AECOM

Parley ERF

Assessment of Air Quality Impact on Dorset Heaths

Veolia

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Quality information

Prepared by	Checked by	Approved by
Danny Duce Principal Air Quality Consultant James Riley Associate – Ecologist	Max Wade Technical Director – Ecology	Max Wade Technical Director – Ecology

Revision History

Revision	Revision date	Details	Authorized	Name	Position
01		1st issue			
02	20/10/17	Amended to include ecological interpretation document			
03	10/11/17	2nd issue			

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Prepared for:

Veolia

Prepared by:

AECOM
Royal Court
Basil Close
Derbyshire
Chesterfield
S41 7SL
UK

T: +44 (1246) 209221
aecom.com

Table of Contents

1. Introduction

1.1 Overview

AECOM has been instructed by Veolia to undertake a screening level air quality assessment for a possible ERF facility at a site near to Bournemouth Airport, Dorset. The project is at an early stage and a detailed design has not yet been put forward.

Emissions to air from the facility have the potential to adversely affect sensitive ecosystems. The site is near to designated ecological habitats which could be sensitive to increases in ambient pollutant concentrations or deposition to ground. The impact of emissions on sensitive ecological receptors is considered in the context of relevant critical loads or critical levels for designated nature sites.

In addition to the ERF, there is a Small Biomass Burner (SBB) which is already operational on the site.

1.2 Scope

This report summarises the findings of an assessment of an outline configuration derived from the outputs of the screening study, and the safeguarding requirements of the adjacent airport. The ERF has been modelled so that the building is aligned from roughly north-west to south-east in order to present the minimum cross sectional area to the airport's radar. The stacks have been placed at the north-western end of the building envelope as preliminary modelling determined that building downwash effects were diminished when the facility was set out in this way.

The dispersion of emissions is predicted using the dispersion model ADMS 5. The results are presented in both tabular format and as contours of predicted ground level process contributions overlaid on mapping of the surrounding area.

The primary emissions scenario presented within this report considers the effects of the simultaneous operation of the SBB and the ERF.

In addition to the pollutants specified within in the Industrial Emissions Directive (IED), emissions of ammonia (NH_3) from the facility have been included in the assessment, due to potential effects on sensitive ecosystems, directly through increased atmospheric concentrations, and indirectly as a component of acid and nutrient nitrogen deposition.

2. Methodology

2.1 Dispersion Model Selection

The assessment of emissions from the proposed ERF has been undertaken using the latest version of ADMS (V5.2.1.0), supplied by Cambridge Environmental Research Consultants Limited (CERC)[1]. ADMS is a modern dispersion model that has an extensive published validation history for use in the UK. This model has been extensively used throughout the UK to demonstrate regulatory compliance.

2.2 Model Inputs

The general model conditions used in the assessment are summarized in Table 1. Other more detailed data used to model the dispersion of emissions is considered below.

Table 1. General ADMS 5 Model Conditions

Variable	Source
Surface Roughness at source	0.3 m
Receptors	Selected discrete receptors
	Nested receptor grid, variable spacing
Receptor location	x,y co-ordinates determined by GIS, z = 0
Source location	x,y co-ordinates determined by GIS
Emissions	IED emissions limits and data provided by Veolia
Sources	2 x ERF process stacks (modelled as a combined source) 1 x SBB stack
Meteorological data	5 years of hourly sequential data, Bournemouth Airport Meteorological Station (2012-2016)
Terrain data	Flat Terrain
Buildings that may cause building downwash effects	ERF Facility building

2.3 Emissions Data

The physical properties of the combustion emission sources as represented within the model are presented in Table 2.

Table 2. Physical Properties, Modelled Emission Sources

Parameter	Unit	ERF Stacks (Combined)	SBB Stack
Stack position	(NGR) m	410121, 98818	410236, 98911
Stack release height	m	42.2	15.0
Effective internal stack diameter	m	1.98	0.7
Flue temperature	°C	140	179.5
Stack gas exit velocity	m/s	18.0	13.1
Stack flow (actual)	m^3/s	55.42	5.04
Stack flow at reference conditions (STP, dry)	Nm^3/s	36.64	2.81

1 CERC (2016) ADMS Validation Papers, Cambridge Environmental Research Consultants, from: http://www.cerc.co.uk/environmental-software/model-validation.html

The modelled pollutant emission rates (in g/s) are determined by the daily average Emission Limit Values (ELVs) set out within Annex V of the IED. The emissions limits are shown in Table 3.

Pollutant mass emission rates from the waste combustion process (in g/s) have been calculated by multiplying the IED daily average ELVs by the volumetric flow rate at reference conditions. The pollutant mass emission rates from the main stack, as used within the dispersion modelling assessment, are presented in Table 4.

Emissions of NH_3 from the ERF stacks are not included in the IED. Conservative emission rates for these pollutants have been assumed for this assessment, determined through discussion with Veolia on likely maximum achievable levels for the ERF. NH_3 emission concentrations for the SBB have been set at 1 mg/m^3, as set out in information provided by Veolia.

This assessment assumes that the ERF process would operate at continuous design load (8,760 hours per year). No time-based variation in ERF emissions has therefore been accounted for within the model. For the assessment of short term impacts, emissions have been modelled at the maximum emission rate, reflecting the assumption that it is not possible to predict when the operational hours may be.

Table 3. Air Emission Limit Values (ELVs) as Specified in the Industrial Emissions Directive (IED, 2010/75/EU)

Pollutant	Emission Limit (mg/m^3)	
	Half Hour Average[a]	Daily Average[b]
NO_X (as NO_2)	400	200
SO_2	200	50
HCl	60	10
HF	4	1

Table 4. Pollutant Emission Rates

Pollutant	Emission Limit (mg/m^3)	Emission Rate (g/s)	
		ERF (combined stacks)	SBB
NO_X (as NO_2)	200	7.328	0.563
SO_2	50	1.832	0.141
HCl	10	0.366	0.028
HF	1	0.037	0.0028
NH_3	5 (ERF) 1 (SBB)	0.183	0.014

2.4 Modelled Domain – Discrete Receptors

Ground level concentrations of the pollutants relevant to sensitive ecological receptors have also been modelled at a number of discrete receptor points as shown on Figure 1 (Receptors E1 to E29). These locations represent the boundary of the surrounding Dorset Heaths SAC.

2.5 Modelled Domain – Receptor Grid

Emissions from the main stack have also been modelled on a receptor grid of regular spacing, in order to determine the location and magnitude of maximum ground level impacts and to enable the generation of pollutant isopleth plots. Details of the receptor grid are summarised in Table 5. The dimensions of the receptor grid were chosen in order to allow detail to be retained in the area around the proposed ERF containing the nearest ecological receptors. A future assessment of impacts for planning and environmental permitting consents would be required to use a nested grid encompassing a wider area of 10 km in distance from the site.

Table 5. Modelled Domain - Receptor Grid

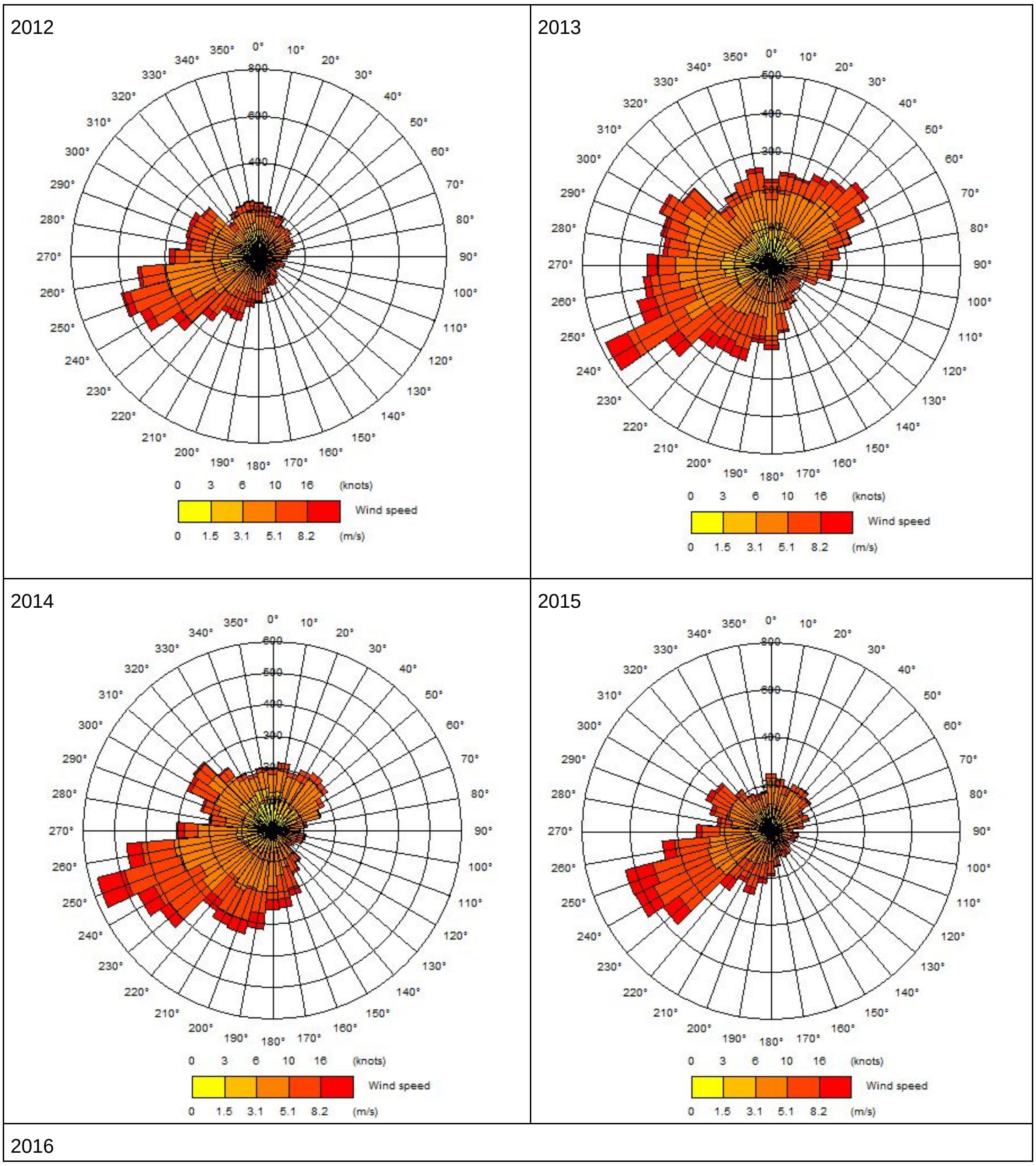
Grid Spacing (m)	Dimensions (m)	Number of Nodes in Each Direction	National Grid Reference of SW Corner
20	2,000 x 2,000	101	409300, 97750

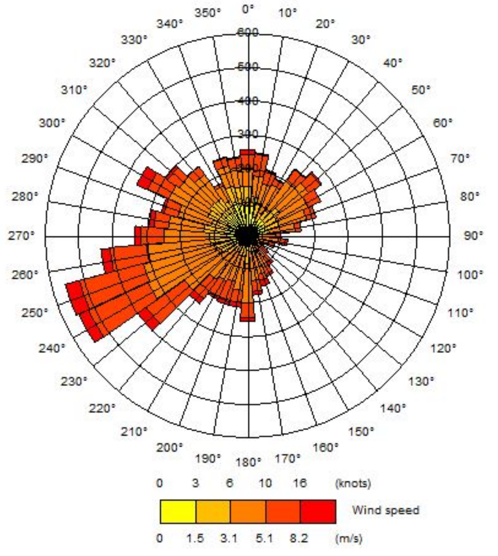
2.6 Meteorological Data

Hourly sequential data from Bournemouth Airport for the years 2012 to 2016 inclusive has been used in this study. The station is situated to the immediate south east of the ERF site.

A visual representation of the meteorological data used in the assessment is shown in the wind roses presented in Drawing 1.

Drawing 1: Wind Roses for Bournemouth Airport (2012-2016)





2.7 Building Downwash Effects

The buildings that make up the ERF would have the potential to affect the dispersion of emissions from the main stack. The ADMS buildings effect module has therefore been used to incorporate building downwash effects as part of the modelling procedure. Buildings greater than one third of the range of stack heights modelled have been included within the modelling assessment.

The building dimensions, as represented within the model, are presented in Table 6. As buildings within ADMS must be defined as rectangular or circular structures, the shape of the structures have been simplified. The dimensions used in the modelling were approximate as the detailed design process had not commenced at the time of writing.

Table 6. Building Parameters

Building	National Grid Reference of Centre Point	Height (m)	Length (m)	Width (m)	Angle (°)
Main Section	410168, 98789	34	110	55	122.5
Admin	410183, 98735	18	40	20	122.5
ACC	410229, 98808	20	40	26	122.5
Tipping Hall	410234, 98748	20	45	55	122.5

2.8 Terrain

The site is situated in an area where the land is a gently undulating character with no pronounced changes in height. The modelling has therefore been undertaken using flat or simple terrain. The surrounding heathland rises at distance to become higher than the ERF location, so a future assessment of air quality effects over a wider area could include a consideration of terrain effects to account for this feature.

2.9 Surface Roughness

A surface roughness of 0.3 m was used within ADMS to represent local conditions. This option is considered as representative of the landscape between the stack and the closest sensitive receptors.

A surface roughness value of 0.2 was used within ADMS to represent conditions at the meteorological station.

2.10 Calculation of Deposition at Sensitive Ecological Receptors

The deposition of nutrient nitrogen and acid at sensitive ecological receptors is calculated, using the modelled process contribution predicted at the receptor points. The deposition rates are determined using conversion rates and factors contained within Environment Agency guidance[2], which account for variations in deposition mechanisms in different types of habitat.

The conversion rates and factors used in the assessment are detailed in Table 7 and Table 8.

Table 7. Conversion Factors - Calculation of Nitrogen Deposition

Pollutant	Deposition Velocity Grasslands (m/s)	Deposition Velocity Forests (m/s)	Conversion Factor ($\mu g/m^2/s$ to kg/ha/yr)
NO_X as NO_2	0.0015	0.003	96
NH_3	0.02	0.03	259.7

Table 8. Conversion Factors - Calculation of Acid Deposition

Pollutant	Deposition Velocity Grasslands (m/s)	Deposition Velocity Forests (m/s)	Conversion Factor ($\mu g/m^2/s$ to kg/ha/yr)	Conversion Factor (kg/ha/yr to keq/ha/yr)
SO_2	0.012	0.024	157.7	0.0625
NO_2	0.0015	0.003	96	0.0714
NH_3	0.02	0.03	259.7	0.0714
HCl	0.025	0.06	306.7	0.0282
HF	0.025	0.06	306.7	0.0282

As HCl is readily soluble in water, wet deposition processes can also significantly contribute to total acid deposition. The assumption has been made in this assessment that the wet deposition will be equal to dry deposition, in effect doubling the predicted process contribution from HCl at the sensitive receptor.

2.11 Specialised Model Treatments

Emissions have been modelled such that they are not subject to dry and wet deposition or depleted through chemical reactions. The assumption of continuity of mass is likely to result in an over-estimation of impacts at receptors.

2 Environment Agency (2011), AQTA AG06 Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air

3. Ecological Interpretation

The results of the dispersion modelling of predicted impacts on sensitive ecological receptors are presented in Appendix B. The tables set out the predicted PC to atmospheric concentrations of NO_X, SO_2, NH_3, acid deposition and nutrient nitrogen deposition. The background values used in the assessment have been obtained from the APIS website, and it is assumed that such values capture the contribution to existing deposition rates made by the operational composting facility.

An analysis is presented below of the potential ERF and the air quality impact on the Dorset Heaths Special Area of Conservation (SAC) (and by extension the Dorset Heathlands Special Protection Area and the two most relevant constituent SSSIs: Hurn Common SSSI and Parley Common SSSI). These designated sites entirely surround the potential facility and are in some places immediately adjacent to the site. It is a requirement of the Conservation of Habitats and Species Regulations 2010 that projects are considered cumulatively ('in combination') rather than in isolation. Therefore, the modelling scenario which is the focus of this memo is for an ERF, plus cumulative impacts from an operational Small Biomass Burner (SBB) on the same piece of land. Each relevant pollutant is discussed in turn.

3.1 Oxides of Nitrogen

3.1.1 Long-term (annual mean) NOx

The combined contributions of the two facilities to elevating long-term NOx is forecast to exceed 10% of the critical level, a large magnitude change, at 5 different modelled points (Table 9: receptors E2, E20, E21, E23 and E27). However, even with such an increase the total NOx concentrations (PEC) are forecast to remain well below the critical level of 30 μgm^{-3}.

3.1.2 Short-term (24hr mean) NOx

The WHO (2000) guidelines include a short-term (24 hour average) NOx critical level of 75 $\mu g/m^3$. Originally set at 200 $\mu g/m^3$, the guideline was updated in 2000 to reflect the fact that, globally, short-term episodes of elevated NOx concentrations are often combined with elevated concentrations of O_3 or SO_2, which cause effects to be observed at lower NOx concentrations. However, very high concentrations of SO_2 are now rarely recorded in the UK. As such, there is reason to conclude that in the UK the short-term NOx concentration mean is not especially ecologically useful as a threshold. The Centre for Ecology & Hydrology have commented that '*UN/ECE Working Group on Effects strongly recommended the use of the annual mean value, as the long-term effects of NOx are thought to be more significant than the short-term effects*'[3]. In any case, Table 10 shows that the total short-term NOx (PEC) is only forecast to breach the critical level of 75 μgm^{-3} at receptor E2 and then only to a small extent (3%).

3.2 Sulphur dioxide

Sulphur dioxide in itself (Table 11) is not a concern for this geographic area. The critical level for sulphur dioxide is 20 μgm^{-3}. The background concentrations are less than 1 μgm^{-3}. The two schemes cumulatively are forecast to elevate sulphur dioxide concentrations but the maximum Predicted Environmental Concentration (PEC) is forecast to be 1.5 μgm^{-3} (receptor E21), with an average PEC of 0.7μgm^{-3} across all 29 modelled locations) and thus remains well below the critical level. However, see below for the implications of the elevated SO_2 on acid deposition.

3.3 Ammonia

As with NOx, ammonia contributes to nitrogen deposition. However, unlike NOx ammonia is also directly toxic to vegetation at low concentrations. The critical level for ammonia with regard to general vegetation is 3 μgm^{-3} and this was the critical level used in previous applications on this site. With both facilities operating together (Table 12) ammonia concentrations are increased: fourteen receptor locations would experience a small increase of

[3] Sutton MA, Howard CM, Erisman JW, Billen G, Bleeker A, Grennfelt P, van Grinsven H, Grizzetti B. 2013. The European Nitrogen Assessment: Sources, Effects and Policy Perspectives. Page 414. Cambridge University Press. 664pp. ISBN-10: 1107006120

June 2011. Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads & Levels and Air Pollution Effects, Risks and Trends. Chapter 3: Mapping Critical Levels for Vegetation between 1 and 5% of the critical level. However, total ammonia concentrations (PEC) would remain below the critical level at all modelled locations.

3.4 Nitrogen deposition

Nitrogen deposition from atmosphere is a function of both NOx and ammonia. The critical load for nitrogen deposition is expressed as a range, which for heathland varies from 10 kgN/ha/yr to 20 kgN/ha/yr. Although the higher numeral can be used when there is a high water table, in this case much of the heathland is dry and therefore the lower critical load should be used (10 kgN/ha/yr). Nitrogen deposition rates are already quite elevated, as they are over much of the UK (ranging in this case from 14 kgN/ha/yr to 19.88 kgN/ha/yr for the relevant 5km grid squares). While there is an expectation that nitrogen deposition rates will improve in the future, the assessment should be done for the opening year of the facility. Unlike comparison with critical levels, which are absolute, the effect of nitrogen deposition is relative and depends not only on the habitat in question but the existing background deposition rates. The amount of extra nitrogen needed to cause a measurable ecological effect is greater in heathland already subject to high background deposition rates than it is in those with low deposition rates[4].

Table 13 presents the calculated deposition rates with all both schemes in operation. The average forecast increase in deposition rate (PC) across all 29 modelled receptors as a result of the two schemes operating together is 0.42 kg/N/ha/yr (4% of the minimum part of the critical load range). This reflects the relatively small change in deposition rate at most modelled receptors coupled with a larger change at a few others (notably receptors E2 and E21 where the change in deposition rate would exceed 1 kgN/ha/yr). Most nitrogen deposition from the 2 schemes is likely to be from their NOx emissions although ammonia will also make a contribution.

Examination of research into changes in species richness in heathland due to incremental increases in nitrogen deposition at different background rates indicates that the average PC (an additional 0.42 KgN/ha/yr) is well below the amount (1.3 - 1.7 kgN/ha/yr) that would be expected to result in a reduction in species richness in lowland heathland at a background deposition rate of 15-20 kgN/ha/yr[5]. Effects on coarse habitat structure are therefore also likely to be small (and negligible at most locations). There is a single receptor (E21) where the change in deposition rate (from both the ERF and SBB combined) is forecast to reach 1.17 kgN/ha/yr but that is still below the deposition rate at which change in species richness would be expected to arise given the existing background rates. Referring to habitat structure metrics available in the literature, grass cover in lowland heathland has been shown to increase by c. 0.5% for each 1 kgN/ha/yr increase above the mid-point of the critical load range (15 kgN/ha/yr)[6]. Therefore it seems probable that a small increase in grass cover would result at the most affected receptors (E2 and E21), with no change at most receptors.

3.5 Acid deposition

Total (PEC) nitrogen deposition inputs that are below the CLminN will not acidify the system and in such cases only sulphur deposition needs to be considered (by reference to the CLmaxS); if the CLminN is exceeded (which is the case across much of England), additional nitrogen will contribute towards acidification and in such cases the total acid deposition (nitrogen plus sulphur) is calculated as a proportion of the CLmaxN. Table 14 shows that existing background nitrogen deposition already exceeds the CLminN by almost 300% and total acid deposition similarly exceeds the CLmaxN by more than 150%. The two schemes operating together are forecast to result in a large further increase[7] in acid deposition at 10 out of 29 modelled receptor locations. The greatest contribution is at receptor location E21, where the PEC (N+S) is forecast to be 27% greater than the background acid deposition (N+S). This is due to the increase in forecast sulphur and NOx emissions from the 2 schemes operating together (even though the actual critical levels for SO_2 and NOx will not be breached).

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[4] Caporn, S., Field, C., Payne, R., Dise, N., Britton, A., Emmett, B., Jones, L., Phoenix, G., S Power, S., Sheppard, L. & Stevens, C. 2016. Assessing the effects of small increments of atmospheric nitrogen deposition (above the critical load) on semi-natural habitats of conservation importance. Natural England Commissioned Reports, Number 210.

[5] According to Caporn et al (2016), the increase in nitrogen deposition rate required to reduce species richness of a lowland heathland sward at background nitrogen deposition rates of 15-20 kgN/ha/yr is 1.3-1.7 kgN/ha/yr. Note that ‘reduction in species richness’ means that fewer species are recorded in a typical 2m x 2m quadrat. Therefore, it does not mean species are ‘lost’ from a site, or even part of a site; it simply means that at least one species would be expected to occur at a reduced frequency.

[6] Ibid, table 20

[7] Defined as an increase of more than 10% when the PC (N+S combined) is considered as a percentage of the CLmaxN

4. Conclusion

In summary, the critical levels for SO_2 and NOx will not be exceeded even with both facilities operating in combination. However, there are forecast to be ‘in combination’ increases in nitrogen deposition (primarily attributable to increased NOx emissions) and acid deposition (attributable mainly to increased NOx and SO_2 emissions) equivalent to more than 10% of the critical level. However, the nitrogen deposition impact is forecast to be below the level that would result in ecologically significant effects given the existing background rates. There may be a slight increase in grass cover at the most affected receptors.

With regard to acid deposition, the existing background total acid deposition at all receptor locations already exceeds the critical load (CLmaxN) by between 40% and 90%. This is likely to reduce the ecological effect of additional acid deposition to a large degree.

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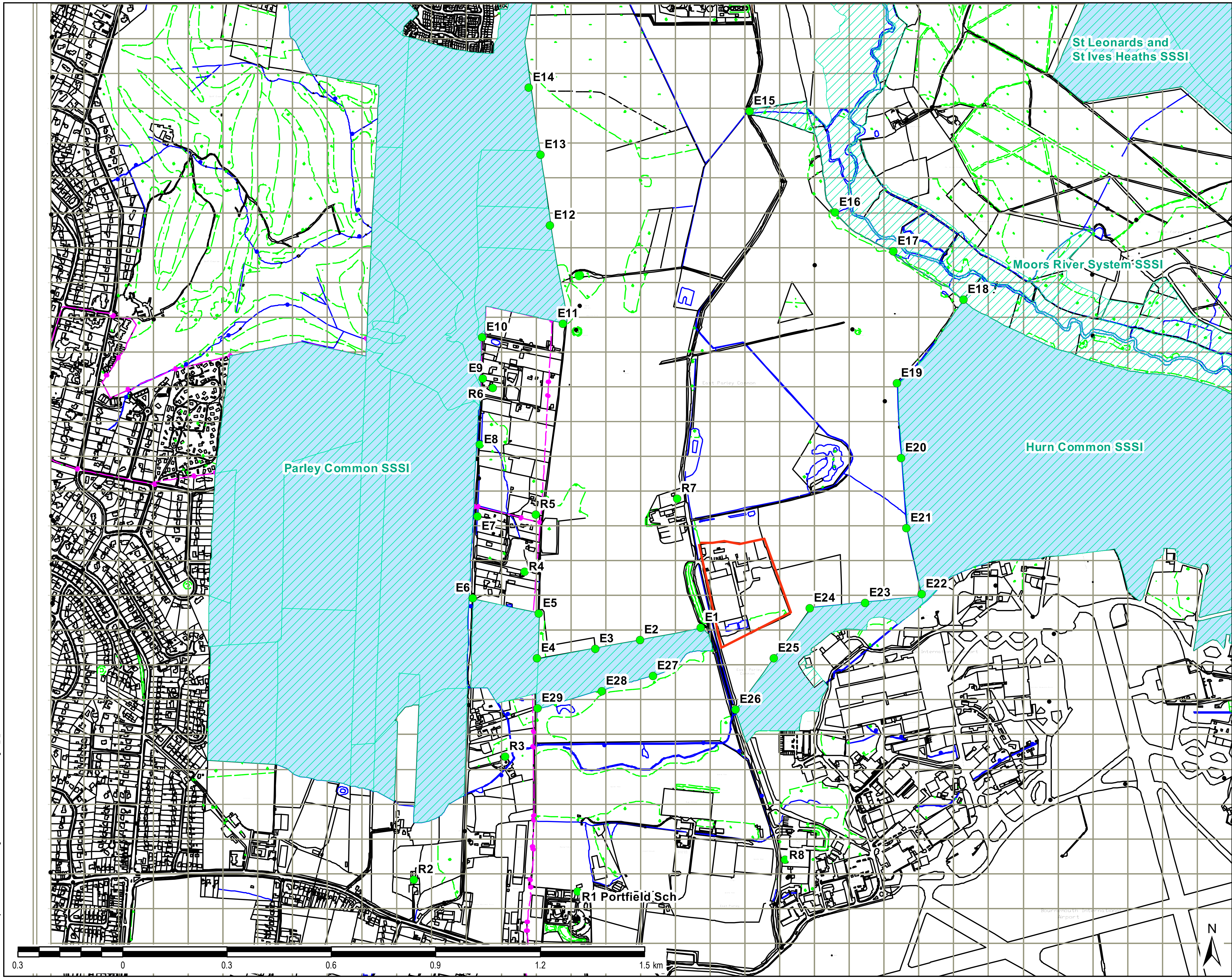
Appendix A Figures



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LEGEND

- Receptors
- Approximate Site Boundary
- SSSIs
- Dorset Heathlands SPA & Dorset Heaths SAC

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue
FOR DISCUSSION ONLY

Client
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Project Title
CONFIDENTIAL - SCREENING MODELS

Drawing Title
AIR QUALITY STUDY AREA

Drawn	Checked	Approved	Date
JLM	DD	DD	13/10/2017

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AECOM
Scott House
Alençon Link, Basingstoke
Hampshire, RG21 7PP
Telephone (01256) 310200
Fax (01256) 310201
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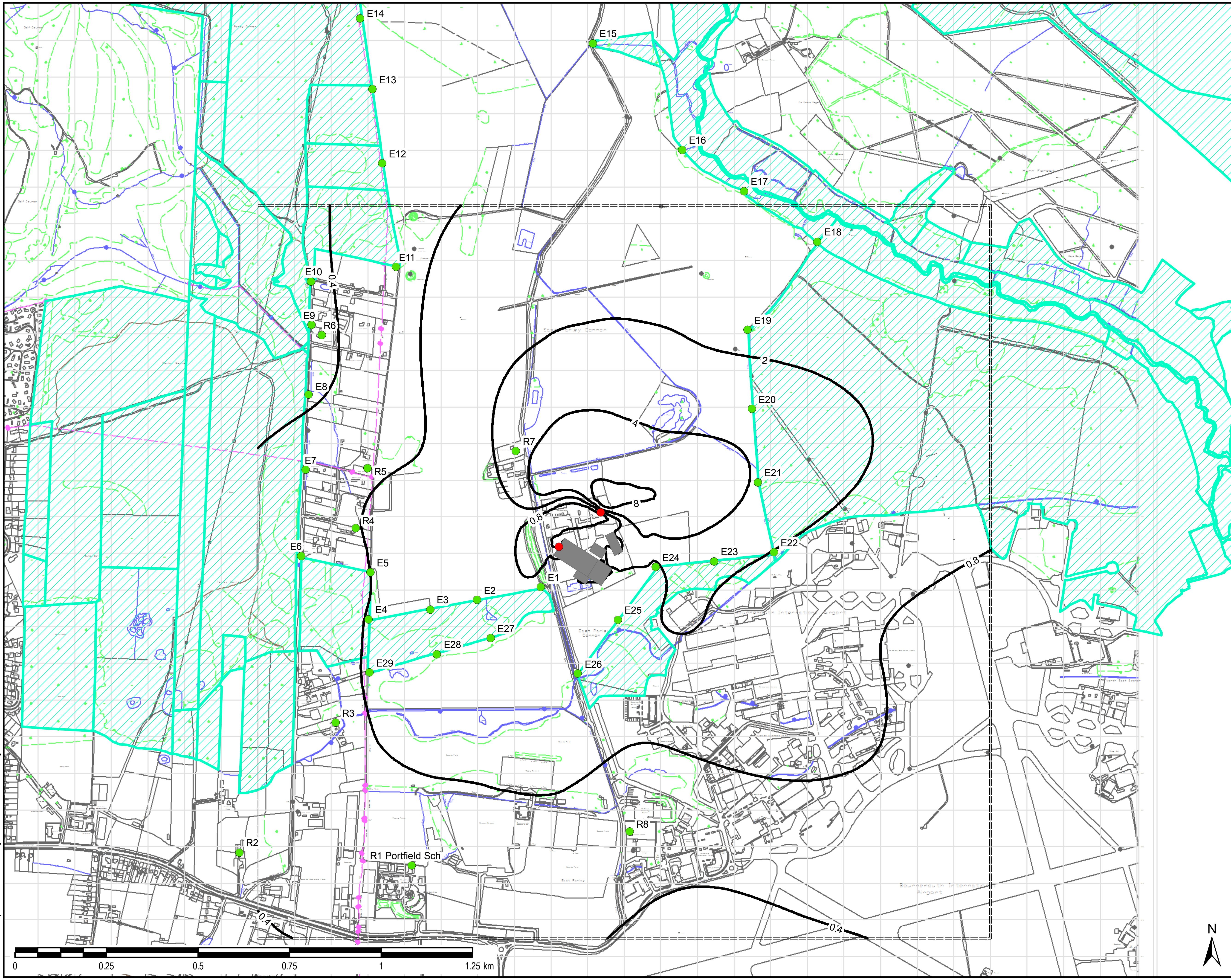

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LEGEND

- Receptors
- Emission Source
- NO_2 PC ($\mu g/m^3$)
- Modelled Domain
- Modelled Buildings
- Ecological Sites

Purpose of Issue
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Project Title
CONFIDENTIAL - SCREENING MODELS

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LONG TERM OXIDES OF NITROGEN PROCESS CONTRIBUTION ERF AND SBB EMISSIONS

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AECOM
Royal Court,
Basil Close,
Chesterfield, Derbyshire, S41 7SL
Telephone (01246) 209 221
www.aecom.com

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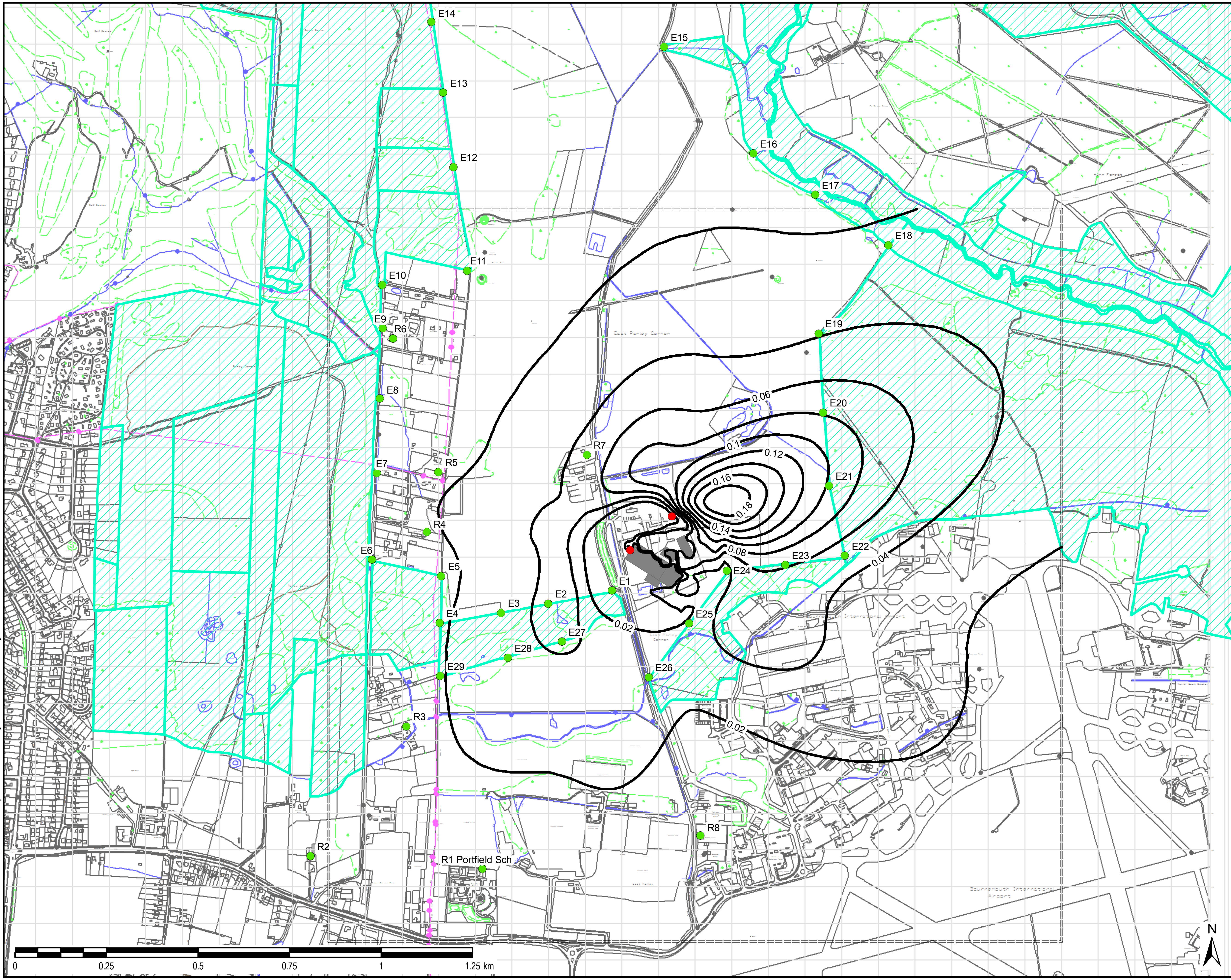

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LEGEND

- Receptors
- Emission Source
- NH_3 PC ($\mu g/m^3$)
- Modelled Domain
- Modelled Buildings
- Ecological Sites

Purpose of Issue
DRAFT

Client
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Project Title
CONFIDENTIAL - SCREENING MODELS

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LONG TERM AMMONIA PROCESS CONTRIBUTION ERF AND SBB EMISSIONS

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Royal Court,
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Chesterfield, Derbyshire, S41 7SL
Telephone (01246) 209 221
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Appendix B Modelling Results

Table 9. Dispersion Modelling Results for Sensitive Ecological Receptors, Annual Mean NO_X - ERF and SBB

Receptor ID	Background ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC % CLe	PEC ($\mu g/m^3$)	PEC % CLe
E1	16.2	1.35	4.5	17.5	58
E2	13.2	3.94	13.1	17.1	57
E3	13.2	2.57	8.6	15.8	53
E4	13.2	1.54	5.1	14.7	49
E5	13.2	1.46	4.9	14.6	49
E6	13.2	0.95	3.2	14.1	47
E7	13.2	0.76	2.5	13.9	46
E8	13.2	0.46	1.5	13.6	45
E9	13.2	0.41	1.4	13.6	45
E10	13.2	0.36	1.2	13.5	45
E11	13.2	0.63	2.1	13.8	46
E12	13.2	0.52	1.7	13.7	46
E13	13.2	0.44	1.5	13.6	45
E14	13.2	0.38	1.3	13.5	45
E15	13.2	0.59	2.0	13.8	46
E16	12.4	0.90	3.0	13.2	44
E17	12.4	0.98	3.3	13.3	44
E18	12.4	1.09	3.6	13.4	45
E19	12.4	1.80	6.0	14.2	47
E20	12.4	3.78	12.6	16.1	54
E21	16.2	4.62	15.4	20.8	69
E22	16.2	2.48	8.3	18.6	62
E23	16.2	3.20	10.7	19.4	65
E24	16.2	2.23	7.4	18.4	61
E25	16.2	1.62	5.4	17.8	59
E26	16.2	2.16	7.2	18.3	61
E27	13.2	3.22	10.7	16.4	55
E28	13.2	2.45	8.2	15.6	52
E29	13.2	1.54	5.1	14.7	49

Table 10. Dispersion Modelling Results for Sensitive Ecological Receptors, Peak 24h NO_X - ERF and SBB

Receptor ID	Background ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC % CLe	PEC ($\mu g/m^3$)	PEC % CLe
E1	24.2	13.72	18.3	38.0	51
E2	19.8	57.81	77.1	77.6	103
E3	19.8	46.52	62.0	66.3	88
E4	19.8	31.09	41.4	50.9	68
E5	19.8	26.97	36.0	46.7	62
E6	19.8	14.52	19.4	34.3	46
E7	19.8	18.10	24.1	37.9	50
E8	19.8	9.80	13.1	29.6	39
E9	19.8	8.62	11.5	28.4	38
E10	19.8	8.17	10.9	27.9	37
E11	19.8	13.65	18.2	33.4	45
E12	19.8	9.06	12.1	28.8	38
E13	19.7	6.57	8.8	26.3	35
E14	19.7	5.84	7.8	25.6	34
E15	19.7	6.31	8.4	26.1	35
E16	18.5	7.67	10.2	26.2	35
E17	18.5	8.08	10.8	26.6	35
E18	18.5	8.58	11.4	27.1	36
E19	18.5	14.28	19.0	32.8	44
E20	18.5	25.52	34.0	44.0	59
E21	24.2	28.54	38.1	52.8	70
E22	24.2	21.91	29.2	46.2	62
E23	24.2	29.06	38.7	53.3	71
E24	24.2	21.31	28.4	45.6	61
E25	24.2	23.14	30.8	47.4	63
E26	24.2	43.35	57.8	67.6	90
E27	19.8	41.00	54.7	60.8	81
E28	19.8	33.44	44.6	53.2	71
E29	19.8	19.55	26.1	39.3	52

Table 11. Dispersion Modelling Results for Sensitive Ecological Receptors, Annual Mean SO_2 - ERF and SBB

Receptor ID	Background ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC % CLe	PEC ($\mu g/m^3$)	PEC % CLe
E1	0.39	0.34	3.4	0.7	7
E2	0.33	0.99	9.9	1.3	13
E3	0.33	0.64	6.4	1.0	10
E4	0.33	0.38	3.8	0.7	7
E5	0.33	0.36	3.6	0.7	7
E6	0.33	0.24	2.4	0.6	6
E7	0.33	0.19	1.9	0.5	5
E8	0.33	0.12	1.2	0.4	4
E9	0.33	0.10	1.0	0.4	4
E10	0.33	0.09	0.9	0.4	4
E11	0.33	0.16	1.6	0.5	5
E12	0.33	0.13	1.3	0.5	5
E13	0.37	0.11	1.1	0.5	5
E14	0.37	0.09	0.9	0.5	5
E15	0.37	0.15	1.5	0.5	5
E16	0.31	0.22	2.2	0.5	5
E17	0.31	0.24	2.4	0.6	6
E18	0.31	0.27	2.7	0.6	6
E19	0.31	0.45	4.5	0.8	8
E20	0.31	0.95	9.5	1.3	13
E21	0.39	1.15	11.5	1.5	15
E22	0.39	0.62	6.2	1.0	10
E23	0.39	0.80	8.0	1.2	12
E24	0.39	0.56	5.6	0.9	9
E25	0.39	0.41	4.1	0.8	8
E26	0.39	0.54	5.4	0.9	9
E27	0.33	0.80	8.0	1.1	11
E28	0.33	0.61	6.1	0.9	9
E29	0.33	0.39	3.9	0.7	7

Table 12. Dispersion Modelling Results for Sensitive Ecological Receptors, Annual Mean NH_3 - ERF and SBB

Receptor ID	Background ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC % CLe	PEC ($\mu g/m^3$)	PEC % CLe
E1	1.04	0.01	0.3	1.0	35
E2	2.34	0.09	3.0	2.4	81
E3	2.34	0.06	1.9	2.4	80
E4	2.34	0.03	1.2	2.4	79
E5	2.34	0.03	1.1	2.4	79
E6	2.34	0.02	0.7	2.4	79
E7	2.34	0.02	0.6	2.4	79
E8	2.34	0.01	0.3	2.4	78
E9	2.34	0.01	0.3	2.3	78
E10	2.34	0.01	0.3	2.3	78
E11	2.34	0.01	0.5	2.4	78
E12	2.34	0.01	0.4	2.4	78
E13	1.18	0.01	0.3	1.2	40
E14	1.18	0.01	0.3	1.2	40
E15	1.18	0.01	0.4	1.2	40
E16	1.04	0.02	0.6	1.1	35
E17	1.04	0.02	0.7	1.1	35
E18	1.04	0.02	0.8	1.1	35
E19	1.04	0.04	1.3	1.1	36
E20	1.04	0.08	2.6	1.1	37
E21	1.04	0.10	3.3	1.1	38
E22	1.04	0.05	1.8	1.1	36
E23	1.04	0.07	2.2	1.1	37
E24	1.04	0.04	1.3	1.1	36
E25	1.04	0.03	0.9	1.1	36
E26	1.04	0.04	1.5	1.1	36
E27	2.34	0.07	2.3	2.4	80
E28	2.34	0.06	1.8	2.4	80
E29	2.34	0.03	1.2	2.4	79

Table 13. Dispersion Modelling Results for Sensitive Ecological Receptors, Annual Mean Nutrient Nitrogen Deposition - ERF and SBB

Receptor ID	Background N Dep (kg/ha/yr)	Lower Range CLo (kg/ha/yr)	Upper Range CLo (kg/ha/yr)	PC (kg/ha/yr)	PC % Lower Range CLo	PC % Upper Range CLo	PEC (kg/ha/yr)	PEC % Lower Range CLo	PEC % Upper Range CLo
E1	14.00	10	20	0.24	2.4	1.2	14.2	142	71
E2	19.88	10	20	1.03	10.3	5.1	20.9	209	105
E3	19.88	10	20	0.67	6.7	3.4	20.6	206	103
E4	19.88	10	20	0.40	4.0	2.0	20.3	203	101
E5	19.88	10	20	0.38	3.8	1.9	20.3	203	101
E6	19.88	10	20	0.25	2.5	1.2	20.1	201	101
E7	19.88	10	20	0.19	1.9	1.0	20.1	201	100
E8	19.88	10	20	0.12	1.2	0.6	20.0	200	100
E9	19.88	10	20	0.10	1.0	0.5	20.0	200	100
E10	19.88	10	20	0.09	0.9	0.5	20.0	200	100
E11	19.88	10	20	0.16	1.6	0.8	20.0	200	100
E12	19.88	10	20	0.13	1.3	0.7	20.0	200	100
E13	14.56	10	20	0.11	1.1	0.6	14.7	147	73
E14	14.56	10	20	0.10	1.0	0.5	14.7	147	73
E15	14.56	10	20	0.15	1.5	0.8	14.7	147	74
E16	14.00	10	20	0.23	2.3	1.1	14.2	142	71
E17	14.00	10	20	0.25	2.5	1.2	14.2	142	71
E18	14.00	10	20	0.28	2.8	1.4	14.3	143	71
E19	14.00	10	20	0.46	4.6	2.3	14.5	145	72
E20	14.00	10	20	0.95	9.5	4.8	15.0	150	75
E21	14.00	10	20	1.17	11.7	5.9	15.2	152	76
E22	14.00	10	20	0.63	6.3	3.2	14.6	146	73
E23	14.00	10	20	0.80	8.0	4.0	14.8	148	74
E24	14.00	10	20	0.53	5.3	2.6	14.5	145	73
E25	14.00	10	20	0.37	3.7	1.8	14.4	144	72
E26	14.00	10	20	0.54	5.4	2.7	14.5	145	73
E27	19.88	10	20	0.83	8.3	4.1	20.7	207	104
E28	19.88	10	20	0.64	6.4	3.2	20.5	205	103
E29	19.88	10	20	0.40	4.0	2.0	20.3	203	101

Table 14. Dispersion Modelling Results for Sensitive Ecological Receptors, Annual Mean Acid Deposition - ERF and SBB

Receptor ID	Background Dep (N) (keq/ha/yr)	Background Dep (N) (keq/ha/yr)	Total Bkg Dep (N+S)	Lower Range CLo Function (keq/ha/yr)	PC (N) (keq/ha/yr)	PC (S) (keq/ha/yr)	PC (N+S) (keq/ha/yr)	PC (N+S) % CLMaxN	PEC (N+S) (keq/ha/yr)	PEC (N+S) % CLMaxN
E1	1.00	0.20	1.20		0.048	0.040	0.088	10.5	1.29	153
E2	1.42	0.20	1.62		0.159	0.117	0.276	32.8	1.90	225
E3	1.42	0.20	1.62		0.104	0.076	0.180	21.4	1.80	214
E4	1.42	0.20	1.62		0.062	0.046	0.108	12.8	1.73	205
E5	1.42	0.20	1.62		0.059	0.043	0.102	12.1	1.72	205
E6	1.42	0.20	1.62		0.038	0.028	0.066	7.9	1.69	200
E7	1.42	0.20	1.62		0.030	0.022	0.053	6.3	1.67	199
E8	1.42	0.20	1.62		0.019	0.014	0.032	3.8	1.65	196
E9	1.42	0.20	1.62		0.016	0.012	0.028	3.4	1.65	196
E10	1.42	0.20	1.62		0.015	0.011	0.025	3.0	1.65	195
E11	1.42	0.20	1.62		0.025	0.019	0.044	5.2	1.66	198
E12	1.42	0.20	1.62		0.021	0.015	0.036	4.3	1.66	197
E13	1.04	0.21	1.25		0.018	0.013	0.031	3.7	1.28	152
E14	1.04	0.21	1.25	CLMinN 0.499	0.015	0.011	0.026	3.1	1.28	152
E15	1.04	0.21	1.25	CLMax N 0.842	0.024	0.018	0.041	4.9	1.29	153
E16	1.00	0.20	1.20	CLMaxS 0.200	0.036	0.026	0.062	7.4	1.26	150
E17	1.00	0.20	1.20		0.039	0.029	0.068	8.1	1.27	151
E18	1.00	0.20	1.20		0.044	0.032	0.076	9.0	1.28	152
E19	1.00	0.20	1.20		0.072	0.053	0.126	14.9	1.33	157
E20	1.00	0.20	1.20		0.151	0.112	0.263	31.2	1.46	174
E21	1.00	0.20	1.20		0.185	0.136	0.321	38.2	1.52	181
E22	1.00	0.20	1.20		0.099	0.073	0.172	20.5	1.37	163
E23	1.00	0.20	1.20		0.127	0.095	0.222	26.4	1.42	169
E24	1.00	0.20	1.20		0.087	0.066	0.153	18.1	1.35	161
E25	1.00	0.20	1.20		0.063	0.048	0.110	13.1	1.31	156
E26	1.00	0.20	1.20		0.086	0.064	0.150	17.8	1.35	160
E27	1.42	0.20	1.62		0.129	0.095	0.225	26.7	1.84	219
E28	1.42	0.20	1.62		0.099	0.072	0.171	20.3	1.79	213
E29	1.42	0.20	1.62		0.062	0.046	0.108	12.8	1.73	205

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