West Burton C (Gas Fired Generating Station)

Appendix 6A: Air Quality Technical Appendix

EDF Energy (Thermal Generation) Limited

Project Number: 60572265

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Table of Contents

Tables

1. Introduction

1.1 Overview

1.1.1 This Technical Appendix supplements **Chapter 6**: Air Quality (ES Volume I) and describes the additional details for the construction dust assessment, and dispersion modelling of point source emissions from the Proposed Development once operational.

2. Construction Dust Emissions

2.1 Significance Criteria

Magnitude Definitions

2.1.1 The magnitude of effects for dust emissions is categorised as detailed in **Table 1**.

Table 1: Definition of magnitude of demolition and construction activities

Magnitude	Demolition	Earthworks	Construction	Trackout
Large	Total building volume >50,000m^3, potentially dusty construction material (e.g. concrete) on-site crushing and screening, demolition activities >20m above ground	Site area >1ha, potentially dusty soil type (e.g. clay), >10 heavy earth moving vehicles at once, bunds >8m high, total material moved >100,000 tonnes (t)	Total building volume >100,000m^3, on-site concrete batching, sandblasting	>50 heavy duty vehicle (HDV) (>3.5t) peak outward movements per day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m
Medium	Total building volume 20,000-50,000m^3, potentially dusty construction material, demolition activities 10-20m above ground	Site area 0.25-1ha, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles at once, bunds 4-8m high, total material moved 20,000-100,000t	Total building volume 25,000-100,000m^3, potentially dusty materials e.g. concrete, on-site concrete batching	10-50 HDV (>3.5t) peak outward movements per day, moderately dusty surface material (e.g. high clay content), unpaved road length 50-100m
Small	Total building volume <20,000m^3, construction material with low potential for dust (e.g. metal/timber), demolition activities <10m	Site area <0.25ha, large grain soil type (e.g. sand), <5 heavy earth moving vehicles at once, bunds <4m high, total material moved	Total building volume <25,000m^3, low dust potential construction materials e.g. metal/ timber	<10 HDV (>3.5t) peak outward movements per day, surface material low dust potential, unpaved road length <50m

Magnitude	Demolition	Earthworks	Construction	Trackout
	above ground, demolition during wetter months	<20,000 t		

Receptor Sensitivity Definitions

2.1.2 The sensitivity of receptors to potential dust emissions is categorised as detailed in **Table 2**. The area sensitivity defined by the distance to number of receptors for each potential effect is categorised as detailed in **Table 3, Table 4, and Table 5.**

Table 2: Definition of receptor sensitivity to demolition and construction dust effects

Receptor sensitivity	Human perception of dust soiling effects	PM_{10} health effects	Ecological effects
High sensitivity	Enjoy a high level of amenity; appearance/aesthetics/value of property would be diminished by soiling; receptor expected to be present continuously/regularly; e.g. residential/museums/car showrooms/commercial horticulture	Public present for 8 hours per day or more (e.g. residential, schools, car homes)	Ecological receptor within 50m of source, of national or international importance including Special Area of Conservation (SAC), or Site of Special Scientific Interest (SSSI) with dust sensitive feature(s)
Moderate sensitivity	Enjoy a reasonable level of amenity; appearance/ aesthetics/value of property could be diminished by soiling; receptor not expected to be present continuously/regularly; (e.g. parks/places of work)	Only workforce present (no residential or high sensitivity receptors) 8 hours per day or more	Ecological receptor within 50m of source, of national or regional importance including SSSI or local wildlife site (LWS) with features with dust sensitive features
Low sensitivity	Enjoyment of amenity not reasonably expected; appearance/ aesthetics/ value of property not diminished by soiling; receptors are transient	Transient human exposure, e.g. footpaths,	Ecological receptor within 50m of source, of local importance (e.g. local nature

Receptor sensitivity	Human perception of dust soiling effects	PM_{10} health effects	Ecological effects
	/ present for limited period of time; e.g. playing fields, farmland, footpaths, short term car parks* and roads - *subject to typical usage, could be high sensitivity	playing fields, parks	reserve (LNR)) with dust sensitive features

Table 3: Sensitivity of receptor area to dust soiling effects on people and property

Receptor sensitivity	Number of receptors	Distance from source (m)			
		<20	<50	<100	<350
High	>100	High	High	Moderate	Low
	10-100	High	Moderate	Low	Low
	1-10	Moderate	Low	Low	Low
Moderate	>1	Moderate	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 4: Sensitivity of receptor area to PM_{10} (human health) impacts

Receptor sensitivity	Number of receptors	Distance from source (m)				
		<20	<50	<100	<200	<350
High (annual mean PM_{10} concentration <24µg/m^3)	>100	Moderate	Low	Low	Low	Low
	10-100	Low	Low	Low	Low	Low
	1-10	Low	Low	Low	Low	Low
Moderate (annual mean PM_{10} concentration <24µg/m^3)	>10	Low	Low	Low	Low	Low
	1-10	Low	Low	Low	Low	Low
Low	>1	Low	Low	Low	Low	Low

Table 5: Sensitivity of receptor area to ecological impacts

Receptor sensitivity	Distance to source	
	<20m	<50m
High	High	Moderate
Moderate	Moderate	Low
Low	Low	Low

Risk of Impact Definitions

2.1.3 The definition of risk of impact, from each activity with no mitigation applied, is categorised by combination of the magnitude of impact (Step 1) with area sensitivity (Step 2), as detailed in **Table 6**, **Table 7**, **Table 8**, and

2.1.4 **Table** 9.

Table 6: Risk of dust impacts: Demolition

Sensitivity of Area	Dust emission magnitude		
	Large	Medium	Small
High	High risk	Moderate risk	Moderate risk
Moderate	High risk	Moderate risk	Low risk
Low	Moderate risk	Low risk	Negligible

Table 7: Risk of dust impacts: Earthworks

Sensitivity of Area	Dust emission magnitude		
	Large	Medium	Small
High	High risk	Moderate risk	Low risk
Moderate	Moderate risk	Moderate risk	Low risk
Low	Low risk	Low risk	Negligible

Table 8: Risk of dust impacts: Construction

Sensitivity of Area	Dust emission magnitude		
	Large	Medium	Small
High	High risk	Moderate risk	Low risk

Sensitivity of Area	Dust emission magnitude		
	Large	Medium	Small
Moderate	Moderate risk	Moderate risk	Low risk
Low	Low risk	Low risk	Negligible

Table 9: Risk of dust impacts: Trackout

Sensitivity of Area	Dust emission magnitude		
	Large	Medium	Small
High	High risk	Moderate risk	Low risk
Moderate	Moderate risk	Low risk	Negligible
Low	Low risk	Low risk	Negligible

3. Point Source Emissions

3.1 Dispersion Model Parameters

3.1.1 The Emissions Inventory modelled for the assessment of impacts from the operational Proposed Development is detailed in **Chapter 6**: Air Quality (ES Volume I), and the additional model input parameters are provided in the sections below, including emission parameters for West Burton B (WBB) Power Station modelling.

NO_x to NO_2 Conversion: Combustion Plant

3.1.2 Emissions of nitrogen oxides from industrial point sources are typically dominated by nitric oxide (NO), with emissions from combustion sources typically in the ratio of nitric oxide to nitrogen dioxide (NO_2) of 9:1. However, it is NO_2 that has specified National Air Quality Strategy (NAQS) (Ref 6A-1) objectives (**Section 6.2, Chapter 6**: Air Quality (ES Report Volume I)) due to its potential impact on human health. In the ambient air, NO is oxidised to NO_2 by the ozone present, and the rate of oxidation is dependent on the relative concentrations of NO and ozone in the ambient air.

3.1.3 For the purposes of detailed modelling, and in accordance with Environment Agency technical guidance (Ref 6A-2) it is assumed that 70% of emitted nitric oxide is oxidised to nitrogen dioxide in the long-term and 35% of the emitted nitric oxide is oxidised to nitrogen dioxide in the local vicinity of the Site in the short-term.

West Burton B Modelling

3.1.4 The maximum emissions from the existing WBB Power Station CCGT plant have been modelled with the emissions from the Proposed Development. The nominal output of the plant is 1,332MW from three CCGT and associated waste heat recovery boilers and steam turbine plant.

3.1.5 Conservative assumptions have been made for operational parameters to represent a realistic worst-case long-term contribution to the baseline, including:

- Continuous operation of all three WBB Power Station units, where typical 'two-shifting' operation, may include several starts of one or more CCGT units over the course of a day. Annual operating hours are currently around 6,000 per unit per year; and
- Conservative emission rates based on Emission Limit Values (ELVs) for short-term impacts, and mean hourly concentration data for long-term impacts.

3.1.6 Modelled emission parameters are summarised in **Table 10** below.

Table 10: Modelled WBB combustion plant air emission parameters

Assumed Parameter	WBB Power Station CCGT (per unit)
Nominal power output (MW)	444
Maximum volumetric flow (Am^3/s)	850
Oxygen content (%)	13
Moisture content (%)	6.5
Temperature (°C)	92
Maximum volumetric flow at reference conditions (Nm^3/hr)[1]	2,700,000
Flue diameter (m)	7.0
Average efflux velocity (m/s)	22.0
NO_x concentration (mg/Nm^3)	50 (ELV, peak impacts) 30 (mean hourly, long-term impacts)
NO_x release rate (g/s)	37.5 (peak) 22.5 (long-term)
CO concentration (mg/Nm^3)	100
CO release rate (g/s)	75
Stack height (m)	80
Assumed maximum operating hours / year	8,760

Note: Reference conditions: 273K, 15% O_2, dry

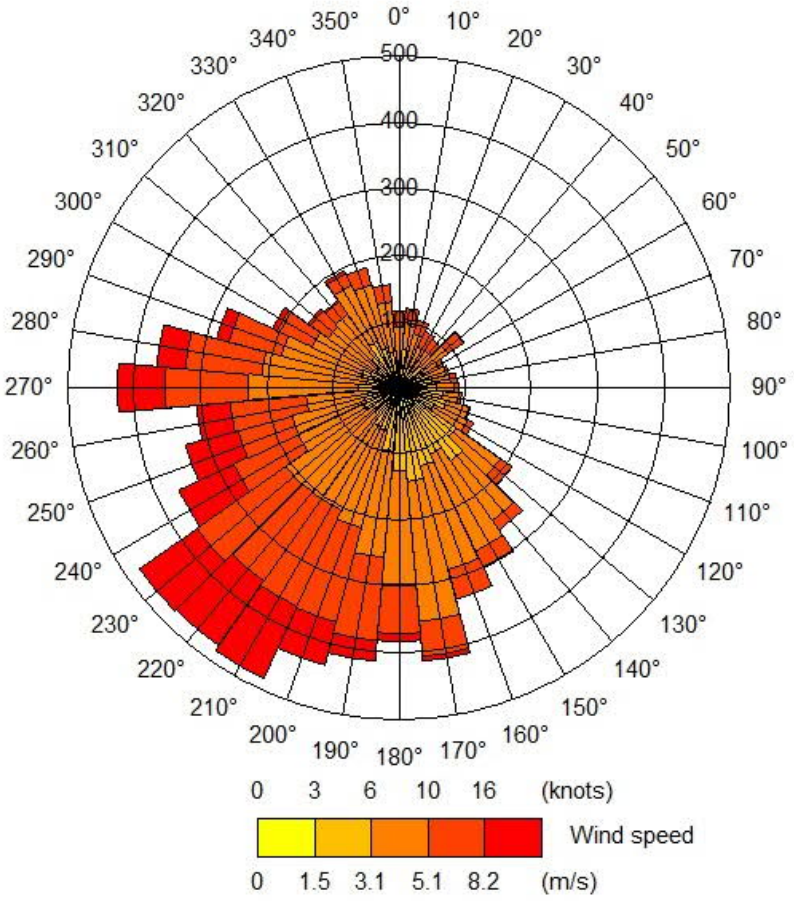
Meteorological Data

3.1.7 Actual measured hourly sequential meteorological data is available for input into dispersion models, and it is important to select data as representative as possible for the site that is modelled. This is usually achieved by selecting a meteorological station as close to the site as possible, although other stations may be used if the local terrain and conditions vary considerably, or if the station does not provide sufficient data.

3.1.8 The meteorological site that was selected for the assessment is Robin Hood airport, located approximately 18km north-west of the Proposed Power Plant Site, at a flat airfield, and therefore a surface roughness of 0.2m (representative of minimum agricultural areas) has been selected for the meteorological site.

3.1.9 The modelling for this assessment has utilised five years of meteorological data for the period 2011-2015, with 2011 providing the worst-case results. Therefore, the reported results provided in **Chapter 6**: Air Quality (ES Volume I) are taken from 2011 and the sensitivity of the results to different years' data is discussed in **Section 4**. The wind rose for Robin Hood airport in 2011 is provided in **Plate 1** as an example.

Plate 1: Wind rose, Robin Hood airport 2011



Buildings and Terrain

3.1.10 The presence of buildings or structures near to the emission points can have a significant effect on the dispersion of emissions. The wind field can become entrained into the wake of buildings, which causes the wind to be directed to ground level more rapidly than in the absence of a building. If an emission is entrained into this deviated wind field, this can give rise to elevated ground-level concentrations. Building effects are typically considered where a structure of height greater than 40% of the stack height is situated within 8-10 stack heights of the emissions source.

3.1.11 Buildings associated with the Proposed Development that are considered to be of sufficient height and volume to potentially impact on the dispersion of emissions from the open cycle gas turbine (OCGT) stacks have been included in the

dispersion model. At this stage, the air quality assessment is conservatively based on the maximum (worst-case) building dimensions outlined in **Chapter 4**: The Proposed Development (ES Report Volume I). In reality, the building dimensions may be smaller than the ones used in the assessment. However, this would be expected to reduce the contribution of building impacts on the dispersion of emissions from the main stacks and therefore reduce the maximum predicted ground level concentrations. The results presented in **Chapter 6**: Air Quality (ES Report Volume I) are therefore considered to be conservative with respect to building effects.

3.1.12 The exact positions of the Proposed Power Plant stacks cannot be fixed until the detailed design stage as they will depend on the final technical configuration and plant optimisation. However, the stack locations relative to the buildings and structures are fixed. As such, for the purposes of the assessment, the large single gas turbine and up to five smaller gas turbine unit options have been assessed at alternative locations within the Proposed Power Plant Site, with different building orientations as applicable, in order to determine the worst-case impacts at different receptors. No single layout for either of the design options resulted in worst-case impacts at all receptors, therefore the reported results represent the worst-case from any of the modelled layouts.

3.1.13 Parameters representing the buildings included in the model are shown in **Table 11** and plans showing the alternative building layouts used in the ADMS simulations are illustrated in **Plate 2**.

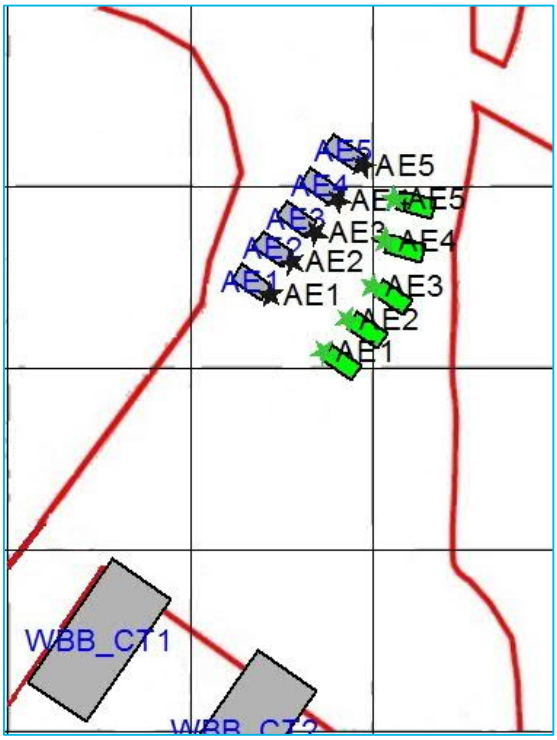
Table 11: Buildings included within the modelling assessment

Building	Height (m)	Length (m)	Width (m)	Angle[1]
Design option A: large single gas turbine scenario				
OCGT enclosure	19	36	12	125°
OCGT air intake structure	27	18	14	125°
Design option B: Up to five smaller gas turbine units (per OCGT unit)				
GT enclosure	15	20	10	125°
WBB:Power Station (per CCGT unit)				
Heat Recovery Steam Generator (HRSG)	40	40	40	125°
Turbine Hall	35	84	45	125°
Cooling Array	26	82	39	125°

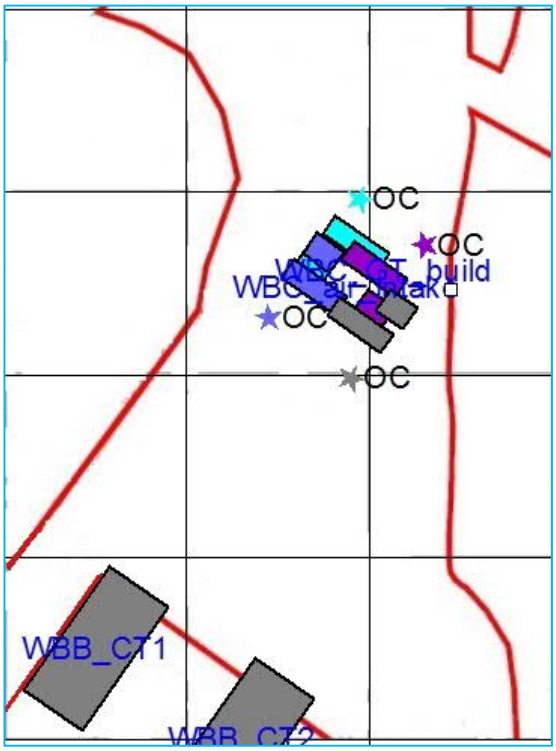
Note: Angle of building length to north, based on indicative concept layouts for the Proposed Development and WBB plant orientation

Plate 2: Buildings representation for alternative assessed scenarios

Up to five smaller OCGT scenario:



Single larger OCGT scenario:



3.1.14 The Proposed Power Plant Site is situated to the north of the existing WBA and WBB Power Station buildings. The local area downwind of the Proposed Power Plant Site is flat, and predominantly agricultural to the west, north and east. A surface roughness of 0.3m, corresponding to the maximum value associated with agricultural areas, has therefore been selected to represent the local terrain. The sensitivity of the model results to surface roughness is discussed in **Section 1.4**.

3.1.15 Site-specific terrain data has not been used in the model, as typically terrain data will only have a marked effect on predicted concentrations where hills with gradient of more than 1 in 10 are present in the vicinity of the source, which is not the case at the Proposed Power Plant Site.

Modelled Domain and Receptors

3.1.16 The model has been based on a grid extending 2km from the point source with a grid resolution output at 80m intervals from the source. The nearest residential receptor to the source is located approximately 1km from the source. Therefore, this resolution is considered conservative and appropriate. Discrete receptor locations up to 2km from the Proposed Development have also been included in the model, as detailed in **Section 6.4** of **Chapter 6**: Air Quality (ES Volume I); and discrete designated ecological receptor locations within 10km of the source have also been included; ecological receptor grid references have been determined

through identification of the nearest receptor boundary to the Proposed Development. Process contributions (PC) at discrete receptor locations have been calculated directly in the model output; PC at non-statutory ecological receptors (e.g. Local Wildlife Sites (LWS)) and Lea Marsh Site of Special Scientific Interest (SSSI) have been determined from isopleth plots to identify the maximum concentration within the ecological site area in accordance with best practice. Modelled receptor locations are shown in **Figure 6.1** (ES Volume III).

Stack Height Determination

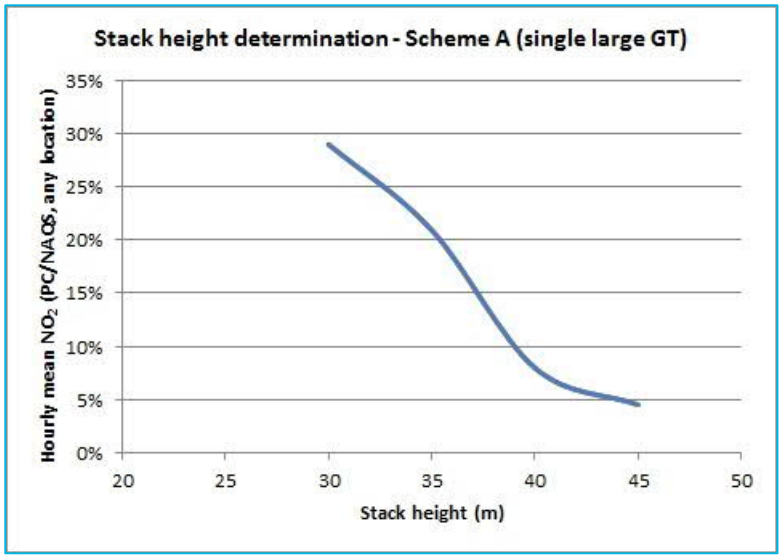
3.1.17 The proposed stack height has been optimised following screening modelling using conservative emission parameters, followed by detailed dispersion modelling and assessment of short-term impacts at sensitive receptors, to identify the appropriate stack height through determination of a Best Available Techniques (BAT) curve. A BAT curve shows the reduction in ground level pollutant concentrations with increasing stack height, and the 'elbow' of the curve typically represents the most appropriate stack height that balances impacts with the height of the stack (i.e. it represents BAT for that emission point).

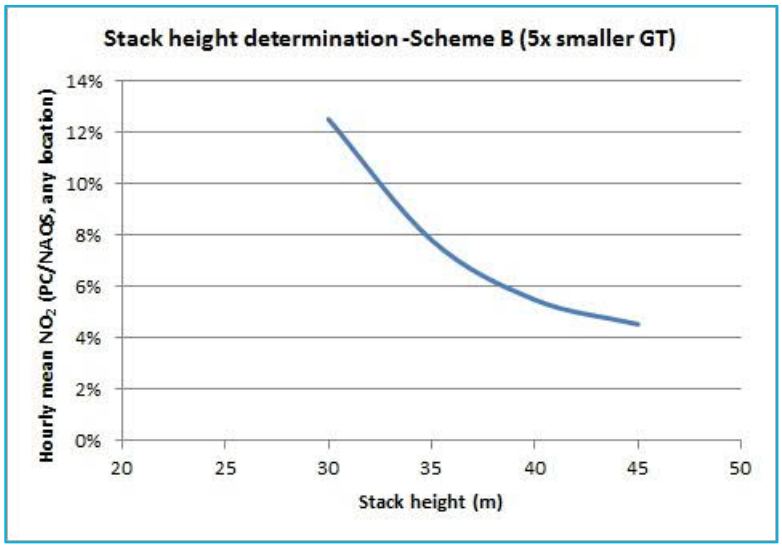
3.1.18 A screening stack height range for each of the two proposed OCGT options scenario was selected based on typical OCGT plant stack heights, as follows:

- large single gas turbine: stack height range of 30-45m; and
- up to five smaller gas turbines: stack height range of 30-45m.

3.1.19 The stack heights plots are presented in **Plate 3** below, and show that that the indicative stack heights for the large single gas turbine and five smaller gas turbines are approximately 40m and 35m respectively as the PC are below 10% of the NAQS short-term objectives off-site. Taller stacks than those identified do not result in pronounced environmental benefit from lower PC.

Plate 3: Maximum short-term NO_2 PC at receptors with stack height





Medium-Long Term Process Contributions

3.1.20 The annual mean PC of NO_x and NO_2 have been factored to take account of the anticipated maximum 2,250 operating hours per year. The emissions have been modelled as a continuous source to account for the worst-case meteorological conditions to assess a robust worst-case and the PC factored for 2,250/ 8,760 hours per year to give the long-term mean result.

3.1.21 The daily mean NO_x PC for ecological receptors has been factored to take account of the discontinuous operation, as average operation for the Proposed Power Plant is expected to be for circa 6-7 hours per day, based on the maximum 2,250 hours per year. The dispersion model has therefore been run with a variable input file for a maximum of 12 hours operation per day, to represent a realistic worst-case daily operation, whilst accounting for variations in meteorological conditions that could lead to peak impacts. The variable input file has been set up for

emissions from the Proposed Power Plant between 06:00-09:00 and 15:00-22:00 hours for each day.

3.1.22 The maximum daily mean NO_x PC from continuous operation, factored for annual operating hours, has also been calculated as a comparison for the maximum long-term daily average NO_x at ecological receptors, as described in **Chapter 6**: Air Quality (ES Volume I).

4. Sensitivity Analysis

4.1 Variables

4.1.1 The assessment has taken into consideration the sensitivity of predicted results to dispersion model input variables, to identify the realistic worst-case PC at sensitive receptor locations. These variables include:

- meteorological data, for which five years' recent data from a representative meteorological station (Robin Hood airport) have been used; and
- buildings, structures and local topography that could affect dispersion from the source.

4.2 Results

4.2.1 The maximum predicted concentration of NO_2 at the worst-affected human health receptors, and NO_x at the worst-affected statutory designated ecological receptor, associated with the variable input parameters are presented in **Table 12** as the percentage of maximum reported values used in determining whether effects are significant or not significant.

Table 12: Point source dispersion model sensitivity analysis – worst-case results

Model Input Variable	Human health receptor		Statutory ecological receptor	
	Short-term	Long-term	Short-term	Long-term
Meteorological data (5-year min-max)	69-100%	55-100%	56-100%	62-100%
Buildings representation (including existing power station buildings; alternative layouts)	92 -100%	94-100%	86-100%	93-100%
Surface roughness representation (0.5m)	106%	102%	93%	105%
Surface roughness representation (0.2m)	97%	80%	105%	97%
Finished ground level (±5m)	90-100%	90-100%	98-100%	94-100%

4.2.2 The main uncertainty associated with the model is considered to be meteorological data, with a variation of 69% in the hourly mean NO_2 PC; this is equivalent to an overall uncertainty associated with the hourly mean PC at the worst-affected receptor of -1.8 µg/m^3 (-1% of the NAQS) and 56% in the daily NO_x PC at the statutory receptor (-4% of the Critical Level).

4.2.3 The effect of representation of buildings within the dispersion model has been assessed, with 8-14% variation in short-term PCs at the worst-affected receptors determined for the alternative layouts as shown in **Plate 2**. The inclusion of existing West Burton Power Station buildings within the model did not change the PC from the Proposed Development at the worst-affected receptor.

4.2.4 Surface roughness representation within the model has been assessed with the inclusion of variable surface roughness across the grid, with the area covering residential areas represented by a surface roughness of 0.5m (corresponding to parkland/ open suburbia), and the remaining area by a surface roughness of 0.2m (corresponding to agricultural areas - minimum). The variation resulted in 5-7% change in the short-term PC at the worst-affected receptor and at the modelled receptor.

4.2.5 Finished ground level representation within the model has been assessed by modelling the stacks and buildings assuming an increase or decrease of 5m in the heights, relative to other modelled structures and receptor locations. The maximum PC at the worst-affected receptor was varied by 10% or less in the short-term and long-term.

4.2.6 The overall worst-case input parameters have been used to generate the PCs used in this assessment. Application of the above sensitivity results to PCs does not significantly alter the predicted effects assessment reported in the main Chapter.

5. Likely Impacts and Effects

5.1 Assessment of Demolition and Construction Dust and Non-Road Mobile Machinery Emissions

5.1.1 The identified air quality sensitive receptors in the vicinity of the Proposed Development are detailed in **Table 13** below, with distances from potential dust-generating sources and therefore the potential for construction dust effects from those sources, with reference to the screening criteria outlined in **Chapter 6**: Air Quality (Section 6.3, ES Volume I)

Table 13: Identified receptors with potential for air quality impacts from the Proposed Development

ID	Receptor type	Receptor dust Sensitivity	Distance from Proposed Development highway link (traffic)	Distance from Proposed Development construction site exit or boundary (dust)	Receptor with potential for:	
					Traffic impacts	Dust impacts
R1	Residential	High	>350m	>500m	No	No
R2	Residential	High	230m	>500m	No	No
R3	Residential	High	25m	>500m	Yes	No
R4	Residential	High	35m	>500m	Yes	No
R5	Residential	High	20m	>500m	Yes	No
R6	Residential	High	>350m	>500m	No	No
R7	Residential	High	85m	>500m	Yes	No
R8	Residential	High	>350m	>500m	No	No
R9	Residential	High	>350m	>500m	No	No
R10	Transient	Low	-	<100m	No	Yes
R11	Residential	High	20m	>500m	Yes	No
R12	Residential	High	<10m	>500m	Yes	No
E1	SSSI	Medium	>350m	>50m	No	No
E2	LWS	Low	<10m	Located partially within Site	No	Yes
E3	LWS	Low	<50m	<50m	No	Yes
E4	LWS	Low	>350m	>50m	No	No

ID	Receptor type	Receptor dust Sensitivity	Distance from Proposed Development highway link (traffic)	Distance from Proposed Development construction site exit or boundary (dust)	Receptor with potential for:	
					Traffic impacts	Dust impacts
E5	LWS	Low	>350m	>50m	No	No
E6	LWS	Low	>350m	>50m	No	No
E7	LWS	Low	>350m	>50m	No	No
E8	LWS	Low	100m	>50m	Yes	No
E9	LWS	Low	>350m	>50m	No	No
E10	LWS	Low	>350m	>50m	No	No
E11	LWS	Low	>350m	>50m	No	No
E12	LWS	Low	>350m	>50m	No	No
E13	SSSI	Medium	>350m	>50m	No	No
E14	SSSI	Medium	>350m	>50m	No	No
E15	SSSI	Medium	>350m	>50m	No	No
E16	SSSI	Medium	>350m	>50m	No	No
E17	SSSI	Medium	>350m	>50m	No	No
E18	SSSI	Medium	>350m	>50m	No	No
E19	SSSI	Medium	>350m	>50m	No	No
E20	SSSI	Medium	>350m	>50m	No	No

Note: SSSI = Site of Special Scientific Interest; LWS = Local Wildlife Site

5.1.2 The receptor area sensitivity to the effects of dust soiling, PM_{10} (human health) and ecological impacts has been determined to be 'low' for all activities, based on the closest distance from the identified receptors to those activities, as summarised in

5.1.3 **Table** 14 below. The overall area sensitivity is therefore considered to be 'low'.

Table 14: Receptor area sensitivity assessment

Activity	Potential Impact	Receptor sensitivity and distance to activity	Receptor area sensitivity
Earthworks	Dust soiling	Low sensitivity (transient) <100m	Low sensitivity
	Ecological	Low sensitivity (LWS) <20m	Low sensitivity
	Health PM_{10}	Low sensitivity (transient) <100m	Low sensitivity
Construction	Dust soiling	Low sensitivity (transient) <100m	Low sensitivity
	Ecological	Low sensitivity (LWS) <20m	Low sensitivity
	Health PM_{10}	Low sensitivity (transient) <100m	Low sensitivity
Trackout	Dust soiling	Low sensitivity (transient) <50m	Low sensitivity
	Ecological	Low sensitivity (LWS) <20m	Low sensitivity
	Health PM_{10}	Low sensitivity (transient) <50m	Low sensitivity

5.1.4 The potential risks from unmitigated activities is determined through combination of the magnitude of potential effect (pre-mitigation) and the receptor area sensitivity, as described in **Table 6, Table 7, Table 8**, and

5.1.5 **Table** 9 above. The results are summarised in **Table 15** below.

Table 15: Magnitude assessment

Activity type	Dust emission magnitude	Area sensitivity	Risk of impacts
Demolition	(None)	-	-
Earthworks	Large	Low	Low risk
Construction	Medium	Low	Low risk
Trackout	Large	Low	Low risk

5.1.6 Additional or cumulative sources of dust from other developments, including the ash processing plant (authorised by Nottinghamshire County Council (NCC) Application Reference 1/16/01441/CDM) and operated by the Applicant) adjacent to the Proposed Development that has become operational since the Defra baseline map publication, would not alter the receptor area sensitivity evaluation and the potential risks from unmitigated activities with cumulative dust sources is evaluated to be the same as described in **Table 15** above.

Assessment of Operational Point Source Emissions

5.1.7 The predicted atmospheric concentrations of pollutants from dispersion modelling of the worst-case operational scenario for human health impacts, and for impacts at designated and non-statutory ecological receptors, are shown in the following tables, together with baseline concentrations and the assessment of effect at identified receptors.

5.1.8 Nutrient nitrogen deposition and acid deposition are reported for statutory designated ecological receptors only, as existing Critical Load baseline data is typically only available for these sites. The indicative nutrient nitrogen deposition rate for the worst-affected LWS is reported for reference only.

Table 16: Maximum NO_2 (1-hour, 99.79th %ile) predicted concentrations at human health receptors (worst-case plant configuration)

Receptor ID	Receptor name	Hourly mean PC - Proposed Development (µg/m^3)	PC/NAQS	Magnitude of change	Short-term AC (µg/m^3)[1]	Combined PC WBB + Proposed Development (µg/m^3)	PC_{WBB+} Proposed Development as % of headroom (PC/(NAQS-AC)	Effect descriptor
R1	Willow Farm; Manor Cottage, East Street, Bole	5.9	3%	Imperceptible	19	17.7	9.7%	Negligible
R2	South Street, Bole	4.7	2%	Imperceptible	19	13.4	7.4%	Negligible
R3	Crossing Keepers Cottage	3.4	2%	Imperceptible	17	13.2	7.2%	Negligible
R4	Mill House Farm	3.9	2%	Imperceptible	17	14.5	7.9%	Negligible
R5	Grange Farm	4.6	2%	Imperceptible	17	12.7	6.9%	Negligible
R6	High Farm cottages	2.8	1%	Imperceptible	16	9.9	5.4%	Negligible
R7	St Ives	3.8	2%	Imperceptible	17	14.0	7.6%	Negligible
R8	North Street, Sturton-le-Steeple	3.7	2%	Imperceptible	17	14.9	8.1%	Negligible
R9	Watkins Lane, Sturton-le-Steeple	3.7	2%	Imperceptible	17	13.6	7.4%	Negligible

Receptor ID	Receptor name	Hourly mean PC - Proposed Development (µg/m^3)	PC/NAQS	Magnitude of change	Short-term AC (µg/m^3)[1]	Combined PC WBB + Proposed Development (µg/m^3)	PC_{WBB+} Proposed Development as % of headroom (PC/(NAQS-AC)	Effect descriptor
R11	Rose Lea	3.9	2%	Imperceptible	19	12.1	6.7%	Negligible
R12	Gainsborough Rd South	3.4	2%	Imperceptible	17	12.8	7.0%	Negligible
NAQS (µg/m^3)		*200*						

Note: Short-term ambient concentration (AC) is represented by twice the annual mean concentration in accordance with EA guidance (Ref 6A-2), **Chapter 6**: Air Quality (ES Report Volume I)); Receptor ID R10 represents transient receptors for the assessment of construction dust only, identified as per IAQM guidance. Transient receptors are not specified within the guidance for the assessment of operational emissions, although the off-site impacts have been considered in general terms, as discussed in **Section 6.7**, **Chapter 6**: Air Quality (ES Report Volume I).

Table 17: Maximum annual mean NO_2 predicted concentrations at human health receptors (worst-case plant configuration)

Receptor ID	Receptor name	Annual mean PC – Proposed Development (µg/m^3)	PC/NAQS	Magnitude of change	Annual mean AC (µg/m^3)	Combined PC WBB + Proposed Development (µg/m^3)	PEC_{WBB+} Proposed Development (µg/m^3)	PEC/NAQS	Effect descriptor
R1	Willow Farm; Manor Cottage, East Street, Bole	<0.1	<1%	Imperceptible	9	0.3	10	24%	Negligible
R2	South Street, Bole	<0.1	<1%	Imperceptible	9	0.2	10	24%	Negligible
R3	Crossing Keepers Cottage	<0.1	<1%	Imperceptible	9	0.2	9	22%	Negligible
R4	Mill House Farm	<0.1	<1%	Imperceptible	8	0.1	9	21%	Negligible
R5	Grange Farm	<0.1	<1%	Imperceptible	8	0.1	9	21%	Negligible
R6	High Farm cottages	<0.1	<1%	Imperceptible	8	0.1	8	21%	Negligible
R7	St Ives	<0.1	<1%	Imperceptible	8	0.3	9	22%	Negligible
R8	North Street, Sturton-le-Steeple	<0.1	<1%	Imperceptible	8	0.3	9	22%	Negligible

Receptor ID	Receptor name	Annual mean PC – Proposed Development (µg/m^3)	PC/NAQS	Magnitude of change	Annual mean AC (µg/m^3)	Combined PC WBB + Proposed Development (µg/m^3)	PEC_{WBB+} Proposed Development (µg/m^3)	PEC/NAQS	Effect descriptor
R9	Watkins Lane, Sturton-le-Steeple	<0.1	<1%	Imperceptible	8	0.2	9	22%	Negligible
R11	Rose Lea	<0.1	<1%	Imperceptible	8	0.1	8	21%	Negligible
R12	Gainsborough Rd South	<0.1	<1%	Imperceptible	9	0.2	9	22%	Negligible
NAQS (µg/m^3)		*40*							

Table 18: Maximum CO (8-hour, running mean) predicted concentrations at human health receptors (worst-case plant configuration)

Receptor ID	Receptor name	8-hr mean Proposed Development ($\mu g/m^3$)	PC/NAQS	Magnitude of change	Short-term AC ($\mu g/m^3$)[1]	Combined PC WBB + Proposed Development ($\mu g/m^3$)	PC_{WBB+} Proposed Development as % of headroom (PC/(NAQS-AC)	Effect descriptor
R1	Willow Farm; Manor Cottage, East Street, Bole	47	<1%	Imperceptible	220	76	<1%	Negligible
R2	South Street, Bole	36	<1%	Imperceptible	220	58	<1%	Negligible
R3	Crossing Keepers Cottage	29	<1%	Imperceptible	220	78	<1%	Negligible
R4	Mill House Farm	25	<1%	Imperceptible	220	78	<1%	Negligible
R5	Grange Farm	44	<1%	Imperceptible	220	62	<1%	Negligible
R6	High Farm cottages	31	<1%	Imperceptible	220	48	<1%	Negligible
R7	St Ives	34	<1%	Imperceptible	220	64	<1%	Negligible
R8	North Street, Sturton-le-Steeple	39	<1%	Imperceptible	220	68	<1%	Negligible
R9	Watkins Lane, Sturton-le-Steeple	47	<1%	Imperceptible	220	59	<1%	Negligible
R11	Rose Lea	36	<1%	Imperceptible	220	48	<1%	Negligible

Receptor ID	Receptor name	8-hr mean Proposed Development (µg/m^3)	PC/NAQS	Magnitude of change	Short-term AC (µg/m^3)[1]	Combined PC WBB + Proposed Development (µg/m^3)	PC_{WBB+} Proposed Development as % of headroom (PC/(NAQS-AC)	Effect descriptor
R12	Gainsborough Rd South	42	<1%	Imperceptible	220	54	<1%	Negligible
	NAQS (µg/m^3)	*10,000*						

Note: Short term ambient concentration (AC) is represented by twice the annual mean concentration in accordance with EA guidance (Ref 6-6, **Chapter 6**: Air Quality (ES Report Volume I)

Table 19: Maximum CO (1-hour) predicted concentrations at human health receptors (worst-case plant configuration)

Receptor ID	Receptor name	Hourly mean PC – Proposed Development ($\mu g/m^3$)	PC/NAQS	Magnitude of change	Short-term AC ($\mu g/m^3$)[1]	Combined PC WBB + Proposed Development ($\mu g/m^3$)	PC_{WBB+} Proposed Development as % of headroom (PC/(NAQS-AC)	Effect descriptor
R1	Willow Farm; Manor Cottage, East Street, Bole	49	<1%	Imperceptible	220	133	<1%	Negligible
R2	South Street, Bole	41	<1%	Imperceptible	220	99	<1%	Negligible
R3	Crossing Keepers Cottage	28	<1%	Imperceptible	220	97	<1%	Negligible
R4	Mill House Farm	43	<1%	Imperceptible	220	105	<1%	Negligible
R5	Grange Farm	37	<1%	Imperceptible	220	99	<1%	Negligible
R6	High Farm cottages	26	<1%	Imperceptible	220	77	<1%	Negligible
R7	St Ives	27	<1%	Imperceptible	220	98	<1%	Negligible
R8	North Street, Sturton-le-Steeple	25	<1%	Imperceptible	220	96	<1%	Negligible
R9	Watkins Lane, Sturton-le-Steeple	25	<1%	Imperceptible	220	94	<1%	Negligible
R11	Rose Lea	34	<1%	Imperceptible	220	95	<1%	Negligible
R12	Gainsborough Rd South	25	<1%	Imperceptible	220	86	<1%	Negligible

Receptor ID	Receptor name	Hourly mean PC – Proposed Development (µg/m^3)	PC/NAQS	Magnitude of change	Short-term AC (µg/m^3)[1]	Combined PC WBB + Proposed Development (µg/m^3)	PC_{WBB+} Proposed Development as % of headroom (PC/(NAQS-AC)	Effect descriptor
	NAQS (µg/m^3)	*30,000*						

Note: Short term ambient concentration (AC) is represented by twice the annual mean concentration in accordance with EA guidance (Ref 6-6, **Chapter 6**: Air Quality (ES Report Volume I)

Table 20: Maximum NOx (24-hour) predicted concentrations at ecological receptors (worst-case plant configuration)

Receptor ID	Receptor name	Receptor type	PC – Proposed Development (µg/m^3)	$PC_{Proposed\ Development}$ / Critical Level	Magnitude of change	Combined PC WBB + Proposed Development (µg/m^3)	$PC_{WBB+\ Proposed\ Development}$ / Critical Level	Effect descriptor
E1	Lea Marsh	SSSI	7.4	9.9%	Imperceptible	40	54%	Negligible
E2	West Burton Power Station LWS	LWS	20	27%	-	65	87%	Negligible
E3	West Burton Reedbed	LWS	11	14%	-	10	13%	Negligible
E4	Burton Round Ditch	LWS	10	13%	-	25	33%	Negligible
E5	Bole Ings	LWS	13	17%	-	65	87%	Negligible
E6	Bole Ings Drains	LWS	7.0	9%	-	40	53%	Negligible
E7	Mother Drain, Upper Ings	LWS	4.0	5.3%	-	25	33%	Negligible
E8	West Burton Meadow	LWS	2.0	2.7%	-	10	13%	Negligible
E9	Bole Ings Flood Pasture	LWS	5.5	7.3%	-	35	47%	Negligible
E10	Saundby Ponds	LWS	3.0	4.0%	-	15	20%	Negligible
E11	Saundby Marsh Drains	LWS	4.0	5.3%	-	15	20%	Negligible
E12	Lea Meadow	LWS	4.7	6.3%	-	21	29%	Negligible

Receptor ID	Receptor name	Receptor type	PC – Proposed Development (µg/m^3)	$PC_{Proposed\ Development}$ / Critical Level	Magnitude of change	Combined PC WBB + Proposed Development (µg/m^3)	$PC_{WBB+Proposed\ Development}$ / Critical Level	Effect descriptor
E13	Clarborough Tunnel	SSSI	0.9	1.3%	Imperceptible	4.4	5.8%	Negligible
E14	Treswell Wood	SSSI	0.7	0.9%	Imperceptible	4.1	5.4%	Negligible
E15	Ashton's Meadow	SSSI	0.8	1.0%	Imperceptible	6.3	8.4%	Negligible
E16	Chesterfield Canal (a)	SSSI	0.9	1.2%	Imperceptible	6.1	8.2%	Negligible
E17	Sutton and Lound Gravel Pits	SSSI	0.6	0.8%	Imperceptible	3.6	4.8%	Negligible
E18	Chesterfield Canal (b)	SSSI	0.9	1.2%	Imperceptible	5.1	6.8%	Negligible
E19	Mother Drain, Misterton	SSSI	1.0	1.3%	Imperceptible	5.9	7.9%	Negligible
E20	Castle Hill Wood	SSSI	0.6	0.9%	Imperceptible	3.7	5.0%	Negligible
Critical Level (µg/m^3)			*75*					

Table 21: Maximum annual mean NOx predicted concentrations at ecological receptors (worst-case plant configuration)

Receptor ID	Receptor name	Receptor type	Annual mean PC – Proposed Development (µg/m^3)	PC/ Critical Level	Magnitude of change	Annual mean AC (µg/m^3)	Combined PC WBB + Proposed Development (µg/m^3)	PEC_{WBB+} Proposed Development (µg/m^3)	PEC/Critical Level	Effect descriptor
E1	Lea Marsh	SSSI	0.2	0.7%	Imperceptible	17	1.4	18	60%	Negligible
E2	West Burton Power Station	LWS	0.4	1.4%	Imperceptible	15	1.8	17	57%	Negligible
E3	West Burton Reedbed	LWS	< 0.1	0.32%	Imperceptible	15	0.1	16	52%	Negligible
E4	Burton Round Ditch	LWS	< 0.1	0.3%	Imperceptible	15	0.3	16	52%	Negligible
E5	Bole Ings	LWS	0.3	1.1%	Imperceptible	16	1.6	18	59%	Negligible
E6	Bole Ings Drains	LWS	0.3	1.0%	Imperceptible	16	1.5	17	58%	Negligible
E7	Mother Drain, Upper Ings	LWS	< 0.1	0.3%	Imperceptible	15	1.0	16	54%	Negligible
E8	West Burton Meadow	LWS	< 0.1	0.2%	Imperceptible	16	0.3	16	53%	Negligible
E9	Bole Ings Flood Pasture	LWS	0.2	0.7%	Imperceptible	17	1.5	18	60%	Negligible
E10	Saundby Ponds	LWS	< 0.1	0.3%	Imperceptible	16	0.6	17	55%	Negligible
E11	Saundby Marsh Drains	LWS	0.1	0.4%	Imperceptible	16	0.6	17	55%	Negligible

Receptor ID	Receptor name	Receptor type	Annual mean PC – Proposed Development (µg/m^3)	PC/ Critical Level	Magnitude of change	Annual mean AC (µg/m^3)	Combined PC WBB + Proposed Development (µg/m^3)	PEC$_{WBB+}$ Proposed Development (µg/m^3)	PEC/Critical Level	Effect descriptor
E12	Lea Meadow	LWS	0.1	0.5%	Imperceptible	16	1.0	17	56%	Negligible
E13	Clarborough Tunnel	SSSI	< 0.1	<0.1%	Imperceptible	18	0.2	18	59%	Negligible
E14	Treswell Wood	SSSI	< 0.1	<0.1%	Imperceptible	16	0.1	16	55%	Negligible
E15	Ashton's Meadow	SSSI	< 0.1	<0.1%	Imperceptible	16	0.2	16	54%	Negligible
E16	Chesterfield Canal (a)	SSSI	< 0.1	<0.1%	Imperceptible	16	0.1	16	53%	Negligible
E17	Sutton and Lound Gravel Pits	SSSI	< 0.1	<0.1%	Imperceptible	17	0.1	17	58%	Negligible
E18	Chesterfield Canal (b)	SSSI	< 0.1	<0.1%	Imperceptible	16	0.2	16	52%	Negligible
E19	Mother Drain, Misterton	SSSI	< 0.1	0.1%	Imperceptible	16	0.3	16	54%	Negligible
E20	Castle Hill Wood	SSSI	< 0.1	<0.1%	Imperceptible	17	0.1	17	57%	Negligible
Critical Level (µg/m^3)			*30*							

Note: Critical Loads and existing baseline levels taken from APIS (Ref 6-3, **Chapter 6**: Air Quality (ES Report Volume I))

Deposition Impacts and Effects on Ecological Receptor

Table 22: Nutrient Nitrogen deposition to ground (as kg N/Ha/year) at statutory designated habitats (worst-case plant configuration)

Receptor ID	Receptor name (Critical Load Class: most sensitive species)	Empirical Critical Load	Annual mean PC_{WBC}	PC/Critical Load (lower)	Magnitude of change	Annual mean baseline	Combined PC WBB + Proposed Development	PEC_{WBB+} Proposed Development /Critical Load (lower)	Effect descriptor
E1	Lea Marsh SSSI (Low and medium altitude hay meadows)	20-30	0.020	0.1%	Imperceptible	17.9	0.73%	90%	Negligible
E13	Clarborough Tunnel SSSI (Sub-Atlantic semi-dry calcareous grassland)	15-25	0.002	<0.1%	Imperceptible	19.7	0.1%	131%	Negligible
E14	Treswell Wood SSSI (Meso- and eutrophic Quercus woodland)	15-20	0.003	<0.1%	Imperceptible	33.7	0.1%	225%	Negligible
E15	Ashton's Meadow SSSI (Low and medium altitude hay meadows)	20-30	0.002	<0.1%	Imperceptible	19.9	<0.1%	99%	Negligible
E16	*Chesterfield Canal* SSSI *(a)* (none defined)	*None defined*	-	-	-	-		-	-

Receptor ID	Receptor name (Critical Load Class: most sensitive species)	Empirical Critical Load	Annual mean PC_{WBC}	PC/Critical Load (lower)	Magnitude of change	Annual mean baseline	Combined PC WBB + Proposed Development	PEC_{WBB+} Proposed Development /Critical Load (lower)	Effect descriptor
E17	*Sutton and Lound Gravel Pits* SSSI (standing open water and canals)	*None defined*	-	-	-	-		-	-
E18	*Chesterfield Canal* SSSI *(b)* (none defined)	*None defined*	-	-	-	-		-	-
E19	*Mother Drain SSSI,* Misterton (Invertebrate assemblage)	*None defined*	-	-	-	-		-	-
E20	Castle Hill Wood SSSI (Meso- and eutrophic Quercus woodland)	15-20	0.002	<0.1%	Imperceptible	32.2	0.1%	215%	Negligible
E2[1]	*West Burton Power Station LWS (broad-leaved deciduous woodland)*	*10-20*	*0.085*	*0.9%*	*Imperceptible*	-	-	-	*Negligible*

Note: Critical Loads and existing baseline levels taken from APIS (Ref 6-3, **Chapter 6**: Air Quality (ES Report Volume I))

1. Indicative level for LWS only

Table 23: Acid deposition to ground (as keq/Ha/year) at statutory designated habitats (worst-case plant configuration)

Receptor ID	Receptor name (Critical Load Class: most sensitive species)	*Empirical Critical Load (keq N/Ha/yr)*	*Empirical Critical Load (keq S/Ha/yr)*	*Total Baseline (N:S keq/Ha/yr)*[1]	PC Proposed Development of N to acid deposition [1]	PC_{WBB+} Proposed Development of N to acid deposition [1]	PEC_{WBB+} Proposed Development N Deposition (<CLMinN?)	PC_{WBB+} Proposed Development / Critical Load	PEC_{WBB+} Proposed Development / Critical Load	Effect descriptor
E1	Lea Marsh SSSI (Low and medium altitude hay meadows)	*0.44-2.48*	*1.61*	*1.28:0.28*	0.001	0.014	1.290 (>CLMinN)	0.4% (CLMaxN)	64%	Negligible
E13	Clarborough Tunnel SSSI (Sub-Atlantic semi-dry calcareous grassland)	*0.93-4.93*	*4.00*	*1.41:0.28*	1e-4	0.002	1.412 (>CLMinN)	<0.1% (CLMaxN)	34%	Negligible
E14	Treswell Wood SSSI (Meso- and eutrophic Quercus woodland)	*0.21-1.98*	*1.77*	*2.41:0.34*	2e-4	0.003	2.413 (>CLMinN)	0.1% (CLMaxN)	139%	Negligible
E15	Ashton's Meadow SSSI (Low and medium altitude hay meadows)	*0.30-4.40*	*4.10*	*1.42:0.28*	1e-4	0.002	1.422 (>CLMinN)	<0.1% (CLMaxN)	39%	Negligible

Receptor ID	Receptor name (Critical Load Class: most sensitive species)	*Empirical Critical Load (keq N/Ha/yr)*	*Empirical Critical Load (keq S/Ha/yr)*	*Total Baseline (N:S keq/Ha/yr)*[1]	PC Proposed Development of N to acid deposition [1]	PC_{WBB+} Proposed Development of N to acid deposition [1]	PEC_{WBB+} Proposed Development N Deposition (<CLMinN?)	PC_{WBB+} Proposed Development / Critical Load	PEC_{WBB+} Proposed Development / Critical Load	Effect descriptor
E16	*Chesterfield Canal* SSSI *(a)* (none defined)	-	-	-		-	-			-
E17	*Sutton and Lound Gravel Pits* SSSI (standing open water and canals)	-	-	-		-	-			-
E18	*Chesterfield Canal* SSSI *(b)* (none defined)	-	-	-		-	-			-
E19	*Mother Drain SSSI,* Misterton (Invertebrate assemblage)	-	-	-		-	-			-
E20 [2]	Castle Hill Wood SSSI (Meso- and eutrophic Quercus woodland)	0.21-11.3	1.79	2.37:0.34	1e-4	0.001	2.371 (>CLMinN)	<0.1% (CLMaxN)	24%	Negligible

Note: 1. Sulphur contribution from Proposed Development assumed to be zero; 2. Indicative level for LWS only

6. References

Ref 6A-1 HM Government (2010) Air Quality Standards Regulations 2010.

Ref 6A-2 Department for Environment, Food & Rural Affairs and Environment Agency (2016). *Air emissions risk assessment for your environmental permit*. 'https://www.gov.uk/government/collections/risk-assessments-for-specific-activities-environmental-permits.