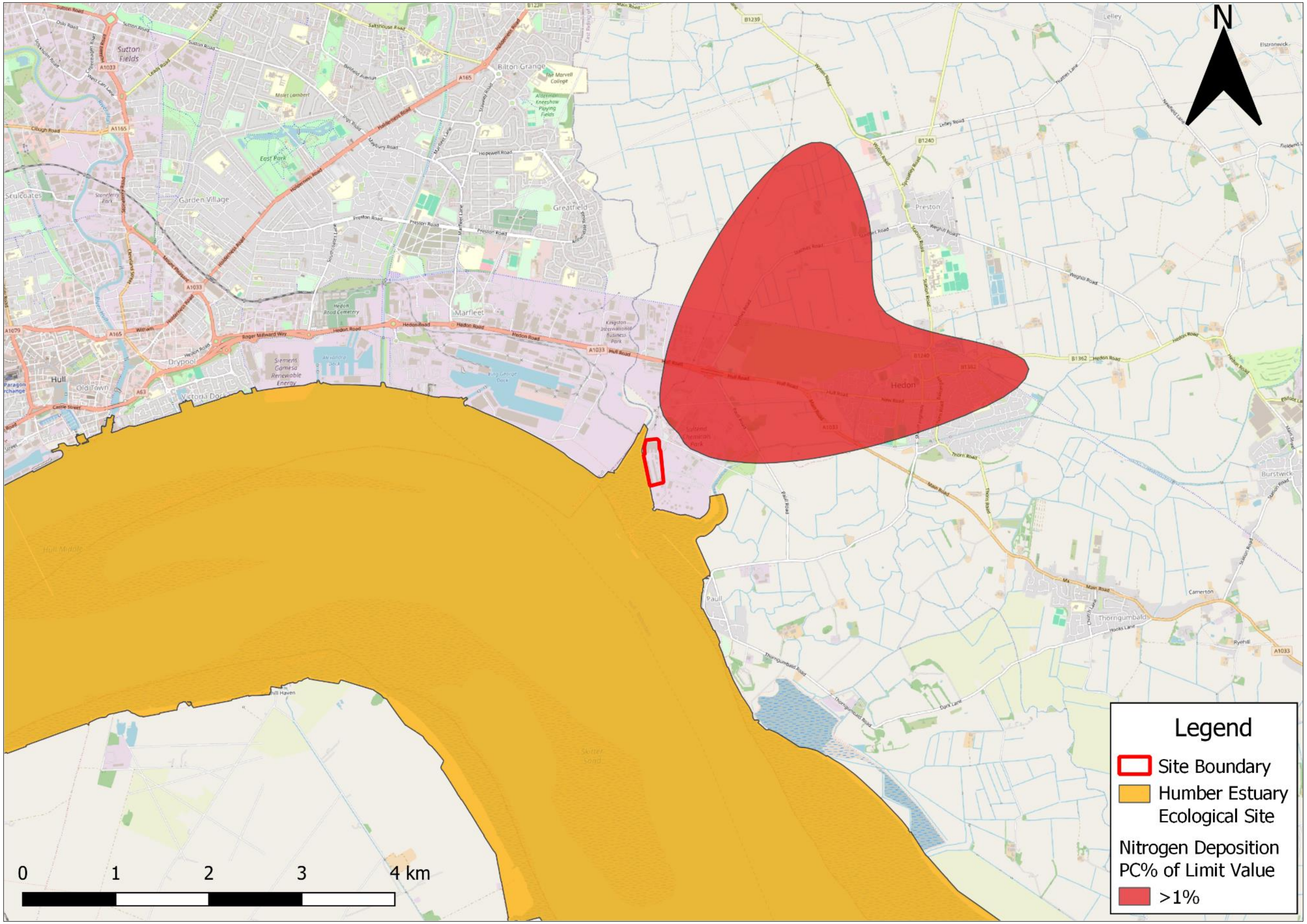
Figure B.5 2020 Nitrogen Deposition Process Contribution as Percentage of the Lower Critical Load for Coastal Saltmash (10 kgN/ha/yr) – Proposed



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