Environmental Permit Application – Air Quality Impact Assessment

Aldbrough Hydrogen Pathfinder

PREPARED FOR

SSE Hornsea Ltd

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Environmental Permit Application – Air Quality Impact Assessment

Aldbrough Hydrogen Pathfinder

0653313

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ACRONYMS AND ABBREVIATIONS

Acronym	Description
AGS	Aldbrough Gas Storage
AHP	Albrough Hydrogen Pathfinder
APIS	Air Pollution Information System
AQIA	Air Quality Impact Assessment
AQMA	Air Quality Management Area
AQS	Air Quality Standards
BAT	Best Available Techniques
BREF	Best Available Techniques Reference document
CEA	Cumulative Effects Assessment
CH_4	Methane
CL	Critical Level

Acronym	Description
CO_2	Carbon Dioxide
DEFRA	Department for Environment, Food and Rural Affairs
DESNZ	Department for Energy Security and Net Zero
EA	Environment Agency
EAL	Environmental Assessment Level
EC	European Commission
EP	Environmental Permit
ERM	Environmental Resources Management Limited
EU	European Union
g	Grams
h	Hours
H_2	Hydrogen
H_2O	Water
HCl	Hydrogen Chloride
kg	Kilograms
km	Kilometres
LAQM	Local Air Quality Management
LNR	Local Nature Reserve
LWS	Local Wildlife Site
m	Metres
MWe	Megawatt Electrical
NH_3	Ammonia
NNR	National Nature Reserve
Nm^3	Normalised cubic metre
N_2	Nitrogen
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
O_3	Ozone
OCGT	Open Cycle Gas Turbine
pLWS	Potential Local Wildlife Site
PEC	Predicted Environmental Concentration
PC	Process Contribution
PM	Particulate Matter

Acronym	Description
s	Second
SAC	Special Area of Conservation
SCR	Selective Catalytic Reduction
SO_2	Sulphur Dioxide
SPA	Special Protection Area
SSE	SSE Hornsea Ltd
SSSI	Site of Special Scientific Interest

APPLICATION CHECKLIST

For ease of reference, the table below sets out all of the information required for the Permit application by the Environment Agency guidance "Environmental permitting: air dispersion modelling reports", and the relevant section in this report.

Requirement	Location in Report
Purpose of the study	Section 1 Introduction
Describe the site	Section 3.2 Study Areas
Modelled scenarios	Section 3.3.3 Operational Modelling
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Surrounding land use map	Figure 3.2 – Surrounding land use
Relevant environmental standards	Section 2.1.5 Guidance
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Explain the model	Section 3.3 Methodology for the Assessment of Effects
Emission parameters	Section 3.3 Methodology for the Assessment of Effects
Stack location	Figure 3.3 – Site Layout as Modelled
Modelled domain and receptors	Section 3.3 Methodology for the Assessment of Effects
Weather and surface characteristics	Section 3.3 Methodology for the Assessment of Effects. Wind Roses in Appendix A.
Terrain and building treatments	Section 3.3 Methodology for the Assessment of Effects.
Special treatments	Section 3.3 Methodology for the Assessment of Effects for NO_x to NO_2 conversion
Sensitivity analysis	Section 5.1.3 Sensitivity Analysis
Impact Assessment	Section 5 Assessment of Effects
Isopleths/Contour plots	Figure 5.1 - Contour Plot – Scenario 2 NO2 1hr 99.8P (2018) Figure 5.2 – Contour Plot – Scenario 3 NO2 1hr 99.8P (2018) Figure 5.3 – Contour Plot – Scenario 3 NOx 24hr max (2020)
Model input files	Sent with application electronically

1. INTRODUCTION

This Air Quality Impact Assessment (AQIA) has been prepared for the proposed Aldbrough Hydrogen Pathfinder (AHP) project to support the Environmental Permit (EP) application described further below being made by SSE Hornsea Ltd (SSE). The facility will be operated at SSE's Aldbrough Gas Storage (AGS) site on Garton Road, East Riding of Yorkshire (hereafter referred to as the 'Site').

The AHP project is an important building block in the development of a thriving Humber hydrogen economy, underpinning the region's decarbonisation and supporting economic growth locally and nationally. In the context of this application, 'the Site' is the "installation" permitted boundary.

The concept aims to store energy during periods of low carbon abundant generation and release that energy as low carbon power during periods of shortfall such as high barometric pressure (low wind) and low solar radiation (sunlight). Therefore, the AHP project supports energy security in the UK, which is an important consideration for the UK Government and the Department for Energy Security and Net Zero (DESNZ). This concept also aims at reducing reliance on natural gas for power generation when renewable energy is unavailable. The Site therefore enables decarbonisation of the Humber region and should support the region economically as it becomes a hub for low carbon power.

The AHP project is an innovative power-to-power project, integrating electrolytic hydrogen production, salt cavern hydrogen storage and use of the hydrogen for the generation of low carbon power by way of an Open Cycle Gas Turbine (OCGT) (up to 50 MWe (gross) capacity). All three components of the Site will be located on the same site, making it a First of a Kind (FOAK) development.

The main commercial activity of the Site will be the combustion of hydrogen and natural gas in an OCGT to produce electricity. This activity is listed under Schedule 1, Part 2 of the Environmental Permitting (England and Wales) Regulations 2016 (as amended) (EP Regulations), specifically the combustion of natural gas and hydrogen in an appliance with an aggregated thermal input of more than 50 megawatts (MWth). To support this operation, a new hydrogen plant is also being developed to produce hydrogen from electrolysis, which is also considered a listed activity under Schedule 1, Part 2 of the EP Regulations. As such, SSE are seeking to apply for an Environmental Permit (EP) with the Environment Agency (EA) for these activities.

This AQIA has been prepared by Environmental Resources Management Limited (ERM) on behalf of SSE, based on current and anticipated operations provided to ERM by SSE and publicly available data.

Separately, a full planning application[1] has been submitted in August 2024 to East Riding of Yorkshire Council (ERYC) under the Town and Country Planning Act 1990. Parts of the assessment work used in the planning application AQIA have been used in this report.

This impact assessment has been carried out using an air dispersion model to estimate the potential impact of the Site's emissions relative to human health protective standards (short-

[1] *Construction and operation of an electrolytic hydrogen production, storage and energy generation facility, known as Aldbrough Hydrogen Pathfinder, to be located at SSE Hornsea Limited's existing Aldbrough Gas Storage site*

term and long-term NO_2 and NH_3 standards) and protected conservation areas (short-term and long-term NO_x, NH_3, nitrogen deposition and acid deposition standards).

2. LEGAL FRAMEWORK

2.1 SUMMARY

Air quality is regulated in England through multiple mechanisms. Ambient air quality standards are set for the protection of health throughout England, and these are legally binding. There are also Critical Levels and Critical Loads for the protection of habitats, and these too are legally binding. In addition, through the EP issued by the EA, an industrial facility has set emission limits for those emission points deemed to be of potential significance in terms of their impacts onto air quality. These emissions limits may be derived from BREF Notes, from national guidance or set on a per facility basis.

As part of the EP process, a facility must demonstrate that the emissions to air from the facility will not result in unacceptable impacts. This impact assessment considers the underlying environmental conditions in the surrounding environment to determine the overall air quality when the Site becomes operational.

2.2 GUIDANCE

The AQIA takes into consideration the requirements of Environmental Permitting. As such this AQIA references several pieces of EA guidance and methodology. The AQIA was undertaken with reference to applicable guidance documents. These include:

- Environment Agency, 2024, Air emissions risk assessment for your environmental permit, https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit;
- Environment Agency, 2024, Environmental permitting: air dispersion modelling reports, https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports;
- Environment Agency, 2024, Guidance: Hydrogen combustion: comply with emission limit values (https://www.gov.uk/guidance/hydrogen-combustion-comply-with-emission-limit-values?utm_medium=email&utm_campaign=govuk-notifications-topic&utm_source=c31421b0-7b4e-441a-9c22-a0d67cdbf9d5&utm_content=daily); and
- Environment Agency, 2014, AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air (https://ukwin.org.uk/files/ea-disclosures/AQTAG06_Mar2014%20.pdf).

2.2.1 AIR QUALITY STANDARDS

The protection of sensitive human receptors is regulated through the following:

- Air Quality Standards imposed by The Air Quality Standards Regulations 2010 (as amended)[2] transposed from EU standards[3]; and
- Environmental Assessment Levels (EALs) set out by the Environment Agency.

[2] The Air Quality Standards Regulations 2010 Statutory Instrument 2008/301. Available online at: http://www.legislation.gov.uk/uksi/2010/1001/contents/made
[3] European Union Air Quality Standards. Available online at: http://ec.europa.eu/environment/air/quality/standards.htm

Collectively these are referred to as Air Quality Standards (AQS). The AQSs of relevance for this assessment are set out in Table 2.1.

TABLE 2.1 – AIR QUALITY STANDARDS

Pollutant	Averaging period	Assessment Criterion (µg m^{-3})
NO_2	Annual mean	40
NO_2	1 hour mean (not to be exceeded more than 18 times per year)	200
NH_3	Annual mean	180
NH_3	1 hour maximum	2500

2.2.2 SENSITIVE ECOLOGICAL RECEPTORS

The protection of sensitive ecological receptors is regulated through the following:

- Air Quality Standards imposed by The Air Quality Standards Regulations 2010 (as amended) transposed from EU standards;
- targets for protected conservation areas set out by the Environment Agency; and
- site-specific Critical Loads set out on the Air Pollution Information Service (APIS) website[4].

Those relating to ambient air are referred to as Critical Levels and those relating to deposition are referred to as Critical Loads. The Critical Levels (CLs) of relevance for this assessment are set out in Table 2.2. As the Critical Loads are site specific, these are set out in the detailed results in Table 5.6 and Table 5.7.

TABLE 2.2 - CRITICAL LEVELS

Pollutant	Averaging period	Assessment Criterion (µg m^{-3})
NH_3	Annual mean	1 (lichens and bryophytes) 3 (other species)
SO_2	Annual mean	10 (lichens and bryophytes) 20 (other species)
NO_x (as NO_2)	Annual mean	30
NO_x (as NO_2)	24 hour mean	75 or 200 in locations with low ozone and SO_2

[4] UK Air Pollution Information System. Available online at: www.apis.ac.uk

3. ASSESSMENT METHODOLOGY

3.1 SCOPE OF ASSESSMENT

For the operational phase the impacts relate to the emissions from:

- the operation of the Open Cycle Gas Turbine (OCGT), which are oxides of nitrogen (NO_x) and also ammonia (NH_3) slip from use of Selective Catalytic Reduction (SCR) abatement system; and
- hydrogen flaring during maintenance, which are limited to oxides of nitrogen (NO_x).

Human health impacts will be associated with NO_2 whilst ecological impacts will be associated with NO_x and NH_3 (and by association nutrient nitrogen and acid deposition).

3.2 SITE LOCATION AND STUDY AREA

The Site will be constructed within the boundary of SSE's AGS facility and will utilise approximately 3 ha of the AGS land. Location and the EP installation boundary of the Site is shown in Figure 3.1 and an illustration of the surrounding land uses is shown in Figure 3.2.

The existing AGS facility at Garton Road, Aldbrough (Grid Reference TA 260370) is situated approximately 12 km north-east of Hull and approximately 21 km east of Beverley, in the county of East Riding of Yorkshire. It is located approximately 2.5 km south-east of the village of Aldbrough, with the hamlet of East Newton approximately 1 km away to the north-east and the village of Garton approximately 2 km away to the south.

The Site lies within a rural-urban fringe area with occasional manmade industrial features, including the AGS facility.

The Site is also located within 15 km of a number of designated ecological sites.

- Human health impacts are considered for receptors within a 10 km radius from the emissions source, but principally focus on the maximum off-site constructions.
- Ecological impacts are considered for various receptors up to 15 km from the emissions source[5].

[5] As per EA guidance for >50MW emitters. Available online at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#screening-for-protected-conservation-areas

Proposed Installation Boundary

16m

Mill Hill

Gas Dist Sta

Drain

9m

8m

11m

North Sea

UNITED KINGDOM

Dublin

London

Amsterd

0 20 40 60 80 100

Metres

N

SCALE: 1:10,000	VERSION: A01
SIZE: A3	DRAWN: MTC
PROJECT: 0653313	CHECKED: TR
DATE: 17/03/2025	APPROVED: BT

Figure 3.1
Site Location

ERM

sse

PROJECTION: British National Grid

Path: \\uksprdgisfs01\Data\London\Projects\0653313 - Project Accelerator\Maps\0653313 - Project Accelerator - A01.aprx\0653313 - Pathfinder - Site Context - Site Location - A01

Proposed Installation Boundary
Proposed Installation Boundary 1 km Buffer
Road
Buildings
Landcover
Tree Cover
Grassland
Cropland
Built-up
Bare/Sparse Vegetation
Permanent Water Bodies
Herbaceous Wetland

Grange Farm
Field House Farm
Ringborough Farm
Ringborough West
Owsthill House
Springfield Farm
Bail Wood
Browning Plantation
East
Newton
Drain
Bail Wood Farm
Grand Rest
Northfield House

North
Sea
UNITED
KINGDOM
Dublin
London

0 100 200 300 400 500
Metres
N

SCALE: 1:10,000	VERSION: A01
SIZE: A3	DRAWN: MTC
PROJECT: 0653313	CHECKED: TR
DATE: 17/03/2025	APPROVED: BT

Figure 3.2
Site Context - Sensitive Built Receptor

ERM
sse

PROJECTION: British National Grid

Path: \\uksprdgisfs01\Data\London\Projects\0653313 - Project Accelerator\Maps\0653313 - Project Accelerator - A01.aprx\0653313 - Pathfinder - Site Context - Sensitive Built Receptor - A01

3.3 METHODOLOGY FOR THE ASSESSMENT OF EFFECTS

3.3.1 OVERVIEW

The impacts on air quality of the emissions from the facility are assessed taking into consideration the:

- Process Contribution (PC), this being the contribution from the Site only;
- existing baseline; and
- Predicted Environmental Concentration (PEC), this being the PC plus the baseline.

3.3.2 SIGNIFICANCE FRAMEWORK

The EA criteria for identifying whether a significant contribution is made to impacts at sensitive human or ecological receptors are set out in Table 3.1.

TABLE 3.1 – SIGNIFICANCE OF PROCESS CONTRIBUTIONS AT SENSITIVE ECOLOGICAL RECEPTORS

Receptor	PC, as % of AQS or CL	PEC, as % of AQS or CL	Significance
Sensitive Human receptors			
Short-term impact			
Any Sensitive human receptor	<10%	-	Insignificant
	>10%	<100%	Insignificant
	>10%	>100%	Significant
Long-term impact			
Any Sensitive human receptor	<1%	-	Insignificant
	>1%	<100%	Insignificant
	>1%	>100%	Significant
Sensitive Ecological receptors			
Short-term impact			
Ramsar, SAC, SPA or SSSI	<10%	-	Insignificant
	>10%	<100%	Insignificant
	>10%	>100%	Significant
AW, LWS, LNR or NNR	<100%	-	Insignificant
	>100%	-	Significant
Long-term impact			
Ramsar, SAC, SPA or SSSI	<1%	-	Insignificant
	>1%	<100%	Insignificant
	>1%	>100%	Significant

Receptor	PC, as % of AQS or CL	PEC, as % of AQS or CL	Significance
AW, LWS, LNR or NNR	<100%	-	Insignificant
	>100%	-	Significant

3.3.3 OPERATIONAL MODELLING

3.3.3.1 GENERAL

The AQIA utilises detailed dispersion modelling to predict the potential impacts on air quality as a result of emissions from the process. The model Aermod View 11.2.0 has been used to assess point source emissions. The results of the model are used to provide a comprehensive understanding of air quality impacts at sensitive receptors.

Three different emission scenarios have been modelled, corresponding to relevant emission scenarios as presented in Table 3.2 below. Scenario 1 and Scenario 2 were considered for the OCGT stack height (25 m and 30 m) to understand the sensitivity of changes in stack heights and the resulting impact to the environment.

TABLE 3.2 – MODELLED SCENARIOS

Scenario	Stack height (m)	Hours of operations (h/y)	NO_x emissions	NH3 emissions
Scenario 1 (Selective Catalytic Reduction)	25 (stack height sensitivity testing)	1500	68.5 mg/Nm^3	10 mg/Nm^3
Scenario 2 (Selective Catalytic Reduction)	30 (confirmed stack height)	1500	68.5 mg/Nm^3	10 mg/Nm^3
Scenario 3 (Flare)	10	1 (maintenance flaring is anticipated to be limited to one event per year, taking ~1 hour)	17.3 kg/y	0 kg/y

The key data for the overall model approach, and key input data for each source type is summarised in Table 3.3 and Table 3.4.

3.3.3.2 BUILDING DOWNWASH/ENTRAINMENT

The presence of buildings close to emission sources can significantly materially affect the dispersion of pollutants by leading to a phenomenon called downwash. In this assessment buildings were included in the model (see Table 3.3).

3.3.3.3 NITRIC OXIDE TO NO_2 CONVERSION

Oxides of nitrogen (NO_x) emitted to the atmosphere as a result of combustion will consist of nitric oxide (NO) ~90-95% and NO_2, with NO_2 being of interest to human health. Once released into the atmosphere, NO is oxidised to NO_2. The proportion of NO converted to NO_2 depends on

a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O_3).

The EA provides conversion ratios for the calculation of NO_x to NO_2. These are 70% for the long-term average concentration and 35% for short term average concentrations.

3.3.3.4 LOCAL METEOROLOGICAL DATA

The dispersion modelling has been carried out using five years (2018 – 2022) of hourly sequential meteorological data to take account of inter-annual variability and reduce the effect of any atypical conditions. The worst case of the five years is used in the impact assessment. Data from a meteorological station at Bridlington (approximately 30 km north of the Site) has been used for the assessment, which is the most representative data currently available for the area.

Wind roses for each year of meteorological data are presented in Appendix A.

3.3.3.5 MODEL SETUP

General

The input parameters used in the assessment of the model are identified in Table 3.3, Table 3.4 and Table 3.5.

TABLE 3.3 – MODEL APPROACH AND PARAMETERS

Parameter	Approach	Notes
Dispersion model	Aermod View 11.2.0	
Model Domain	15 km x 15 km	Multi-tier grid.
Receptor Grid resolution	50 m (0-2 km) 100 m (2-10 km) 200 m (10 – 15 km)	The assessment considers both sensitive human receptors and habitats.
Buildings	Included in all scenarios	3 buildings (see Figure 3.3) **ID** / **Base Elevation (m)** / **LxWxH (m)** / **Reference Coordinate** / **Shape** OCGT enclosure / 11.85 / 14x 32x16 / X:526187 Y: 437010 / Rectangular OCGT SCR Ducting / 10.87 / 5x14x13 / X:526196.9 Y: 436998.81 / Rectangular Demineralisation plant / 11.98 / 10x67x8 / X:526177.07 Y: 437967.55 / Rectangular See also Sensitivity Analysis in Section 5.1.3 for conceptual building.

Parameter	Approach	Notes
Terrain	Not required	There are no sustained gradients of >1:10 in the vicinity of the Site and therefore terrain has not been included.
Meteorological Data	Bridlington, 2018 - 2022	Hour-sequential data. Wind roses are presented in Appendix A.
Surface Characteristics	Surface roughness: 0.5 (site) 0.1 (meteorological site)	Representative of mixed industrial and agricultural land use.

OCGT

Source terms have been established for the OCGT (see Figure 3.3), which:

- take due consideration of preliminary design information and vendor specifications;
- have been derived from relevant emission limits as a worst case;
  - for NO_x - IED Annex V limits with the use of a hydrogen combustion factor as agreed with the EA and stated in EA Guidance[6];
  - for NH_3 based on Large Combustion Plant BAT Conclusions top of range values;
- use the best available test data for the flow rate: 100% H_2 data was not available, therefore the data for a H_2/NG blend of 75:25 was chosen as a worst case (volume flow rate for 100% H_2 is expected to be lower);
- assume operation of 1500 hours per year.

TABLE 3.4 - MODEL PARAMETER INPUTS OCGT

		OCGT (75% H_2, 25% NG)	
Parameter	**Unit**	**Value**	
Scenario		1	2
Number of stacks		1	
Number of flues per stack		1	
Stack height actual	m	25	30
Flue diameter	m	4.5	
Emission velocity	m/s	19.2	
Volume flow rate Actual	Am^3/s	306	
Emission temperature (actual)	^oC	454	
Flue Easting	m, OSGB36	Stack 1: 526162	

[6] Environment Agency, 2024, Guidance: Hydrogen combustion: comply with emission limit values (https://www.gov.uk/guidance/hydrogen-combustion-comply-with-emission-limit-values?utm_medium=email&utm_campaign=govuk-notifications-topic&utm_source=c31421b0-7b4e-441a-9c22-a0d67cdbf9d5&utm_content=daily)

		OCGT (75% H_2, 25% NG)
Parameter	**Unit**	**Value**
Flue Northing	m, OSGB36	Stack 1: 437091
Hours of operation	h/a	1500
Pollutant mass concentration (dry, 15% O_2) per stack		
NO_x	mg/Nm^3	68.5
NH_3	mg/Nm^3	10
Pollutant mass emission per stack		
NO_x	g/s	6.42
NH_3	g/s	0.938

Flare

The Site will be equipped with an enclosed ground flare (see Figure 3.3) for the safe disposal of hydrogen. However instead of flaring at height, the ground flare shall be located within an enclosed chamber at ground level to minimise the visual impact of the flare.

The details of the proposed flare design or capacity are available and outlined in the table below.

TABLE 3.5 – MODEL PARAMETER INPUTS FLARE

Flare Design	**Enclosed Ground Flare**	
Internal diameter of the ground flare chamber	4 m	
Height of the flare chamber above ground level	10 m	
Maximum release rate	1686 kg/h (1644 kg H_2 + 42 kg natural gas)	
Maximum volume released per event	53908 Nm^3	
#events per year	Assume maximum 1, for 1 hour duration	
Composition of feed gas (mol%)	CH_4 H_2 Non-combustible fraction (N_2, H_2O, CO_2 etc.)	0.032 0.968 <0.001
NO_x emission rate	4.82 g/s, 17.3 kg/a	

FIGURE 3.3 – SITE LAYOUT AS MODELLED*

**The Site layout used in the model considers the wider site boundary used in the planning application at time of modelling. The installation Site boundary (as shown in Figure 3.1) sits within this boundary and considers the same locations of equipment. For the purpose of assessing offsite impacts, the reduction in the installation site boundary is not considered to have an impact on results as the outer most boundaries to the north and east of the Site still remain as the installation boundary and where most impact is concentrated in the contour plots presented later in this report.*

3.3.3.6 HABITAT ASSESSMENT

Following EA guidance, impacts at habitats within up to 15 km from the emissions source have been modelled. Impacts have been modelled at the following sites within 15 km of the emissions source:

- Special Areas of Conservation (SACs) and candidate SACs designated under the EC Habitats Directive;
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive;
- Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act; and
- within 2 km of the source, local wildlife sites including the following:
  - National Nature Reserves (NNR);
  - Local Nature Reserves (LNR);
  - Local Wildlife Sites (LWS) and potential LWS (pLWS); and
  - Ancient woodland.

Habitat receptor designations and locations relevant to the assessment are presented in Table 3.6. The following points should be noted:

- Ramsar Sites designated under the Convention on Wetlands of International Importance are not specifically considered in the assessment, as they are not subject to site specific Critical Loads.
- The modelled ground level pollutant concentrations are used to predict deposition rates, using deposition velocities set out by the EA in the AQTAG (06) document. The dry deposition velocities for NO_2, SO_2, HCl and NH_3 are presented in Table 3.7.
- Following EA guidance[7], a long-term conversion rate of 70% for NO_x to NO_2 is applied to calculate nutrient nitrogen and acid deposition rates from NO_x.
- Predicted ground level concentrations and acidification/ deposition rates are compared with relevant Critical Levels and Critical Loads for the protection of sensitive ecosystems and vegetation (see Section 5.1.2).
- The impact assessment on ecological sites has been performed following a tiered approach. This approach has been used to focus on the key ecological receptors and eliminate from investigation those where it is clear that no likely significant effects will arise.
    - Tier 1: The maximum impact anywhere within the designated habitat is compared to the most stringent Critical Level and Critical Load. Where this does not identify as a potentially significant impact contribution (see Section 5.1.2), the site is screened out.
    - Tier 2: For the Tier 1 sites screened in, more detailed analysis is undertaken comparing the maximum impact anywhere within the designated habitat to the habitat type specific Critical Level and Critical Load. Where the habitat feature does not show a potentially significant contribution, the site is screened out.
    - Tier 3: For the Tier 2 sites and habitat types screened in, these data are mapped and reviewed to identify the overlap of the critical habitat types, with locations where significant contributions are identified.

The assessment results are set out in Section 5.1.2.

Some habitats of interest overlap, in which case the maximum extent of all designated areas has been assessed. In terms of the dispersion modelling, impacts of air quality at the receptor locations are captured using a grid of receptors defined throughout each habitat.

TABLE 3.6 – LOCATION OF SENSITIVE HABITAT RECEPTORS

ID	Receptor	Type	Approximate Location relative to the Site
H1	Humber Estuary	SAC	12.7 km south-west
H2	Greater Wash	SPA (marine)	0.0 km
H3	Humber Estuary	SPA	12.7 km south-west
H4	Hornsea Mere	SPA	11.3 km north-west
H5	Humber Estuary	SSSI	12.7 km south-west

[7] Environment Agency, 2007, Review of methods for NO_x to NO_2 conversion in plumes at short ranges, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290985/scho0907bnhi-e-e.pdf

ID	Receptor	Type	Approximate Location relative to the Site
H6	Hornsea Mere	SSSI	11.3 km north-west
H7	Roos Bog	SSSI	7.6 km south
H8	Lambwath Meadows	SSSI	4.9 km north-west
H9	Kelsey Hill Gravel Pits	SSSI	9.9 km south-west

TABLE 3.7 – DRY DEPOSITION VELOCITY (M S^{-1})

Pollutant	Grassland	Woodland
Nitrogen Dioxide (NO_2)	0.0015	0.0030
Sulphur Dioxide (SO_2)	0.012	0.024
Hydrogen Chloride (HCl)	0.025	0.06
Ammonia (NH_3)	0.02	0.03

3.3.4 CUMULATIVE EFFECTS

A Cumulative Effects Assessment (CEA) has been carried out based on existing and proposed sites in the Study Area. Cumulative effects are defined as those effects on a receptor that may arise when the Site is considered together with other projects.

The maximum spatial extent of potential effects on Air Quality as identified within this report are determined by the proximity of the Development to other local developments. Areas beyond this range are unlikely to experience any measurable change. As such, only plans or projects with potential to overlap spatially or temporally will be included in the cumulative assessment.

A cumulative assessment with the adjacent AGS facility has not been considered any further in this assessment as the combustion plant on the AGS site pre-dates 2018 and is therefore already considered to be part of the baseline air quality levels as presented in Section 3.4.

On this basis, the projects and their cumulative pathways considered within the cumulative assessment are presented in Appendix B, with a summary of conclusions of the CEA presented in Section 5.3.

3.3.5 ASSESSMENT LIMITATIONS

Assessment limitations relating to this report are limited to the following points.

- The emissions data when burning 100% H_2 within the proposed industrial gas turbine was unavailable for this assessment. As such, emission flow rate data for 75% H_2 was used and combined with the emissions limit for NO_x at 100% H_2 (as per EA Guidance[8]) and an upper

[8] Environment Agency, 2024, Guidance: Hydrogen combustion: comply with emission limit values. Available online at: https://www.gov.uk/guidance/hydrogen-combustion-comply-with-emission-limit-values?utm_medium=email&utm_campaign=govuk-notifications-topic&utm_source=c31421b0-7b4e-441a-9c22-a0d67cdbf9d5&utm_content=daily

range NH_3 emission concentration[9]. The assessment was designed to represent the worst-case envelope for both NO_x and NH_3 emissions and impacts. On the basis of the data available, it is anticipated that at 100% H_2 impacts would be less than those in this assessment;

- Little baseline data was available for some of the pollutants. For these pollutants, baseline data has been derived from non-local sources which are considered likely to represent the local conditions.

3.4 BASELINE

3.4.1 SENSITIVE HUMAN RECEPTORS

The baseline has been derived from publicly available sources to derive a representative local baseline. For some of the pollutants, little baseline data was available. For these pollutants, baseline data has been derived from non-local sources which are considered likely to represent the local conditions. The available baseline information has been considered to derive a single value for each pollutant to be used in the assessment. These are presented in Table 3.8.

The short-term average has been derived from multiplying the long-term background by two, as per EA guidance. The following points are noted:

- The Site is located within the jurisdiction of the East Riding of Yorkshire Council.
- Data from various monitoring stations has been used, reflecting the paucity of data for some pollutants.

The baseline has therefore been determined as follows.

- NO_2 has been derived from Defra mapping for 2018 as average of the area.
- NH_3 is from Tadcaster average 2022.

TABLE 3.8 – BASELINE

Pollutant	Averaging period	AQS (µg m^{-3})	Baseline (µg m^{-3})
NO_2 (Defra Mapping)	Annual mean	40	6.6
NO_2 (Defra Mapping)	1 hour mean, not to be exceeded more than 18 times per year	200	13.2
NH_3	Annual mean	180	1.937
NH_3	1 hour mean	2500	3.87

[9]Hitachi Zosen Inova (no date), The SNCR Process That Fulfils Europe's Strict Nitrogen Oxide Standards. Available online at: https://www.hz-inova.com/files/2018/05/DyNOR_EN_online.pdf

3.4.2 SENSITIVE ECOLOGICAL RECEPTORS

The baseline at sensitive ecological receptors is site specific and is set out in Section 5.1.2. The baseline is derived from two sources: Defra background mapping[10] and data from APIS[11].

[10] Defra (accessed June 2023) Background Mapping data for local authorities https://uk-air.defra.gov.uk/data/laqm-background-home
[11] Air Pollution Information System (accessed July 2023) http://www.apis.ac.uk/

4. MITIGATION

4.1 OVERVIEW

This section describes the mitigation measures considered in the assessment. This includes mitigation that is integral to the design of the Site and good practice mitigation measures.

4.2 OPERATION AND MAINTENANCE

The following mitigation is, or will, be incorporated into the design:

- the OCGT plant will be fitted with Selective Catalytic Reduction (SCR) abatement to reduce the emissions of oxides of nitrogen to comply with emission limits; and
- the stack heights have been designed to disperse emissions sufficiently to avoid unacceptable impacts on air quality at sensitive human and ecological receptors.

5. ASSESSMENT OF EFFECTS

The following sections provide the assessment results for the three scenarios presented in Table 3.2. Section 5.1 provides a summary for the operation of the OCGT using SCR at different heights (Scenario 1 and 2) and Section 5.2 provides a summary of the operation of the flare (Scenario 3).

5.1 OPERATIONAL EFFECTS OF OCGT (SCENARIO 1 & 2)

5.1.1 OPERATIONAL EFFECTS – HUMANS

The predicted operational impacts from NO_2 and NH_3 to human receptors are presented in Table 5.1 to Table 5.4 Figure 5.1 and Figure 5.2. These are assessed as per the methodology outlined in Section 3. On the basis of these results, there are predicted to be insignificant effects for both Scenario 1 (25 m stack height) and Scenario 2 (30 m stack height).

TABLE 5.1 – PREDICTED IMPACTS – HUMAN, NO_2 ANNUAL MEAN

Scenario	AQS Value, µg/m³	Baseline, µg/m³	PC, µg/m³	PC/AQS, %	PEC, µg/m³	PEC/AQS, %	Significant?
Scenario 1	40	6.58	0.0135	0.034%	6.60	16%	insignificant
Scenario 2			0.012	0.030%	6.60	16%	insignificant

TABLE 5.2 – PREDICTED IMPACTS – HUMAN, NO_2 1HOUR 99.8P [12]

Scenario	AQS Value, µg/m³	Baseline, µg/m³	PC, µg/m³	PC/AQS, %	PEC, µg/m³	PEC/AQS, %	Significant ?
Scenario 1	200	13.2	3.21	1.6%	16.4	8.2%	insignificant
Scenario 2			2.59	1.3%	15.8	7.9%	insignificant

TABLE 5.3 – PREDICTED IMPACTS – HUMAN, NH_3 ANNUAL MEAN

Scenario	AQS Value, µg/m³	Baseline, µg/m³	PC, µg/m³	PC/AQS, %	PEC, µg/m³	PEC/AQS, %	Significant ?
Scenario 1	180	1.94	0.00282	0.0016%	1.94	1.1%	insignificant
Scenario 2			0.00251	0.0014%	1.94	1.1%	insignificant

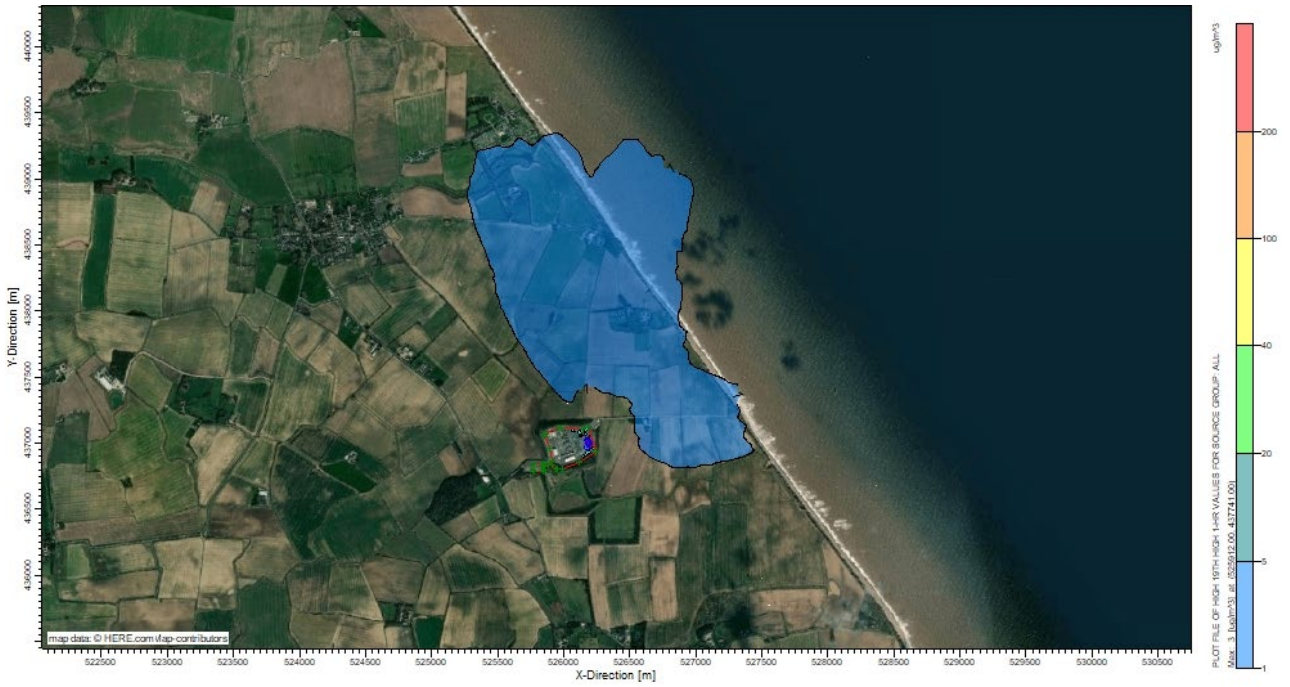
[12] 99.8th percentile

TABLE 5.4 – PREDICTED IMPACTS – HUMAN, NH_3 1HOUR MAX

Scenario	AQS Value, µg/m³	Baseline, µg/m³	PC, µg/m³	PC/AQS, %	PEC, µg/m³	PEC/AQS, %	Significant ?
Scenario 1	2500	3.87	3.73	0.15%	7.61	0.30%	insignificant
Scenario 2			2.51	0.10%	6.39	0.26%	insignificant

FIGURE 5.1 - CONTOUR PLOT – SCENARIO 1 NO_2 1HR 99.8P (2018)

FIGURE 5.2 - CONTOUR PLOT – SCENARIO 2 NO_2 1HR 99.8P (2018)



5.1.2 OPERATIONAL EFFECTS – ECOLOGY

The detailed results (maximum of scenario 1 and 2) of the assessment steps are set out in the tables below and can be summarised as follows.

- NO_x annual mean: there is predicted to be an insignificant contribution at all designated ecological sites for both operational emission scenarios.
- NO_x 24 hour mean: there is predicted to be an insignificant contribution at all designated ecological sites for both operational emission scenarios.
- NH_3 annual mean: there is predicted to be an insignificant contribution at all designated ecological sites for both operational emission scenarios.
- nutrient nitrogen deposition: there is predicted to be an insignificant contribution at all designated ecological sites for both operational emission scenarios.
- acid deposition: there is predicted to be an insignificant contribution at all designated ecological sites for both operational emission scenarios.

On the basis of the findings of the AQIA, which were concluded as Not Significant, no further assessment needs to be undertaken to investigate the impacts of ambient NO_x and NH_3, Nutrient Nitrogen Deposition and Acid Deposition at sensitive ecology receptors.

TABLE 5.5 – MODELLED IMPACT TO AMBIENT CONCENTRATIONS AT HABITATS (MAXIMUM OF SCENARIO 1 AND 2)

Habitat Name	NO_x PC - annual average	EAL	PC/EAL	NO_x PC - 24 hour average	EAL	PC/EAL	NH_3 Annual PC	Habitat Type	EAL	PC/EAL
Humber Estuary SAC	0.001232877	30	0.004%	0.20317	75	0.27%	0.000179795	Lichens and bryophytes	1	0.02%
Greater Wash SPA	0.016636986	30	0.055%	2.96474	75	3.95%	0.002431507	Lichens and bryophytes	1	0.24%
Humber Estuary SPA	0.001232877	30	0.004%	0.20317	75	0.27%	0.000179795	Lichens and bryophytes	1	0.02%
Hornsea Mere SPA	0.002349315	30	0.008%	0.27315	75	0.36%	0.000342466	Lichens and bryophytes	1	0.03%
Humber Estuary SSSI	0.001232877	30	0.004%	0.20317	75	0.27%	0.000179795	Lichens and bryophytes	1	0.02%
Hornsea Mere SSSI	0.002349315	30	0.008%	0.27315	75	0.36%	0.000342466	Lichens and bryophytes	1	0.03%
Roos Bog SSSI	0.002782534	30	0.009%	0.31886	75	0.43%	0.000405822	Lichens and bryophytes	1	0.04%
Lambwath Meadows SSSI	0.003815068	30	0.013%	0.32824	75	0.44%	0.000556507	Lichens and bryophytes	1	0.06%
Kelsey Hill Gravel Pits SSSI	0.001964041	30	0.007%	0.224	75	0.30%	0.000287671	Lichens and bryophytes	1	0.03%

Habitat Name	NO_x PC - annual average	EAL	PC/EAL	NO_x PC - 24 hour average	EAL	PC/EAL	NH_3 Annual PC	Habitat Type	EAL	PC/EAL
Bail Wood AWL	0.006876712	30	0.023%	0.90895	75	1.21%	0.001005137	Lichens and bryophytes	1	0.10%
Bail Wood LWS	0.006876712	30	0.023%	0.90895	75	1.21%	0.001005137	Lichens and bryophytes	1	0.10%
Garton - Humbleton	0.006297945	30	0.021%	0.74664	75	1.00%	0.000919521	Lichens and bryophytes	1	0.09%

TABLE 5.6 - MODELLED NITROGEN DEPOSITION (MAXIMUM OF SCENARIO 1 AND 2)

Habitat name	Background Deposition	Critical load Min	PEC Dep KgN/ha/yr as %CL Min	PC Nitrogen Dep KgN/ha/yr as %CL Min
Humber Estuary SAC	27.01	5	540%	0.02%
Greater Wash SPA	23.837	5	477%	0.29%
Humber Estuary SPA	26.386	5	528%	0.02%
Hornsea Mere SPA	27.507	n/a	n/a	n/a
Humber Estuary SSSI	27.01	5	540%	0.02%
Hornsea Mere SSSI	27.507	10	275%	0.02%
Roos Bog SSSI	27.892	n/a	n/a	n/a

Habitat name	Background Deposition	Critical load Min	PEC Dep KgN/ha/yr as %CL Min	PC Nitrogen Dep KgN/ha/yr as %CL Min
Lambwath Meadows SSSI	28.261	10	283%	0.03%
Kelsey Hill Gravel Pits SSSI	26.986	n/a	n/a	n/a

TABLE 5.7 - MODELLED ACID DEPOSITION (MAXIMUM OF SCENARIO 1 AND 2)

Habitat name	CL (keq ha-1 yr-1)			Baseline (keq ha-1 yr-1)		PC total as % of CL total	PEC total as % of CL total	Baseline total as % of CL total
	LOW Range (Min …)			S baseline	N baseline			
	CLmaxS	CLminN	CLmaxN					
Humber Estuary SAC	4	0.856	4.856	0.32	1.389	0.002%	35.2%	35.2%
Greater Wash SPA	4	0.856	4.856	0.1999	1.242	0.03%	30%	30%
Humber Estuary SPA	4	0.856	4.856	n/a	n/a	n/a	n/a	n/a
Hornsea Mere SPA	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Humber Estuary SSSI	4	0.856	4.856	0.32	1.389	0.002%	35%	35%
Hornsea Mere SSSI	10.739	0.142	10.881	0.175	2.073	0.001%	22%	22%
Roos Bog SSSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lambwath Meadows SSSI	4	1.071	5.071	0.175	2.073	0.005%	44%	44%

Habitat name	CL (keq ha-1 yr-1)			Baseline (keq ha-1 yr-1)		PC total as % of CL total	PEC total as % of CL total	Baseline total as % of CL total
Kelsey Hill Gravel Pits SSSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bail Wood AWL	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bail Wood LWS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Garton - Humbleton	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

5.1.3 SENSITIVITY ANALYSIS

5.1.3.1 METEOROLOGICAL VARIATION

Five years of meteorological data (2018-2022) from Bridlington were used in the model, as detailed in Section 3.3.3. The maximum annual average concentrations for each year, at any location on the receptor grid, with the OCGT running for 100% of the year were compared with each other. The results are shown in Table 5.8. The year giving the highest hourly concentration, 2021, was identified as the worst-year and further sensitivity testing was therefore carried out on model results for that year.

TABLE 5.8 – PREDICTED IMPACTS – HUMAN

Year	Maximum annual mean NO_x Concentration Anywhere on or off-site (µg m^{-3})	Maximum 1h NO_x Concentration Anywhere on or off-site (µg m^{-3})
2018	0.072	7.44
2019	0.073	6.70
2020	0.082	6.98
2021	0.069	7.56
2022	0.067	6.59

5.1.3.2 MODEL SENSITIVITY

After selecting 2021 as a worst-case year for the impact assessment, a sensitivity analysis of the model was carried out, observing the change resulting from one parameter: addition of a conceptual building to the model. The results of which are presented in Table 5.9.

TABLE 5.9 – SENSITIVITY ANALYSIS RESULTS

Parameter	Annual Mean NOx		Maximum 1h NOx	
	Conc (µg m^{-3})	Change	Conc (µg m^{-3})	Change
Base Case	0.0694	-	7.56	-
Addition of Conceptual Building (30mx30mx20m)	0.0699	+0.72%	7.64	+1.1%

Prior to the addition of buildings to the model, a worst-case analysis was completed indicating that the addition of a conceptual 20 m high building to the model results in a very small increase of predicted concentrations.

Following the sensitivity testing both scenarios modelled included relevant buildings in the analysis and it can be noted that no significant effects on human or significant contributions at ecological receptors were noted for any pollutant or averaging period.

5.2 EFFECTS FROM MAINTENANCE FLARING (SCENARIO 3)

Flaring emissions associated with maintenance (see Table 3.5) were modelled using AERMOD (see Table 3.3). The maximum result of this model, anywhere off-site, is shown in Table 5.10. As maintenance flaring only occurs for 1 hour per year, only short-term impacts are assessed.

Figure 5.3 presents a contour plot for the hourly PC. This plot demonstrates that there are no significant impacts predicted anywhere outside the Site Boundary.

The results in Table 5.10 also show that impacts to ecology will be insignificant anywhere outside of the Site Boundary (see Figure 5.3).

TABLE 5.10 – PREDICTED IMPACTS FROM FLARING

Scenario	Pollutant and averaging period	AQS Value, µg/m³	Baseline, µg/m³	PC, µg/m³	PC/AQS, %	PEC, µg/m³	PEC/AQS, %	Significant?
Scenario 3 (for human health impacts)	NO_2, hourly, 99.8P, human health	200	13.2	85.3	43%	98.4	49%	Insignificant
Scenario 3 (for ecology impacts)	NO_x, daily, max, ecology	200	19.7	5.73	2.9%	25.4	13%	Insignificant

FIGURE 5.3 – CONTOUR PLOT – SCENARIO 3 NO_2 1HR 99.8P (2018)

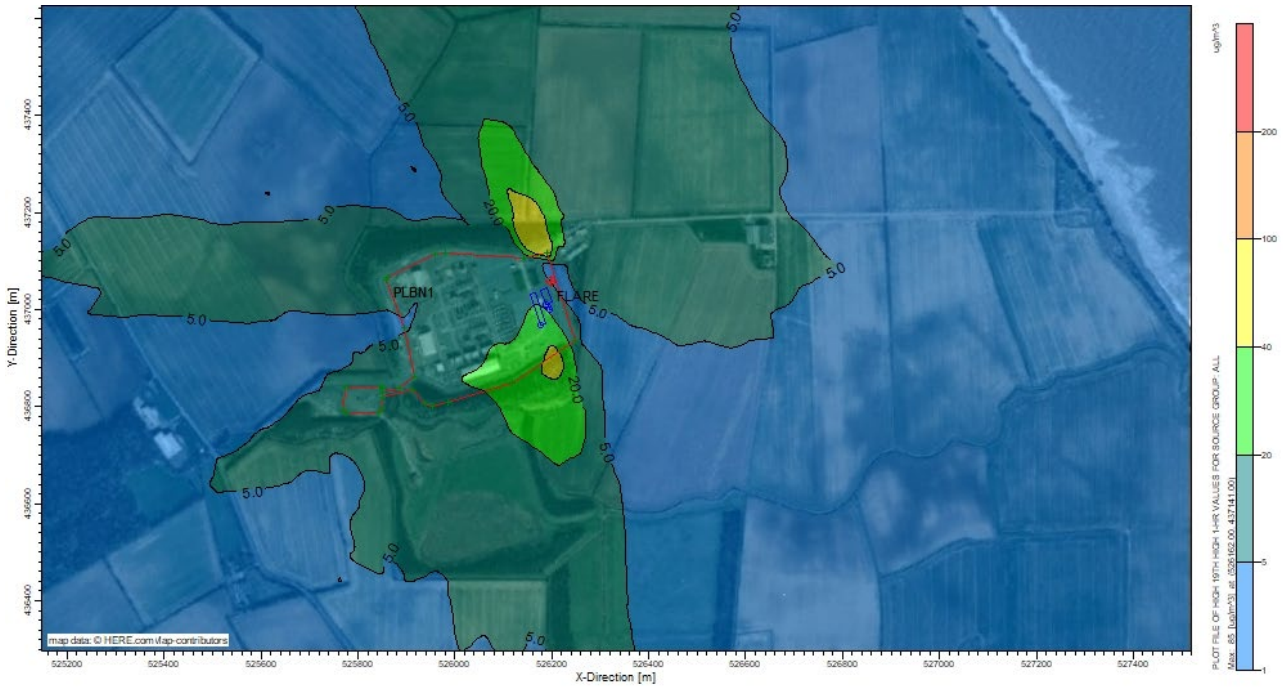


FIGURE 5.4 – CONTOUR PLOT – SCENARIO 3 NO_X 24HR MAX (2020)

5.3 CUMULATIVE EFFECTS

Based on the CEA methodology outlined in Section 3.3.4, the potential effects assessed alone which could have cumulative pathways with other projects (see Appendix B) are presented in Table 5.11.

TABLE 5.11 – CUMULATIVE EFFECT ASSESSMENT

Effects Assessed Alone	Potential for Cumulative Effect	Rationale
Operation and Maintenance Phase		
Human Health Impacts	Negligible.	In terms of cumulative impacts, the pollutant emissions that could contribute to a possible cumulative effect are NH_3, NO_x and by association NO_2; these being emitted from a range of sources including other industry. Local Air Quality Management (LAQM) for the UKs statutory air quality standards states that at locations where ambient air quality standards are either exceeded or at significant risk of being exceeded an Air Quality Management Area (AQMA) should be declared. The vast majority of AQMAs in the UK are associated with NO2. An AQMA for NO_2 is present in Hull. Impacts on the AQMA from the operations of the Site are negligible. For NO_2 the PEC is at most 17% of the annual mean and 19% of the 1-hour standard. There remains therefore sufficient 'headroom' for further projects and future development in

Effects Assessed Alone	Potential for Cumulative Effect	Rationale
		the area, and as noted, impacts on the AQMA are predicted to be negligible.
Ecological Impacts	Not significant or not contributing to any cumulative effects.	In Appendix B, three designated sites (Greater Wash SPA (marine), Roos Bog SSSI and Lambwath Meadows SSSI) are identified for cumulative assessment. Within the '10 km plus 10 km' search area three other developments with large combustion sources not yet operating, but likely to operate concurrently with the Site, with potential cumulative effects from air quality impacts at designated sites are identified. Appendix B considers cumulative effects of nitrogen dioxide, ammonia, nitrogen deposition and acid deposition and found no significant cumulative effects, or PCs so small as to be considered insignificant, and therefore not contributing to any cumulative effects.

6. SUMMARY AND CONCLUSIONS

The AQIA suggests that the operation of the OCGT and the maintenance flare at the Site are modelled to have the potential to create only insignificant impacts at local indicative receptors.

It is important to note that the model is based on conservative assumptions with regards to meteorology, such as maintenance flaring and operations of the OCGT coinciding with unfavourable dispersion conditions. The model outputs are therefore expected to represent a conservative assessment in relation to air quality impacts arising from operations at the Site.

There were no modelled exceedances of the:

- Annual or hourly standards for NO_2 for human health beyond the site boundary;
- Annual or hourly standards for NH_3 for human health beyond the site boundary; or
- Annual standards for NO_x or NH_3 or the daily standard for NO_x for ecology at any of the identified sensitive habitat sites;
- Critical loads or levels for nitrogen or acidifying depositions at any of the identified sensitive habitat sites.

At sensitive human receptors, the operation of the OCGT (scenarios 1 and 2) is modelled to result in a process contribution (PC) of less than 2% of the short term standards, and less than 0.05% of the long term standards. PCs from the OCGT on sensitive habitats are predicted to remain below 0.3% of Critical levels/critical loads, also considered insignificant.

At the time of modelling, the two scenarios undertaken for the stack height (25 m and 30 m) tested the potential for exceedances and provided a sensitivity analysis of the impacts to changes in the stack height. Results of the modelling were subsequently used to inform key design decisions. Whilst the results conclude both scenarios were modelled to be insignificant, SSE has taken forward a stack height of 30 m since this had the least significance.

Maintenance flaring is modelled to result in a PC of 43% of the NO_2 hourly standard and 2.9% of the NO_x daily standard. Neither impact is modelled to cause an exceedance of the AQS; in fact the NO_2 PEC is modelled to remain below 50% and the NO_x PEC is modelled to remain below 15% of the AQS, and these impacts only occur in a very small area close to the Site boundary and on a very infrequent basis.

APPENDIX A WIND ROSE DIAGRAMS 2018 - 2022

FIGURE A1 – WIND ROSE DIAGRAM: BRIDLINGTON 2018

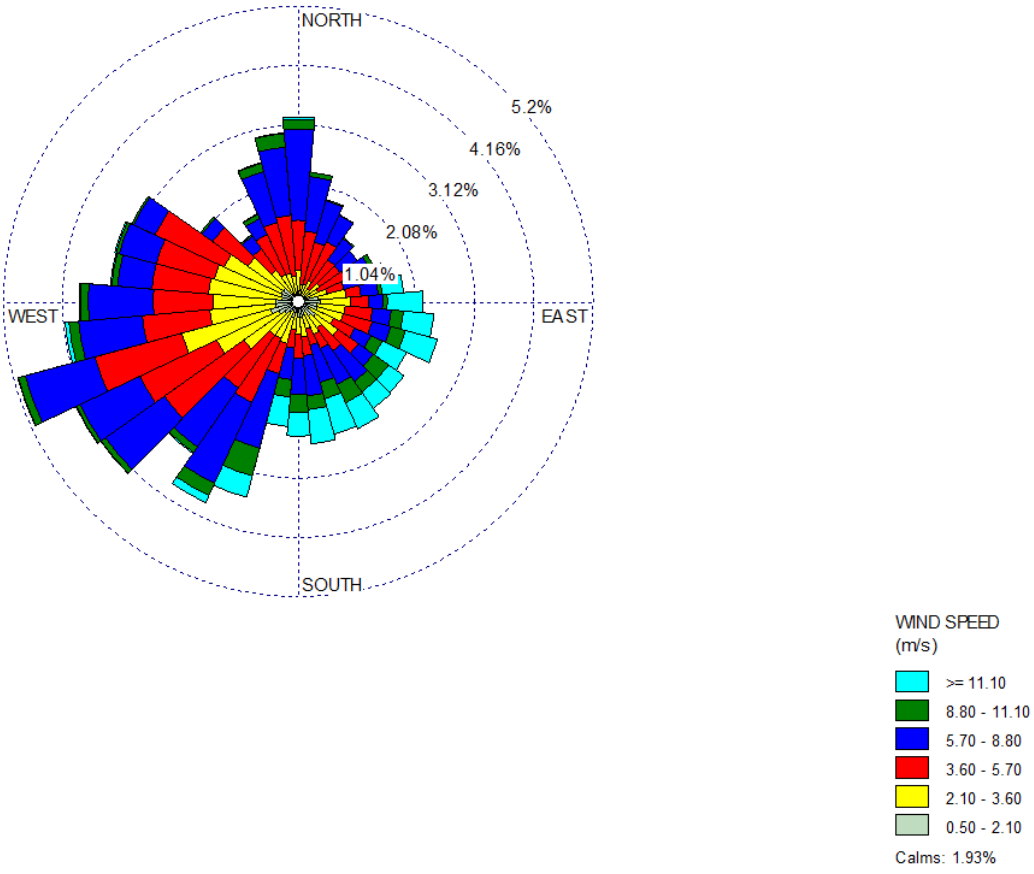


FIGURE A2 – WIND ROSE DIAGRAM: BRIDLINGTON 2019

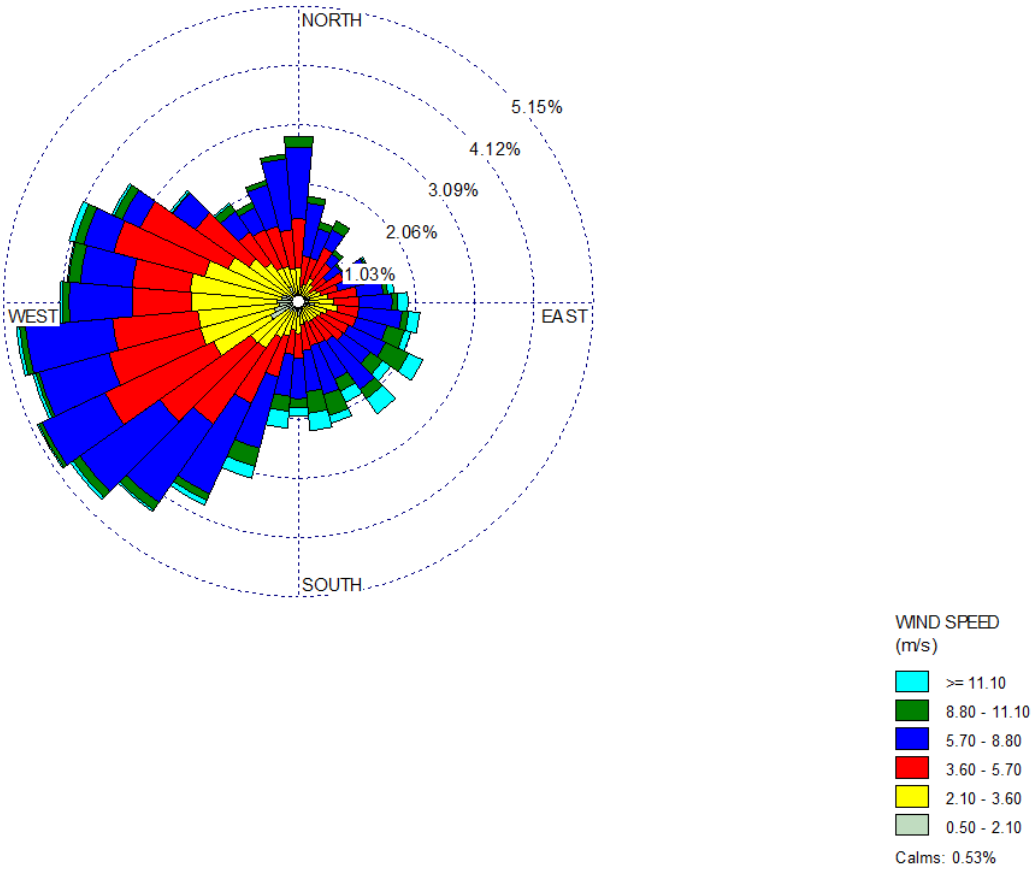


FIGURE A3 – WIND ROSE DIAGRAM: BRIDLINGTON 2020

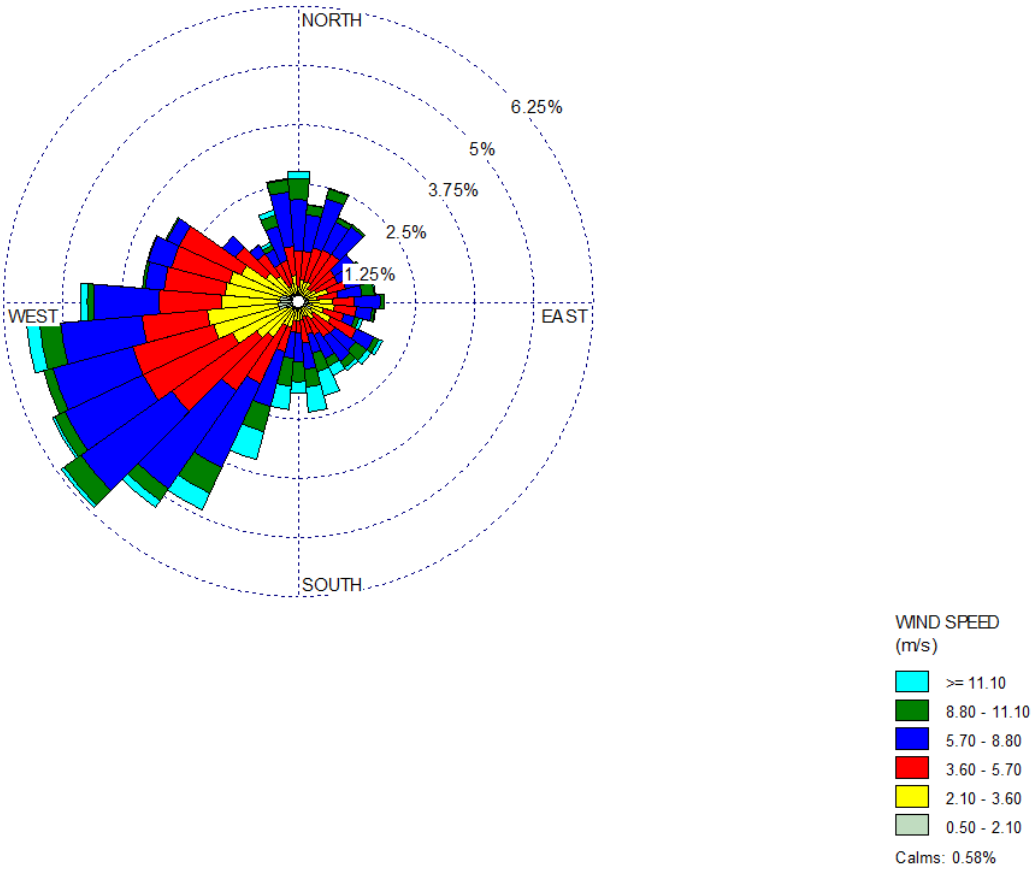
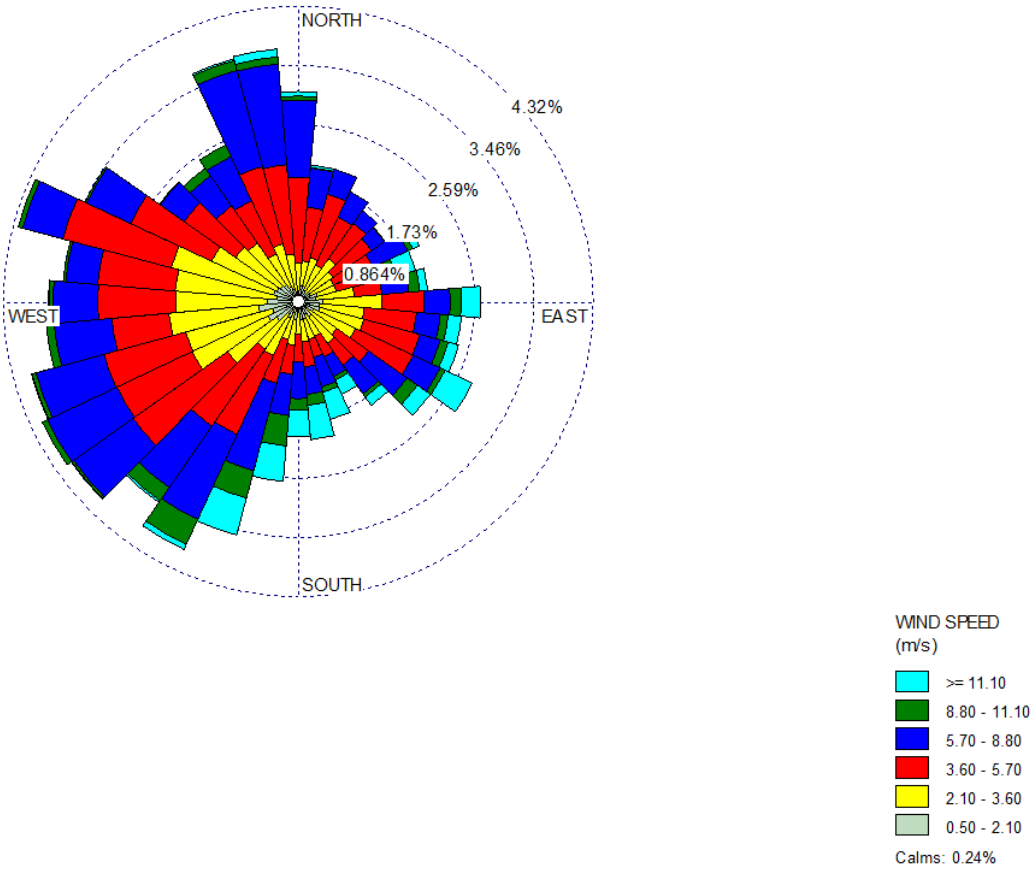
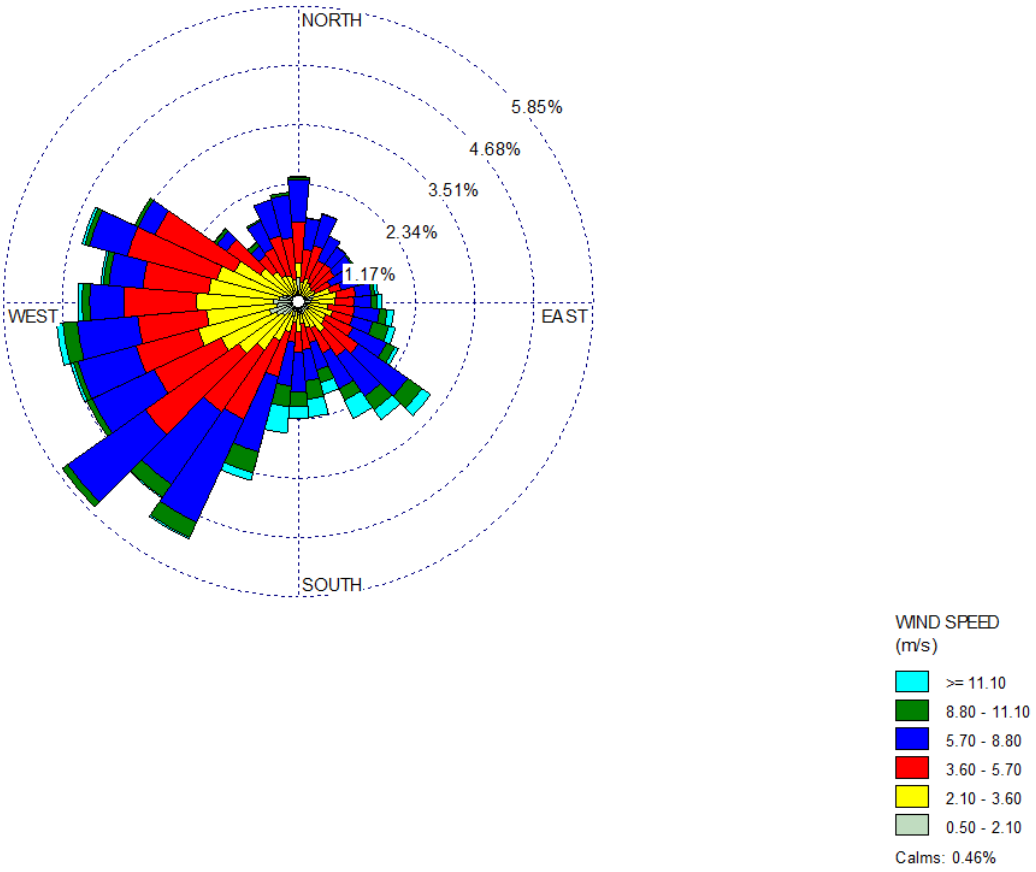


FIGURE A4 – WIND ROSE DIAGRAM: BRIDLINGTON 2021



ERM

FIGURE A5 – WIND ROSE DIAGRAM: BRIDLINGTON 2022



APPENDIX B CUMULATIVE IMPACT ASSESSMENT – ECOLOGY

The cumulative effects of Proposed Development emissions to atmosphere on ecological receptors are assessed based on outputs from the air quality modelling reported in Section 5.

The assessment considers other developments with large combustion emissions with the potential to have a cumulative effect with the Proposed Development. The search areas applied to identify other developments with emissions to air which could potentially have a cumulative effect on SAC, SPA, Ramsar and SSSI sites comprised within a 10 km radius around the emission sources, and then a further 10 km radius around the protected sites that fell within the initial 10 km radius. The sites within the first 10 km radius are listed in Table B.1 and shown in Figure B1.

TABLE B.1 – LOCATION OF SENSITIVE HABITAT RECEPTORS

ID	Receptor	Type	Approximate Location relative to Project site
H2	Greater Wash	SPA (marine)	1.3 km north-east
H7	Roos Bog	SSSI	8.6 km south
H8	Lambwath Meadows	SSSI	4.9 km north-west

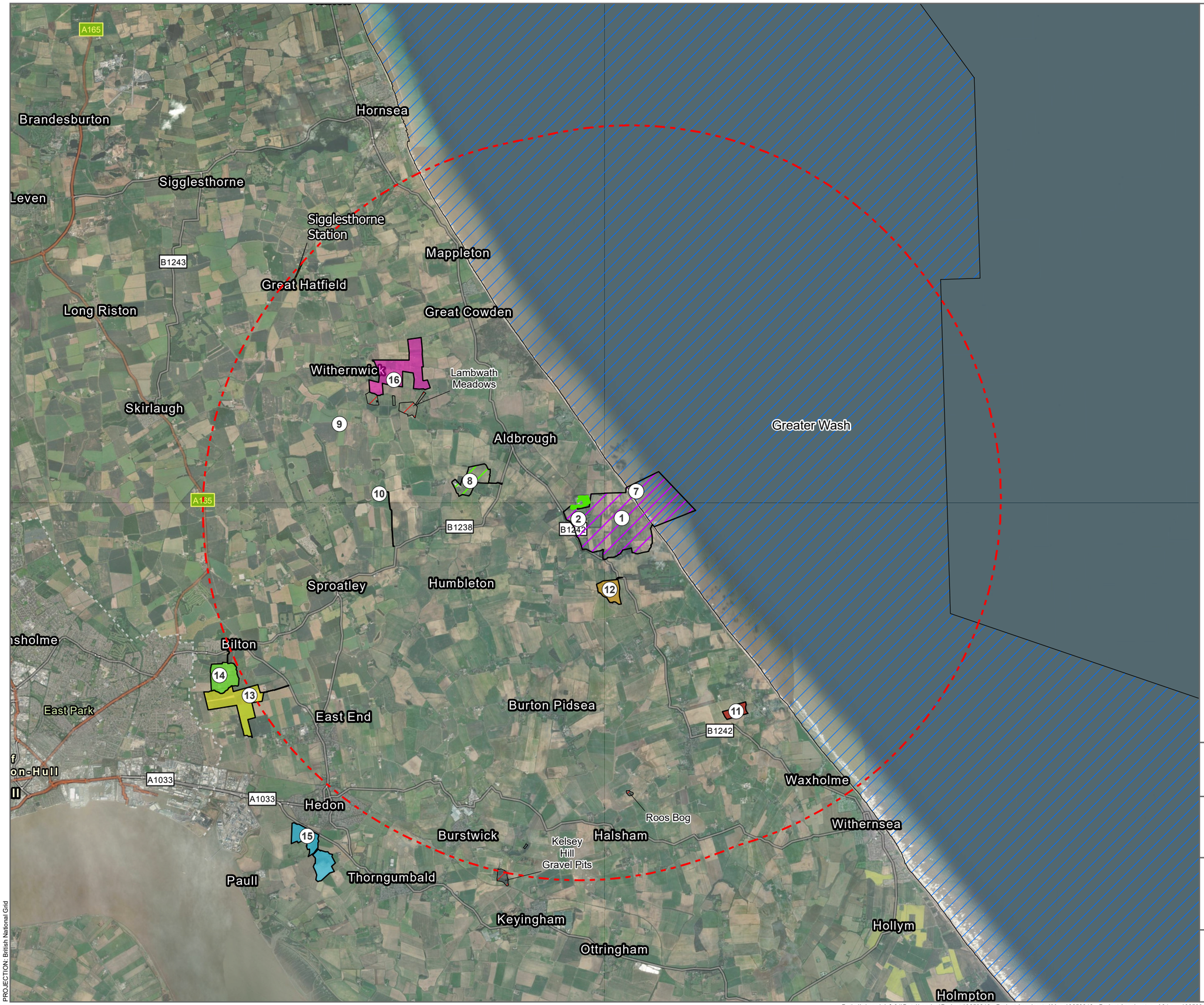
Within the ’10 km plus 10 km’ search area the screening process identified three other developments with large combustion sources not yet operating, but likely to operate concurrently with the Proposed Development, with potential cumulative effects from air quality impacts at designated sites. The other developments are presented in Table B.2 and their locations are shown in Figure B1.

TABLE B.2 – SHORT LIST OF OTHER DEVELOPMENTS FOR CONSIDERATION IN CUMULATIVE ASSESSMENT

ID (from Figure B1)	Application Reference	Description of Other Development	Distance from the nearest part of the Proposed Development site, km	Overlap in temporal scope	Within ZoI for named topic	Scale and nature of development could contribute to a significant effect?
1	NSIP at Pre-application stage Ref: EN030003	Aldbrough Hydrogen Storage (AHS) Construction and operation of an underground hydrogen gas storage facility, with up to nine underground caverns (cavities), surface hydrogen gas processing and compression plant, and associated terrestrial and marine infrastructure to support creation of the caverns by leaching with abstracted seawater and discharging brackish water to sea.	0 km	Operation	Air quality – human health	AHS will not be a material source of emissions of concern to human health
					Air quality - ecology	AHS will not be a material source of emissions of concern to ecology
8	21/04544/STPLFE	Tansterne Hybrid Application consisting of: a) Full Planning Permission for the erection of a biomass material and waste wood processing building, creation of an open storage area with stockpiling pens/bays, erection of fire pump house, and installation of a weighbridge, construction of access and service road with associated parking, creation of reed bed and rainwater harvesting lagoons, planting of a	2 km	Operation	Air quality – human health	No. This application will not produce atmospheric emissions additional to the existing facility

ID (from Figure B1)	Application Reference	Description of Other Development	Distance from the nearest part of the Proposed Development site, km	Overlap in temporal scope	Within ZoI for named topic	Scale and nature of development could contribute to a significant effect?
		woodland block and associated landscaping and b) Outline Planning Permission for the erection of up to 4 vertical farming units, creation of up to 2 rainwater harvesting lagoons and 1 attenuation pond with associated works, construction of up to 6 carbon dioxide storage tanks, underground and overground pipelines and electrical power cabling, construction of a 11kV substation and a high voltage substation with associated landscaping, hedgerows, fencing and wildlife habitats.			Air quality – ecology	No. This application will not produce atmospheric emissions additional to the existing facility
9	21/04625/CM	West Newton Well Site A To construct an extension to the existing West Newton A wellsite, test, appraise and produce from the two existing wells and drill, test, appraise and produce from up to four new wells followed by decommissioning and wellsite restoration.	6.7 km	Operation	Air quality – human health	Yes, this project has operational emissions associated with circa 38 MW of gas-fired power generation
					Air quality – ecology	Yes, this project has operational emissions associated with circa 38 MW of gas-fired power generation
10	21/04629/CM (Original permission:	West Newton Well Site B Construction of the West Newton B Wellsite to accommodate the drilling of up to two petroleum	4.9 km	Operation	Air quality – human health	Yes, this project has operational emissions associated with gas-fired power generation

ID (from Figure B1)	Application Reference	Description of Other Development	Distance from the nearest part of the Proposed Development site, km	Overlap in temporal scope	Within ZoI for named topic	Scale and nature of development could contribute to a significant effect?
	14/04107/STPLF)	appraisal boreholes followed by testing and wellsite restoration.			Air quality – ecology	Yes, this project has operational emissions associated with gas-fired power generation
12	19/04280/STPLFE / 20/30139/CONDET	Large free range bird development Erection of a 64,000 bird free range egg unit with associated feed bins, hardstanding, access track, access improvements and drainage attenuation pond	1.8 km	Operation	Air quality – human health	Ammonia
					Air quality - ecology	Ammonia, N and Acid deposition



- Proposed Installation Boundary
- 10 km Buffer of Site Boundary

Designated Sites:

- Special Protection Areas (SPA)
- Sites of Special Scientific Interest (SSSI)
- Local Nature Reserves (LNR)

Other Development Boundaries

- 1: Aldbrough Hydrogen Store
- 9: Tansterne: 21/04544/STPLFE: 2 km from Pathfinder Boundary
- 10: West Newton Well Site A: 21/04625/CM: 6.7 km from Pathfinder Boundary
- 11: West Newton Well Site B: 21/04629/CM: 4.9 km from Pathfinder Boundary
- 12: Large Caravan Site: 23/01325/STPLF: 6.3 km from Pathfinder Boundary
- 13: Large Free Range Bird Development:19/04280/STPLFE / 20/30139/CONDET: 1.8 km from Pathfinder Boundary
- 14: Wyton Road Renewable Energy Project: 23/00760/STPLFE: 9.2 km from Pathfinder Boundary
- 15: Hull Solar Farm: 15/01752/STPLF: 10.2 km from Pathfinder Boundary
- 16: Harbour Farm Solar Project: 22/01545/EIASCO: 11.4 km from Pathfinder Boundary
- 17: Withernwick Wind Farm: 22/00575/STVARE / 08/01964/STPLFE: 5 km from Pathfinder Boundary
- (2) 2: Hydrogen pipeline (nominal starting point, route not available)
- (7) 7: Marine infrastructure for the Proposed Development

The planning application locations and boundaries shown on this map are indicative only and are derived from planning application information displayed on https://newplanningaccess.eastriding.gov.uk/newplanningaccess/

0 1 2 3 4 5
Kilometres

N

SCALE: See Scale Bar	VERSION: A01
SIZE: A3	DRAWN: MC
PROJECT: 0653313	CHECKED: TR
DATE: 19/03/2025	APPROVED: BT

Figure B1
Cumulative Developments and Designated Sites within 10 km of the Pathfinder Boundary

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PROJECTION: British National Grid

Path: \\uksprdgisfs01\Data\London\Projects\0653313 - Project Accelerator\Maps\0653313 - Project Accelerator - A01.aprx\0653313 - Pathfinder - Site Context - Cumulative Developments and Conservations Sites - A01

The other developments relevant to cumulative air quality impacts are:

- West Newton Well site A (WNWa);
- West Newton Well site B (WNWb); and
- Large Free Range Bird Development (LFRBD).

Cumulative effects of nitrogen dioxide, ammonia, nitrogen deposition and acid deposition are considered.

For each of the identified Sensitive Habitat Receptors within 10 km of the Proposed Development, the tables below present:

- the available PC data from the relevant developments;
- the maximum (between scenario 1 and 2) predicted PC from the Project; and
- the resulting cumulative PCs and PEC;

For Greater Wash SPA, the following is observed:

- Annual NO_x:
  - Impact data only available for the WNWa and WNWb: total PC = 1.7% of CL; and
  - Cumulative PEC = 32% of CL, hence no likely significant effects are predicted.
- Daily NO_x:
  - Impact data only available for the WNWa and WNWb: total PC = 12% of CL; and
  - Cumulative PEC = 22% of CL, hence no likely significant effects are predicted.
- Annual NH_3:
  - Impact data only available for the LFRBD: PC = 12% of CL (for lichen/bryophytes);
  - Cumulative PEC = 163% of CL(for lichen/bryophytes), however the PC from the Proposed Development is predicted to be an insignificant contribution at less than 0.3%.

Since the contribution of the Proposed Development to annual NH_3 concentration is so small as to be considered insignificant, it is not assessed as contributing to any cumulative effects.

- Nutrient Nitrogen Deposition:
  - Impact data only available for the WNWa and WNWb: total PC = 2.09% of CL;
  - Cumulative PEC = 479% of CL, however the PC from the Project is predicted to be an insignificant contribution at less than 0.3%.

Since the contribution of the Project to nutrient nitrogen deposition is so small as to be considered insignificant, it is not assessed as contributing to any cumulative effects.

- Acid Deposition:
  - Impact data only available for the WNWa: total PC = 0.25% of CL;
  - Cumulative PEC = 30% of CL, hence no likely significant effects are predicted.

For Roos Bog SSSI, no data from the other developments are available; this is likely to be due to its distance from them.

For Lambwath Meadows SSSI, the following is observed:

- Annual NO_x:
  - Impact data only available for the WNWa: PC = 8.0% of CL;
  - Cumulative PEC = 38% of CL, hence no likely significant effects are predicted.
- Daily NO_x:
  - Impact data only available for the WNWa: PC = 14% of CL;
  - Cumulative PEC = 23% of CL, hence no likely significant effects are predicted.
- Annual NH_3: no data from the other developments are available.
- Nutrient Nitrogen Deposition:
  - Impact data only available for the WNWa: PC = 2.4% of CL;
  - Cumulative PEC = 285% of CL, however the PC from the Project is predicted to be an insignificant contribution at less than 0.05%.

Since the contribution of the Project to nutrient nitrogen deposition is so small as to be considered insignificant, it is not assessed as contributing to any cumulative effects.

- Acid Deposition:
  - Impact data only available for the WNWa: PC = 1.3% of CL;
  - Cumulative PEC = 46% of CL, hence no likely significant effects are predicted.

TABLE B.3 – CUMULATIVE IMPACTS ON GREATER WASH SPA

	Annual NO_x		Daily NO_x		Annual NH_3		Nutrient Nitrogen		Acid Deposition	
CL	30 µg/m^3		200 µg/m^3		1 µg/m^3 (lichen and bryophytes)		5 kgN/ha/yr		MaxS:4 keq/ha/yr MinN: 0.856 keq/ha/yr MaxN: 4.856 keq/ha/yr	
Baseline	8.991 µg/m^3		17.98 µg/m^3		1.513µg/m^3		23.837 kgN/ha/yr		S: 0.1999 keq/ha/yr N: 1.242 keq/ha/yr	
Other Developments	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)
LFRBD	n/a	n/a	n/a	n/a	12%	163%	n/a	n/a	n/a	n/a
WNWa	0.67%	31%	1.3%	10%	n/a	n/a	0.79%	478%	0.15%	30%
WNWb	1.1%	31%	11%	20%	n/a	n/a	1.30%	478%	0.11%	30%
Total Other Developments	*1.7%*	*32%*	*12%*	*21%*	*12%*	*163%*	*2.09%*	*479%*	*0.25%*	*30%*
Project	*0.06%*	*30%*	*1.5%*	*10%*	*0.24%*	*152%*	*0.29%*	*477%*	*0.03%*	*30%*
Cumulative	1.8%	32%	13%	22%	12%	163%	2.38%	479%	0.28%	30%

[13] The EPA H1 guidance for air emissions risk assessments for environmental permits advises that for detailed assessments where ozone is below the AOT40 critical level and sulphur dioxide is below the lower critical level of 10 µg/m^3, a higher AQS of 200 µg/m3 should be used compared to the recommended 75 µg/m^3.

TABLE B.4 – CUMULATIVE IMPACTS ON ROOS BOG SSSI

	Annual NO_x		Daily NO_x		Annual NH_3		Nutrient Nitrogen		Acid Deposition	
CL	30 µg/m^3		200 µg/m^3		1 µg/m^3 (lichen and bryophytes)		n/a		n/a	
Baseline	10.411 µg/m^3		20.822 µg/m^3		1.94 µg/m^3		27.892 kgN/ha/yr		n/a	
Other Developments	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)
LFRBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WNWa	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WNWb	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total Other Developments	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Project	*0.01%*	*35%*	*0.16%*	*11%*	*0.04%*	*194%*	n/a	n/a	n/a	n/a
Cumulative	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

[14] The EPA H1 guidance for air emissions risk assessments for environmental permits advises that for detailed assessments where ozone is below the AOT40 critical level and sulphur dioxide is below the lower critical level of 10 µg/m^3, a higher AQS of 200 µg/m3 should be used compared to the recommended 75 µg/m^3.

TABLE B.5 – CUMULATIVE IMPACTS ON LAMBWATH MEADOWS SSSI

	Annual NO_x		Daily NO_x		Annual NH_3		Nutrient Nitrogen		Acid Deposition	
CL	30 µg/m^3		200 µg/m^3		1 µg/m^3 (lichen and bryophytes)		10 kgN/ha/yr		MaxS: 4 keq/ha/yr MinN: 1.071 keq/ha/yr MaxN: 5.071 keq/ha/yr	
Baseline	9.072 µg/m^3		18.144 µg/m^3		1.846 µg/m^3		28.261 kgN/ha/yr		S: 0.175 keq/ha/yr N: 2.073 keq/ha/yr	
Other Developments	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)	PC (% CL)	PEC (% CL)
LFRBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WNWa	8.0%	38%	14%	23%	n/a	n/a	2.4%	285%	1.3%	46%
WNWb	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total Other Developments	8.0%	38%	14%	23%	n/a	n/a	2.4%	285%	1.3%	46%
Project	*0.013%*	*30%*	*0.16%*	*9.2%*	*0.05%*	*185%*	*0.03%*	*283%*	*<0.01%*	*44%*
Cumulative	8.0%	38%	14%	23%	n/a	n/a	2.5%	285%	1.3%	46%

[15] The EPA H1 guidance for air emissions risk assessments for environmental permits advises that for detailed assessments where ozone is below the AOT40 critical level and sulphur dioxide is below the lower critical level of 10 µg/m^3, a higher AQS of 200 µg/m3 should be used compared to the recommended 75 µg/m^3.

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