



## **Thurrock Flexible Generation Plant**

**Environmental Statement Volume 6  
Appendix 12.1: Assessment of Air Quality Impacts on Ecological Receptors**

**Date:** February 2020



**Environmental Impact Assessment**

**Environmental Statement**

**Volume 6**

**Appendix 12.1**

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## Summary

This appendix assesses the impacts of air quality on ecological receptors. It outlines the methodology, results and conclusions of the assessment.

## Qualifications

This appendix has been prepared by Rosemary Challen, a Member of the Institution of Environmental Sciences and Member of the Institute of Air Quality Management (IAQM).

It has been checked by Kathryn Barker, a Member of the IAQM and an Associate Member of the Institution of Environmental Sciences.

Contributions on air quality were provided by Dr Nick Betson CEnv MCIEEM who has over 14 years' experience in the assessment of effects of air quality on terrestrial habitats.

It has been reviewed by Fiona Prismall, a Chartered Environmentalist, Member of the Institution of Environmental Sciences and Fellow of the IAQM. Fiona is the IAQM committee secretary. Fiona was a member of the working groups that produced the IAQM 2014 'Guidance on the assessment of dust from demolition and construction', the Environmental Protection UK & IAQM 2017 'Land-use Planning & Development Control: Planning for Air Quality' guidance and the IAQM 2019 'A guide to the assessment of air quality impacts on designated nature conservation sites'.

# 1. Assessment of Air Quality Impacts on Ecological Receptors

## 1.1 Introduction

1.1.1 The following European designated nature conservation sites, within 15 km of the Application Site, have been identified:

- Thames Estuary and Marshes Special Protection Area (SPA); and
- North Downs Woodlands Special Area of Conservation (SAC).

1.1.2 The following nationally and locally designated sites, within 15 km of the Application Site, have also been identified:

- Basildon Meadows Site of Special Scientific Interest (SSSI);
- Canvey Wick SSSI;
- Chattenden Woods and Lodge Hill SSSI;
- Cobham Woods SSSI;
- Darenth Wood SSSI;
- Grays Thurrock Chalk Pit SSSI;
- Great Crabbles Wood SSSI;
- Halling to Trottiscliffe Escarpment SSSI;
- Hangmans Wood and Deneholes SSSI;
- Holehaven Creek SSSI;
- Mucking Flats and Marshes SSSI;
- Northward Hill SSSI;
- Pitsea Marsh SSSI;
- Shorne and Ashenbank Woods SSSI;
- South Thames Estuary and Marshes SSSI;
- Thorndon Park SSSI;
- Tower Hill to Cockham Wood SSSI;
- Vange and Fobbing Marshes SSSI;
- West Thurrock Lagoon and Marshes SSSI;
- Langdon Ridge SSSI;
- Broom Hill Local Wildlife Site (LWS);
- West Tilbury Hall LWS;
- Low Street Pit LWS;
- Lytag Brownfield LWS;

- Tilbury Centre LWS;
- Tilbury Marshes LWS; and
- Goshems Farm LWS.

1.1.3 This Appendix considers the impact of the proposed development on nitrogen oxide (NO<sub>x</sub>) concentrations, nutrient nitrogen deposition and acid deposition at the nature sites listed above.

1.1.4 For the impacts from construction traffic generated by the site, only the following sites have been considered as they are within 200 m of the construction traffic route:

- West Tilbury Hall LWS;
- Low Street Pit LWS;
- Lytag Brownfield LWS; and
- Tilbury Marshes LWS.

1.1.5 Further detail about the assessment of traffic-related emissions is in Volume 6, Appendix 12.6 Assessment of Traffic-related Emissions.

## 1.2 Approach

1.2.1 NO<sub>x</sub> concentrations have been predicted using the same model as used in the assessment of impacts on human-health receptors. Modelling has been undertaken for a grid of receptor points, with a grid spacing of 100 m, across each identified nature conservation site. The receptor grid points have been modelled at ground level. The maximum Process Contribution (PC) from the proposed development at each site and for all the meteorological datasets has been identified and is presented in this Appendix.

1.2.2 Modelling has been undertaken for the following engine scenarios:

- 48 x 12.4 MW engines, each engine with its own stack (48 stacks);
- 48 x 12.4 MW engines, aggregated stacks of four engines per stack (12 stacks);
- 33 x 18.4 MW engines, each engine with its own stack (33 stacks); and
- 33 x 18.4 MW engines, aggregated stacks of six groups of five engines per stack and one group of three engines per stack (7 stacks).

1.2.3 Only the results for 48 x 12.4 MW engines, each engine with its own stack (48 stacks) are given in this Appendix. This is the modelled scenario which predicted the greatest impacts.

## 1.3 Critical Levels/Loads and Significance Criteria

### Critical Levels

1.3.1 Critical levels are maximum atmospheric concentrations of pollutants for the protection of vegetation and ecosystems and are specified within relevant European air quality directives and corresponding UK air quality regulations. PCs and, if appropriate, Predicted Environmental Concentrations (PECs) of NO<sub>x</sub> have been calculated for comparison with the 30 µg.m<sup>-3</sup> critical level. Background NO<sub>x</sub> concentrations at each designated site have been derived from the UK Air Pollution Information System (APIS) (n.d.) database.

### Critical Loads

1.3.2 Critical Loads refer to the quantity of pollutant deposited, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Nutrient nitrogen deposition and acid deposition are considered in this Appendix.

#### **Critical Loads – Nutrient Nitrogen Deposition**

1.3.3 Percentage contributions to nutrient nitrogen deposition have been derived from the modelled NO<sub>x</sub> concentrations. Deposition rates have been calculated using empirical methods recommended by the Environment Agency, as follows:

- i. The dry deposition flux (µg.m<sup>-2</sup>.s<sup>-1</sup>) has been calculated by multiplying the ground level NO<sub>2</sub> concentrations (µg.m<sup>-3</sup>) by the deposition velocity of 0.003 m.s<sup>-1</sup> for forests/tall habitats and 0.0015 m.s<sup>-1</sup> for grassland/short habitats.
- ii. Units of µg.m<sup>-2</sup>.s<sup>-1</sup> have been converted to units of kg.ha<sup>-1</sup>.year<sup>-1</sup> by multiplying the dry deposition flux by the standard conversion factor of 96 for NO<sub>x</sub>.
- iii. Predicted contributions to nitrogen deposition have been calculated and compared with the relevant critical load range for the habitat types associated with the designated site. These have been derived from the APIS database.

#### **Critical Loads – Acid Deposition**

1.3.4 The acid deposition rate, in equivalents keq.ha<sup>-1</sup>.year<sup>-1</sup>, has been calculated by multiplying the dry deposition flux (kg.ha<sup>-1</sup>.year<sup>-1</sup>) by a conversion factor of 0.071428 for N. This takes into account the degree to which a chemical species is acidifying, calculated as the proportion of N within the molecule.

1.3.5 Wet deposition in the near field is not significant compared with dry deposition for N (Hertel *et al.*, 2011) and therefore for the purposes of this assessment, wet deposition has not been considered.

1.3.6 Predicted contributions to acid deposition have been calculated and compared with the minimum critical load function for the habitat types associated with the designated site as derived from the APIS database.

### Significance Criteria

1.3.7 Maximum PCs and PECs of NO<sub>x</sub> and nutrient nitrogen / acid deposition have been compared against the relevant critical level/load for the relevant habitat type/interest feature. Based on current DEFRA and Environment Agency (EA) (2016) guidelines and the Institute of Air Quality Management (IAQM) *A guide to the assessment of air quality impacts on designated nature conservation sites* (IAQM, 2019), the following criteria have been used to determine if the impacts are significant:

1.3.8 For SPAs, SACs and SSSIs:

- If the long-term PC does not exceed 1% of the relevant critical level/load the effect is considered not significant; and
- If the long-term PC exceeds 1% but the resulting PEC is below 100% of the relevant critical level/load, the effect is not considered significant;
- If the short-term PC does not exceed 10% of the relevant critical level/load the effect is considered not significant; and
- If the short-term PC exceeds 10% but the resulting PEC is below 100% of the relevant critical level/load, the effect is not considered significant.

1.3.9 For local nature sites:

- If the short-term PC is less than 100% of the relevant critical level/load the effect is considered not significant; and
- If the long-term PC is less than 100% of the relevant critical level/load the effect is considered not significant.

## 1.4 Results

1.4.1 The ambient NO<sub>x</sub> concentrations and existing deposition rates have been obtained from APIS (n.d.). The highest deposition rates have been obtained taking into account the various habitats across the sites. The lowest critical loads for nitrogen deposition and the nitrogen component for acid deposition have also been obtained from APIS (APIS, n.d.).

### Stack Emissions

- 1.4.2 The maximum predicted annual-mean NO<sub>x</sub> concentrations are compared with the critical level (CL) in Table 1.1. The maximum predicted nutrient nitrogen deposition rates are compared with the critical load (CL) in Table 1.3. The maximum predicted acid deposition rates are compared with the critical load function (CLF) in Table 1.4.
- 1.4.3 Critical levels are maximum atmospheric concentrations of pollutants for the protection of vegetation and ecosystems and are specified within relevant European air quality directives and corresponding UK air quality regulations. Critical loads refer to the quantity of pollutant deposited, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. CL refers to critical level or critical load, as applicable, depending on whether atmospheric concentration of pollutant or deposition of pollutant is being assessed.

**Table 1.1: Predicted Annual-Mean NO<sub>x</sub> Concentrations at Designated Sites – Stack Emissions**

Designated Site	CL ( $\mu\text{g.m}^{-3}$ )	AC ( $\mu\text{g.m}^{-3}$ )	PC ( $\mu\text{g.m}^{-3}$ )	PEC ( $\mu\text{g.m}^{-3}$ )	PC/CL (%)	PEC/CL (%)
Thames Estuary and Marshes SPA	30	21.69	2.1	23.8	7	79
North Downs Woodlands SAC		18.26	0.1	18.4	0	61
Basildon Meadows SSSI		22.13	0.4	22.5	1	75
Canvey Wick SSSI		23.43	0.4	23.9	1	80
Chattenden Woods and Lodge Hill SSSI		19.04	0.3	19.3	1	64
Cobham Woods SSSI		19.71	0.2	19.9	1	66
Darenth Wood SSSI		31.61	0.3	31.9	1	106
Grays Thurrock Chalk Pit SSSI		31.25	0.3	31.6	1	105
Great Crabbles Wood SSSI		23.97	0.2	24.2	1	81
Halling to Trottiscliffe Escarpment SSSI		16.31	0.2	16.5	1	55
Hangmans Wood and Deneholes SSSI		28.82	0.5	29.3	2	98
Holehaven Creek SSSI		29.66	0.5	30.1	2	100
Mucking Flats and Marshes SSSI		26.73	2.4	29.2	8	97
Northward Hill SSSI		17.43	0.3	17.7	1	59
Pitsea Marsh SSSI		20.32	0.4	20.7	1	69
Shorne and Ashenbank Woods SSSI		24.57	0.2	24.8	1	83
South Thames Estuary and Marshes SSSI		21.03	1.2	22.3	4	74
Thorndon Park SSSI		20.15	0.2	20.4	1	68
Tower Hill to Cockham Wood SSSI		24.82	0.2	25.0	1	83
Vange and Fobbing Marshes SSSI		20.08	0.6	20.7	2	69
West Thurrock Lagoon and Marshes SSSI	35.43	0.5	35.9	2	120	
Langdon Ridge SSSI	20.17	0.4	20.6	2	120	
Broom Hill LWS	-	9.7	-	32	-	

Designated Site	CL ( $\mu\text{g.m}^{-3}$ )	AC ( $\mu\text{g.m}^{-3}$ )	PC ( $\mu\text{g.m}^{-3}$ )	PEC ( $\mu\text{g.m}^{-3}$ )	PC/CL (%)	PEC/CL (%)
West Tilbury Hall LWS	-	-	2.9	-	10	-
Low Street Pit LWS		-	8.7	-	29	-
Lyttag Brownfield LWS		-	10.8	-	36	-
Tilbury Centre LWS		-	4.7	-	16	-
Tilbury Marshes LWS		-	3.8	-	13	-
Goshems Farm LWS		-	5.2	-	17	-

Notes:  
Consistent with the Institute of Air Quality Management's *A guide to the assessment of air quality impacts on designated nature conservation sites* (IAQM, 2019), the PC as a % of the CL has been rounded to the nearest integer.  
As per the DEFRA and EA (2016) guidelines, the PEC does not need to be calculated for local nature sites.

**Table 1.2: Predicted Annual-Mean NH<sub>3</sub> Concentrations at Designated Sites – Stack Emissions**

Designated Site	CL ( $\mu\text{g.m}^{-3}$ )	AC ( $\mu\text{g.m}^{-3}$ )	PC ( $\mu\text{g.m}^{-3}$ )	PEC ( $\mu\text{g.m}^{-3}$ )	PC/CL (%)	PEC/CL (%)
Thames Estuary and Marshes SPA	3	1	0.1	1.1	3	36
North Downs Woodlands SAC		1.28	<0.05	1.3	0	43
Basildon Meadows SSSI		3.49	<0.05	3.5	0	117
Canvey Wick SSSI		1.16	<0.05	1.2	1	39
Chattenden Woods and Lodge Hill SSSI		1.24	<0.05	1.3	0	42
Cobham Woods SSSI		1.28	<0.05	1.3	0	43
Darenth Wood SSSI		1.68	<0.05	1.7	0	56
Grays Thurrock Chalk Pit SSSI		1.55	<0.05	1.6	0	52
Great Crabbles Wood SSSI		1.42	<0.05	1.4	0	48
Halling to Trottiscliffe Escarpment SSSI		1.2	<0.05	1.2	0	40
Hangmans Wood and Deneholes SSSI		1.55	<0.05	1.6	1	52
Holehaven Creek SSSI		1.47	<0.05	1.5	1	50
Mucking Flats and Marshes SSSI		1.45	0.1	1.5	3	52



Designated Site	CL ( $\mu\text{g.m}^{-3}$ )	AC ( $\mu\text{g.m}^{-3}$ )	PC ( $\mu\text{g.m}^{-3}$ )	PEC ( $\mu\text{g.m}^{-3}$ )	PC/CL (%)	PEC/CL (%)
Northward Hill SSSI		0.96	<0.05	1.0	0	32
Pitsea Marsh SSSI		4.49	<0.05	4.5	1	150
Shorne and Ashenbank Woods SSSI		1.25	<0.05	1.3	0	42
South Thames Estuary and Marshes SSSI		1	<0.05	1.0	2	35
Thorndon Park SSSI		1.77	<0.05	1.8	0	59
Tower Hill to Cockham Wood SSSI		1.19	<0.05	1.2	0	40
Vange and Fobbing Marshes SSSI		1.99	<0.05	2.0	1	67
West Thurrock Lagoon and Marshes SSSI		1.31	<0.05	1.3	1	44
Langdon Ridge SSSI		1.75	<0.05	1.8	1	59
Broom Hill LWS		-	0.4	-	13	-
West Tilbury Hall LWS		-	0.1	-	4	-
Low Street Pit LWS		-	0.3	-	12	-
Lyttag Brownfield LWS		-	0.4	-	14	-
Tilbury Centre LWS		-	0.2	-	6	-
Tilbury Marshes LWS		-	0.2	-	5	-
Goshems Farm LWS		-	0.9	-	29	-

Notes:  
Consistent with the Institute of Air Quality Management's *A guide to the assessment of air quality impacts on designated nature conservation sites* (IAQM, 2019), the PC as a % of the CL has been rounded to the nearest integer.  
As per the DEFRA and EA (2016) guidelines, the PEC does not need to be calculated for local nature sites.

**Table 1.3: Predicted Nutrient Nitrogen Deposition at Designated Sites– Stack Emissions**

Designated Site	Interest Feature	CL ( $\text{kgN.ha}^{-1}\text{.yr}^{-1}$ )	AC ( $\text{kgN.ha}^{-1}\text{.yr}^{-1}$ )	PC ( $\text{kgN.ha}^{-1}\text{.yr}^{-1}$ )	PEC ( $\text{kgN.ha}^{-1}\text{.yr}^{-1}$ )	PC/CL (%)	PEC/CL (%)
Thames Estuary and Marshes SPA	Charadrius hiaticula (Europe/Northern Africa - wintering) - Ringed plover (A137)	8	12.2	0.7	12.9	8	161

Designated Site	Interest Feature	CL ( $\text{kgN.ha}^{-1}\text{.yr}^{-1}$ )	AC ( $\text{kgN.ha}^{-1}\text{.yr}^{-1}$ )	PC ( $\text{kgN.ha}^{-1}\text{.yr}^{-1}$ )	PEC ( $\text{kgN.ha}^{-1}\text{.yr}^{-1}$ )	PC/CL (%)	PEC/CL (%)
	Circus cyaneus - Hen harrier (A082)	20	12.2	0.7	12.9	3	64
	Recurvirostra avosetta (Western Europe/Western Mediterranean - breeding) - Pied avocet (A132)	20	12.2	0.7	12.9	3	64
	Pluvialis squatarola (Eastern Atlantic - wintering) - Grey plover (A141)	20	12.2	0.7	12.9	3	64
	Calidris canutus (North-eastern Canada/Greenland/Iceland/North-western Europe) - Red knot (A143)	20	12.2	0.7	12.9	3	64
	Calidris alpina alpina (Northern Siberia/Europe/Western Africa) - Dunlin (A149)	20	12.2	0.7	12.9	3	64
	Limosa limosa islandica (Iceland - breeding) - Black-tailed godwit (A156)	20	12.2	0.7	12.9	3	64
	Tringa totanus (Eastern Atlantic - wintering) - Common redshank (A162)	20	12.2	0.7	12.9	3	64
	Taxus baccata woods of the British Isles (H91J0)	5	26.4	0.1	26.5	1	529
	Asperulo-Fagetum beech forests (H9130)	10	26.4	0.1	26.5	1	265
	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) (H6210)	15	15.4	0.1	15.5	0	103



Designated Site	Interest Feature	CL (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	AC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PEC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CL (%)	PEC/ CL (%)
Basildon Meadows SSSI	Neutral grassland (Cynosurus cristatus - Centaurea nigra grassland)	20	23.31	0.1	23.4	1	117
Canvey Wick SSSI	Bombus sylvarum - Shril Carder Bee	10	10.2	0.1	10.3	1	103
	Invertebrate assemblage - Invertebrate Assemblage	10	10.2	0.1	10.3	1	103
Chattenden Woods and Lodge Hill SSSI	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	15	24.4	0.1	24.5	1	164
	Neutral grassland (Cynosurus cristatus - Centaurea nigra grassland)	20	14.2	0.1	14.3	0	71
Cobham Woods SSSI	Broad-leaved, mixed and yew woodland (Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland)	15	26.4	0.1	26.5	1	177
	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	15	26.4	0.1	26.5	1	177
Darenth Wood SSSI	Broad-leaved, mixed and yew woodland (Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland)	15	28	0.1	28.1	1	188

Designated Site	Interest Feature	CL (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	AC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PEC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CL (%)	PEC/ CL (%)
Great Crabbles Wood SSSI	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	15	28	0.1	28.1	1	188
	Broad-leaved, mixed and yew woodland (Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland)	15	26.2	0.1	26.3	1	175
Halling to Trottscliffe Escarpment SSSI	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	15	26.2	0.1	26.3	1	175
	Broad-leaved, mixed and yew woodland (Taxus baccata woodland)	5	25.7	0.1	25.8	2	516
Halling to Trottscliffe Escarpment SSSI	Broad-leaved, mixed and yew woodland (Fagus sylvatica - Mercurialis perennis woodland)	10	25.7	0.1	25.8	1	258
	Broad-leaved, mixed and yew woodland (Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland)	15	25.7	0.1	25.8	1	172
	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	15	25.7	0.1	25.8	1	172
	Calcareous grassland (Bromus erectus lowland calcareous grassland)	15	15.3	0.1	15.4	0	102

Designated Site	Interest Feature	CL (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	AC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PEC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CL (%)	PEC/ CL (%)
	Calcareous grassland (Festuca ovina - Avenula pratensis lowland calcareous grassland)	15	15.3	0.1	15.4	0	102
Mucking Flats and Marshes SSSI	Calidris alpina alpina - Dunlin	20	14.7	0.8	15.5	4	77
	Charadrius hiaticula - Ringed Plover	20	14.7	0.8	15.5	4	77
	Limosa limosa islandica - Black-Tailed Godwit	20	14.7	0.8	15.5	4	77
	Pluvialis squatarola - Grey Plover	20	14.7	0.8	15.5	4	77
	Tadorna tadorna - Shelduck	20	14.7	0.8	15.5	4	77
	Tringa totanus - Redshank	20	14.7	0.8	15.5	4	77
Pitsea Marsh SSSI	Fen, marsh and swamp (Phragmites australis swamp and reed-beds)	15	29.7	0.1	29.8	1	199
Shorne and Ashenbank Woods SSSI	Broad-leaved, mixed and yew woodland (Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland)	15	25.2	0.1	25.3	1	169
	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	15	25.2	0.1	25.3	1	169
South Thames Estuary and Marshes SSSI	Littoral sediment (Annual Salicornia Saltmarsh)	20	12.3	0.4	12.7	2	63
	Littoral sediment (Atriplex portulacoides saltmarsh)	20	12.3	0.4	12.7	2	63
	Littoral sediment (Inula crithmoides stands)	20	12.3	0.4	12.7	2	63

Designated Site	Interest Feature	CL (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	AC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PEC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CL (%)	PEC/ CL (%)
	Littoral sediment (Puccinellia maritima saltmarsh, Puccinellia maritima dominant sub-community)	20	12.3	0.4	12.7	2	63
	Littoral sediment (Rayed Aster tripolium on saltmarsh)	20	12.3	0.4	12.7	2	63
	Littoral sediment (Sarcocornia perennis)	20	12.3	0.4	12.7	2	63
	Littoral sediment (Spartina Anglica Saltmarsh)	20	12.3	0.4	12.7	2	63
	Littoral sediment (Suaeda Maritima Saltmarsh)	20	12.3	0.4	12.7	2	63
	Littoral sediment (Transitional low marsh vegetation with Puccinellia maritima, annual Salicornia species and Suaeda maritima.)	20	12.3	0.4	12.7	2	63
	Circus cyaneus - Hen Harrier	15	12.3	0.4	12.7	3	85
	Anas acuta - Pintail	20	12.3	0.4	12.7	2	63
	Anas crecca - Teal	20	12.3	0.4	12.7	2	63
	Anas querquedula - Garganey	20	12.3	0.4	12.7	2	63
	Anser albifrons albifrons - White-Fronted Goose	20	12.3	0.4	12.7	2	63
	Calidris alpina alpina - Dunlin	20	12.3	0.4	12.7	2	63
	Calidris canutus - Knot	20	12.3	0.4	12.7	2	63
	Charadrius hiaticula - Ringed Plover	20	12.3	0.4	12.7	2	63
	Limosa limosa islandica - Black-Tailed Godwit	20	12.3	0.4	12.7	2	63

Designated Site	Interest Feature	CL (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	AC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PEC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CL (%)	PEC/ CL (%)
	Numenius arquata - Curlew	20	12.3	0.4	12.7	2	63
	Pluvialis squatarola - Grey Plover	20	12.3	0.4	12.7	2	63
	Recurvirostra avosetta - Avocet	20	12.3	0.4	12.7	2	63
	Tadorna tadorna - Shelduck	20	12.3	0.4	12.7	2	63
	Tringa nebularia - Greenshank	20	12.3	0.4	12.7	2	63
	Tringa totanus - Redshank	20	12.3	0.4	12.7	2	63
Thorndon Park SSSI	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	15	28.9	0.1	29.0	1	193
Tower Hill to Cockham Wood SSSI	Broad-leaved, mixed and yew woodland (Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland)	15	24	0.1	24.1	1	161
West Thurrock Lagoon and Marshes SSSI	Calidris alpina alpina - Dunlin	20	14	0.1	14.1	1	71
	Tringa totanus - Redshank	20	14	0.1	14.1	1	71
Langdon Ridge SSSI	Broad-leaved, mixed and yew woodland (Crataegus monogyna - Hedra helix scrub)	10	28.3	0.2	28.5	2	285
	Broad-leaved, mixed and yew woodland (Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland)	15	28.3	0.2	28.5	1	190

Designated Site	Interest Feature	CL (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	AC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PEC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CL (%)	PEC/ CL (%)
	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	15	28.3	0.2	28.5	1	190
	Fen, marsh and swamp (Juncus subnodulosus - Cirsium palustre fen meadow)	15	15.9	0.1	16.0	1	107
	Neutral grassland (Cynosurus cristatus - Centaurea nigra grassland)	20	15.9	0.1	16.0	1	80
Broom Hill LWS	Acid grassland	10	-	3.0	-	30	-
West Tilbury Hall LWS	Acid grassland	10	-	0.9	-	9	-
Low Street Pit LWS	Acid grassland	10	-	2.7	-	27	-
Lyttag Brownfield LWS	Acid grassland	10	-	3.3	-	33	-
Tilbury Centre LWS	Acid grassland	10	-	1.4	-	14	-
Tilbury Marshes LWS	Coastal & floodplain grazing marsh	20	-	1.2	-	6	-
	Coastal saltmarsh	20	-	1.2	-	6	-
Goshems Farm LWS	Coastal & floodplain grazing marsh	20	-	5.1	-	25	-

Notes: Results are not shown for sites/interest features which are not sensitive to nutrient nitrogen deposition, or for which no data are provided on APIS.

Critical loads (CLs) for nutrient nitrogen deposition are provided as a range. In this case, the lower limit of the CL range has been used in the assessment.

Consistent with the Institute of Air Quality Management's *A guide to the assessment of air quality impacts on designated nature conservation sites* (IAQM, 2019), the PC as a % of the CL has been rounded to the nearest integer.

As per the DEFRA and EA (2016) guidelines, the PEC does not need to be calculated for local nature sites.



Table 1.4: Predicted Acid Deposition at Designated Sites – Stack Emissions

Designated Site	Interest Feature	CLF CLmin N (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	CLF CLmax N (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	AC (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	PEC (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CL F (%)	PEC/ CLF (%)
Thames Estuary and Marshes SPA	Charadrius hiaticula (Europe/Northern Africa - wintering) - Ringed plover (A137)	0.223	0.743	0.9	0.05	0.9	6	127
North Downs Woodlands SAC	Taxus baccata woods of the British Isles (H91J0)	0.142	1.983	1.9	0.01	1.9	0	96
	Asperulo-Fagetum beech forests (H9130)	0.142	1.983	1.9	0.01	1.9	0	96
	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) (H6210)	0.856	4.856	1.1	0.01	1.1	0	23
Basildon Meadows SSSI	Neutral grassland (Cynosurus cristatus - Centaurea nigra grassland)	0.438	2.48	1.67	0.01	1.7	0	68
Chattenden Woods and Lodge Hill SSSI	Neutral grassland (Cynosurus cristatus - Centaurea nigra grassland)	0.223	0.733	1	0.01	1.0	1	137
South Thames Estuary and Marshes SSSI	Anas querquedula - Garganey	0.856	0.733	0.9	0.03	0.9	4	127
	Numenius arquata - Curlew	0.856	0.733	0.9	0.03	0.9	4	127
Thorndon Park SSSI	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	0.142	2.645	2.1	0.01	2.1	0	80

Designated Site	Interest Feature	CLF CLmin N (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	CLF CLmax N (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	AC (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	PEC (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CL F (%)	PEC/ CLF (%)
Langdon Ridge SSSI	Broad-leaved, mixed and yew woodland (Crataegus monogyna - Hedra helix scrub)	0.357	2.889	2	0.01	2.0	0	70
	Broad-leaved, mixed and yew woodland (Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland)	0.357	2.889	2	0.01	2.0	0	70
	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	0.357	2.889	2	0.01	2.0	0	70
	Fen, marsh and swamp (Juncus subnodulosus - Cirsium palustre fen meadow)	0.438	2.048	1.1	0.01	1.1	0	54
	Neutral grassland (Cynosurus cristatus - Centaurea nigra grassland)	0.438	2.048	1.1	0.01	1.1	0	54
	Broom Hill LWS	Acid grassland	0.438	4.578	-	0.21	-	49
West Tilbury Hall LWS	Acid grassland	0.48	4.578	-	0.06	-	13	-
Low Street Pit LWS	Acid grassland	0.223	1.113	-	0.19	-	86	-
Lyttag Brownfield LWS	Acid grassland	0.48	4.578	-	0.24	-	50	-
Tilbury Centre LWS	Acid grassland	0.48	4.578	-	0.10	-	21	-

Notes: Results are not shown for sites/interest features which are not sensitive to acid deposition, or for which no data are provided on APIS.

CLF = Critical Load Function.

Consistent with the Institute of Air Quality Management's *A guide to the assessment of air quality impacts on designated nature conservation sites* (IAQM, 2019), the PC as a % of the CL has been rounded to the nearest integer.

As per the DEFRA and EA (2016) guidelines, the PEC does not need to be calculated for local nature sites.  
 \*As advised by the proposed development's ecologist, a CLF CLminN of 0.856 keq.ha<sup>-1</sup>.yr<sup>-1</sup> has been used on the basis that the SSSI is entirely on the south bank of the Thames and is either grazing marsh or saltmarsh sitting over London Clay.

1.4.4 The maximum NO<sub>x</sub> PC does not exceed 1% of the critical level at the following designated sites:

- North Downs Woodlands SAC
- Basildon Meadows SSSI
- Chattenden Woods and Lodge Hill SSSI
- Cobham Woods
- Darenth Wood SSSI
- Grays Thurrock Chalk Pit SSSI
- Great Crabbles Wood SSSI
- Halling to Trottiscliffe Escarpment SSSI
- Hangmans Wood and Deneholes SSSI
- Northward Hill SSSI
- Pitsea Marsh SSSI
- Shorne and Ashenbank Woods SSSI
- Thorndon Park SSSI
- Tower Hill to Cockham Wood SSSI

1.4.5 The NO<sub>x</sub> effects can therefore be screened out as insignificant at these sites.

1.4.6 The maximum NO<sub>x</sub> PCs are below 100% of the critical level at all local wildlife sites and the NO<sub>x</sub> effects can therefore be screened out as insignificant at these sites.

1.4.7 The maximum NO<sub>x</sub> PC exceeds 1% of the critical level at the following sites:

- Thames Estuary and Marshes SPA
- Holehaven Creek SSSI
- Mucking Flats and Marshes SSSI
- South Thames Estuary and Marshes SSSI
- Vange and Fobbing Marshes SSSI
- West Thurrock Lagoon and Marshes SSSI

1.4.8 The PECs are below the critical level at all sites, except Holehaven Creek SSSI and West Thurrock Lagoon and Marshes, and the effects can be screened out as insignificant. At Holehaven Creek SSSI and West Thurrock Lagoon and Marshes, the NO<sub>x</sub> effects cannot be screened out as insignificant based on the results of detailed modelling.

1.4.9 Holehaven Creek SSSI comprises the intertidal mudflats and saltmarsh habitats separating mainland Essex from Canvey Island while West Thurrock Lagoon and Marshes SSSI comprises an area of intertidal mudflats and lagoon with extensive salt marsh. In these locations the maximum PCs NO<sub>x</sub> are both predicted to be 2% of the critical level. The PECs are predicted to be 100% of the critical level at 30.1 µg.m<sup>-3</sup> at Holehaven Creek SSSI and 120% at 35.9 µg.m<sup>-3</sup> at West Thurrock Lagoon and Marshes SSSI. The effect of NO<sub>x</sub> on flora at these concentrations is confined to those driven by changes in N availability and corresponding changes to growth rate, rather than any direct toxic effects (WHO, 2000); direct toxicity has only been reported at concentrations >100 µg.m<sup>-3</sup>.

1.4.10 Given that the nitrogen regime of the intertidal habitats within the SSSIs will be driven primarily by the influence of the marine environment in which they occur and, as such, are not considered sensitive to atmospheric nitrogen input to any great extent (as demonstrated by a high critical load of 20-30 kgN.ha<sup>-1</sup>.yr<sup>-1</sup>), it is considered highly unlikely that the exceedance of the critical level in these locations would have a significant effect on the SSSI.

1.4.11 For ammonia, the PCs do not exceed 1% of the CL or the PEC is less than the CL for all sites and the NH<sub>3</sub> effects can be screened out as insignificant.

1.4.12 At all European and nationally designated sites, with the exception of Thames Estuary and Marshes SPA, the Halling to Trottiscliffe escarpment SSSI and Langdon Ridge SSSI, the maximum nutrient nitrogen deposition PC does not exceed 1% of the critical load or the PECs are below the critical load and the effects can therefore be screened out as insignificant. For Thames Estuary and Marshes SPA, the Halling to Trottiscliffe escarpment SSSI and Langdon Ridge SSSI, the maximum PC is greater than 1% of the CL and the PEC exceeds the CL, and the effects are therefore considered to be potentially significant based on the results of detailed modelling.

1.4.13 The maximum nutrient nitrogen deposition PCs are below 100% of the critical level at all local wildlife sites and the effects can therefore be screened out as insignificant at these sites.

1.4.14 The maximum acid deposition PC does not exceed 1% of the critical load function at all European and nationally designated sites, with the exception of Thames Estuary and Marshes SPA and the South Thames Estuary and Marshes SSSI, and the effects can therefore be screened out as insignificant. For Thames Estuary and Marshes SPA and the South Thames Estuary and Marshes SSSI, the PCs are greater than 1% of the CLF and the PECs exceed the CLF. The effects are therefore considered to be potentially significant based on the results of detailed modelling.

- 1.4.15 The maximum acid deposition PCs are below 100% of the critical level at all local wildlife sites and the effects can therefore be screened out as insignificant at these sites.
- 1.4.16 With respect to nutrient nitrogen and acid deposition effects on the Thames Estuary and Marshes SPA, for the majority of interest features of the SPA, the PCs and/or PECs for all pollutant types were <1% of the EQS. The one exception was nutrient nitrogen deposition and acid deposition for Ringed Plover where the maximum PC >1% and the PEC exceeded the relevant CL/CLF. The CL/CLF used in Table 1.3 and Table 1.4 is taken from the Site-Relevant Critical Load tool on APIS and is for acidic coastal stable dune grassland. This habitat type does not occur within the Thames Estuary and Marshes SPA; indeed the main associations of this species within the SPA are the grazing marsh and inter-tidal mudflats, in particular at Mucking Flats near east Tilbury and further east at Allhallows-on-Sea (Frost et al., 2016). Such habitats are not susceptible to either acid or nutrient nitrogen deposition on the basis that they are both high nutrient systems (as demonstrated by a high critical load of 20-30 kgN.ha<sup>-1</sup>.yr<sup>-1</sup>) and brackish (or salt water) and therefore more alkaline.
- 1.4.17 On this basis, it is considered that the data on APIS is not directly relevant to the population of Ringed Plover using the SPA where a higher critical load/CLF would be more appropriate, given the habitat associations of this species in this geographic location. Therefore, there is no potential for a likely significant effect on Ringed Plover using the Thames Estuary and Marshes SPA as a result of emissions to air from the proposed facility.
- 1.4.18 With respect to nutrient nitrogen deposition effects on the Hailing to Trottscliffe Escarpment SSSI, the closest units of the Hailing to Trottscliffe Escarpment SSSI comprise a matrix of calcareous grassland on steep slopes with mixed woodland including that which is both yew- and beech-dominated. The critical load used in Table 1.3 (5 kgN.ha<sup>-1</sup>.yr<sup>-1</sup>) is the lowest found on APIS for any habitat type and represents coniferous woodland on the very poorest soils with strong lichen/free-living algal communities. APIS notes that unless such lichen communities are present within the site, then 10 kgN.ha<sup>-1</sup>.yr<sup>-1</sup> is a more appropriate critical load for coniferous woodland in the UK (APIS, n.d). Using this value, the PC becomes <1% of the critical load and, as such, insignificant”.

- 1.4.19 With respect to nutrient nitrogen deposition effects on the Langdon Ridge SSSI, the only habitat for which the modelling has identified a potential effect is for the hawthorn/ivy scrubland. The modelling assumes this habitat occurs at the closest location within the SSSI (i.e. the location where the PC is the highest). However, within the SSSI, this habitat type occurs at the Dunton Plotlands (NE, 2018) which is some 11.6 km from the Proposed Development, i.e. 1.6 km north of the closest location within the SSSI where the maximum PC has been modelled. Therefore, although not explicitly modelled, it is highly unlikely that the nutrient nitrogen deposition in this location would exceed 1% of the critical load.
- 1.4.20 With respect to acid deposition effects on the South Thames Estuary & Marshes SSSI, the two interest features for which an exceedance of the CLF for acidity has been predicted (Garganey and Avocet) is based on the data from APIS for acid grassland, which has low buffering capacity and hence more sensitive CLF. However, the soils of north Kent where the SSSI is located are more calcareous in nature, due to both the high-nutrient alluvial deposits present across the grazing marsh and the underlying chalk substrate. On this basis, therefore, it is unlikely that such habitats would be sensitive to acid deposition, being very well buffered against increasing hydrogen ions. As such, no impact on the two interest features is predicted.

#### Traffic-related Emissions

- 1.4.21 This section shows the results of the assessment of construction traffic-related emissions on designated sites within 200 m of the construction traffic route. Volume 6 Appendix 12.6 Assessment of Traffic-related Emissions provides more detail on the assessment of traffic generated by the construction phase of Thurrock FGP and the results on designated sites has been repeated below. The maximum predicted annual-mean NO<sub>x</sub> concentrations are compared with the critical level in Table 1.5. The maximum predicted nutrient nitrogen deposition rates are compared with the critical load in Table 1.6. The maximum predicted acid deposition rates are compared with the critical load function in Table 1.7.

**Table 1.5: Predicted Annual-mean NO<sub>x</sub> Concentrations at Designated Sites – Traffic-related Emissions**

Designated Site	CL (µg.m <sup>-3</sup> )	PC (µg.m <sup>-3</sup> )	PC/CL (%)
West Tilbury Hall LWS	30	0.010	0
Low Street Pit LWS	30	0.053	0
Lyttag Brownfield LWS	30	0.024	0
Tilbury Marshes LWS	30	0.210	0



**Table 1.6: Predicted Nutrient Nitrogen Deposition at Designated Sites – Traffic-related Emissions**

Designated Site	Interest Feature	CL (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (kgN.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CL (%)
West Tilbury Hall LWS	Acid grassland	10	0.001	0
Low Street Pit LWS	Acid grassland	10	0.004	0
Lyttag Brownfield LWS	Acid grassland	10	0.001	0
Tilbury Marshes LWS	Coastal & floodplain grazing marsh	20	0.014	0
	Coastal saltmarsh	20	0.014	0

**Table 1.7: Predicted Acid Deposition at Designated Sites – Traffic-related Emissions**

Designated Site	Interest Feature	CL (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC (keq.ha <sup>-1</sup> .yr <sup>-1</sup> )	PC/CLF (%)
West Tilbury Hall LWS	Acid grassland	0.48	0.0001	0
Low Street Pit LWS	Acid grassland	0.223	0.0003	0
Lyttag Brownfield LWS	Acid grassland	0.48	0.0001	0

1.4.22 The maximum PCs from traffic-related emissions are below 100% of the critical level at all local wildlife sites and the effects can therefore be screened out as insignificant at these sites.

## 1.5 Conclusion

1.5.1 Based on the results of detailed modelling and advice from the proposed development's ecologist, no significant air quality effects on designated habitat sites are expected to arise due to the proposed development.

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