FICHTNER
Consulting Engineers Limited

Shropshire In-Vessel Composting Facility

Veolia

Air Quality Assessment

ENGINEERING CONSULTING

Document approval

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Management Summary

Fichtner Consulting Engineers Ltd (Fichtner) has been engaged by Veolia ES Shropshire Limited (the Client) to prepare an Air Quality Assessment (AQA) to support the Environmental Permit (EP) application for an in-vessel composting facility (the Facility) to be installed at the former Befesa salt slag processing facility, Fenn's Bank, near Whitchurch.

The assessment has been carried out in a number of stages.

1) Review of Legislation

The Facility will be permitted by Natural Resources Wales (NRW) under the Environmental Permitting (England and Wales) Regulations (2016) as amended.

In the UK, the levels of pollution in the atmosphere are controlled by the National Air Quality Strategy and a number of European Directives which have been fully implemented. These have led to the setting of Environmental Assessment Levels (EALs) for the protection of human health. In addition, Critical Levels for ammonia and Critical Loads for nitrogen and acid deposition have been set for the protection of ecosystems.

2) Review of Ambient Air Quality

Mapped background concentrations and monitoring information has been used to assess the current levels of pollutants in the atmosphere close to the site. Baseline concentrations in the vicinity are well below the relevant EALs.

3) Identification of Sensitive Receptors

When assessing the impact of the proposal, the assessment considers the point of maximum impact outside of the installation boundary as a worst-case. In addition, the impact has been assessed at the closest residential receptor. Sensitive ecological sites within the relevant screening distances from the stack have been included in the assessment.

4) Dispersion Modelling of Emissions

The ADMS dispersion model is routinely used for air quality assessments to the satisfaction of local authorities and NRW. The model uses weather data from the local area to predict the spread and movement of the exhaust gases from the stack for each hour over a five-year period. The model takes account of wind speed, wind direction, temperature, humidity and the amount of cloud cover, as all of these factors influence the dispersion of emissions. The model also takes account of the effects of buildings and terrain on the movement of air.

Modelling has been undertaken for two scenarios to account for the expected daily variation in air flow to the biofilters, and for the expected seasonal variation in ammonia emissions concentrations.

The model has been used to predict the ground level concentration of pollutants on a long-term and short-term basis across a grid of points. In addition, concentrations have been predicted at the identified sensitive receptors.

Dispersion modelling of odour emissions has also been undertaken.

5) Assessment of Impact on Air Quality – Protection of Human Health

The air quality impact of the proposals on human health has been assessed using a standard approach based on guidance provided by NRW and the English Environment Agency (EA) as appropriate.

Using this approach, the following can be concluded from the assessment.

1. No exceedance of any EAL is predicted;
2. All impacts can be screened out as 'insignificant'.

6) Assessment of Impact on Air Quality – Protection of Ecosystems

The impact of air quality on ecology has been assessed using a standard approach based on guidance provided by NRW and the EA as appropriate.

1. The impact on annual mean airborne ammonia concentrations can be screened out as 'insignificant', except at the Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses SAC. Taking into account the site context including historical ammonia emissions (from activities for which the site is still permitted), the predicted impact is small and is considered unlikely to have a significant effect.
2. Taking into account the likely emissions profile and average impact over five years of modelled weather data, the nitrogen and acid deposition impact at all receptors can be screened out as 'insignificant'.

7) Odour

The impact of odour has been assessed using a standard approach based on guidance provided by NRW and the EA as appropriate.

1. Odour dispersion modelling has shown that the maximum odour impact due to emissions from the biofilters will be well below the assessment criterion of 1.5 OUE/m^3.
2. An Odour Management Plan will be implemented, which will effectively manage other sources of odour associated with the operation of the Facility to ensure there are no significant odour impacts.

8) Summary and Conclusions

In summary, the assessment has shown that the operation of the Facility would not have a significant impact on local air quality, the general population or the local community. As such there should be no air quality constraint in granting an EP to operate the Facility.

Contents

1 Introduction

Fichtner Consulting Engineers Ltd (Fichtner) has been engaged by Veolia ES Shropshire Limited (the Client) to prepare an Air Quality Assessment (AQA) to support the Environmental Permit (EP) application for an in-vessel composting facility (the Facility) to be installed at the former Befesa salt slag processing facility, Fenn's Bank, near Whitchurch. The site location is shown in Figure 1.

The Facility will treat up to 100,000 tonnes per annum (tpa) of compostable waste. The activities to be undertaken will be permitted by Natural Resources Wales (NRW) under the Environmental Permitting (England and Wales) Regulations (2016).

The assessment has considered the following:

1. the impact of emissions on human health and ecological receptors; and
2. the impact of odour emissions.

1.1 Structure of the report

This report has the following structure.

- Air quality legislation and guidance is considered in section 2.
- The current levels of ambient air quality are described in section 3.
- Section 4 highlights the residential and ecological receptors considered.
- The assessment criteria are detailed in section 5.
- The dispersion modelling methodology and inputs are presented in section 6.
- The results of sensitivity tests for the model inputs are presented in section 7.
- The impact of emissions from the Facility is presented in section 8.
- The assessment of odour emissions is presented in section 9.
- The conclusions of the assessment can be found in section 10.
- The Appendices include figures and detailed results tables.

2 Legislation

2.1 Environmental Assessment Levels

The only pollutant of concern for human health and ecological impacts that will be emitted by the Facility is ammonia. The English Environment Agency (EA) includes Environmental Assessment Levels (EALs) for ammonia in the environmental management guidance 'Air Emissions Risk Assessment for your Environmental Permit'[1] ("Air Emissions Guidance"), which is considered in lieu of guidance specific to Wales. Critical Levels for the protection of sensitive ecosystems and habitats are also contained within the Air Emissions Guidance and the Air Pollution Information System (APIS). Table 1 summarises the EALs and Critical Levels used in this assessment.

Table 1: Environmental Assessment Levels (EALs)

Pollutant	EAL or Critical Level (µg/m³)	Averaging Period	Source
Ammonia	180	Annual	Air Emissions Guidance
	2,500	1 hour	Air Emissions Guidance
	1	Annual mean where lichens and bryophytes are an important part of the ecosystem's integrity	Air Emissions Guidance / APIS
	3	Annual mean for all higher plants	Air Emissions Guidance / APIS

In addition to these Critical Levels, APIS provides habitat specific Critical Loads for nitrogen and acid deposition. These are detailed in Appendix B for the identified ecological receptors.

2.2 Application of EALs

The EALs apply at areas of relevant exposure relevant to the assessment level. The following table extracted from Local Authority Air Quality Technical Guidance (2022) (LAQM.TG(22)) explains where the relevant EALs apply.

Table 2: Guidance on where EALs apply

Averaging period	Objectives should apply at:	Objectives should generally not apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties.

[1] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions

Averaging period	Objectives should apply at:	Objectives should generally not apply at:
		Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer.	Kerbside sites where the public would not be expected to have regular access.

Source: Box 1-1, Local Air Quality Management Technical Guidance (TG22), Defra, August 2022

2.3 Industrial pollution regulation

Atmospheric emissions from industrial processes are controlled through the Environmental Permitting (England and Wales) Regulations (2016). The Facility will be subject to an EP to operate. The EP will include conditions to minimise the environmental impact by:

- preventing fugitive emissions of dust and odour beyond the boundary of the permitted activity; and
- limiting emissions to air in accordance with Best Available Techniques (BAT), as laid out in the Waste Treatment BAT Reference document (BREF) and Waste Treatment BAT Conclusions.

Compliance with these conditions is demonstrated through the periodic monitoring of emissions, as required by the EP.

3 Baseline Air Quality

3.1 Mapped background data

Concentrations will vary over the modelling domain area, which extends up to approximately 5 km from the Facility. Therefore, the maximum from the 1 x 1 km grid squares within 5 km of the Facility has been extracted from the APIS dataset, along with the concentrations at the grid square containing the Facility. These are presented in Table 3.

Table 3: Mapped background analysis

Pollutant	Concentration (µg/m³)		Dataset
	At Facility	Max in modelling domain	
Ammonia	2.90	3.40	APIS 2021 mid-year

Source: APIS

3.2 Monitoring data

A review of the UK Eutrophying and Acidifying Network (UKEAP) shows that there is one ammonia monitoring site within 10 km of the Facility, located at Fenn's Moss approximately 3 km south-west of the Facility. The monitored ammonia concentration at this site for the most recent five years of monitoring data is presented in Table 4.

Table 4: Monitoring data – Fenn's Moss

ID	Distance from site (km)	APIS 2021 Mapped Bg (µg/m³)	Annual mean concentration (µg/m³)				
			2019	2020	2021	2022	2023
Fenn's Moss	3.1	3.10	2.54	2.67	2.13	2.01	1.53

Source: © Crown 2025 copyright Defra via uk-air.defra.gov.uk, licenced under the Open Government Licence (OGL).

As shown, the monitored concentrations have shown a decreasing trend over the most recent five years of data. In addition, the monitored concentrations are lower than the APIS mapped background concentration. This suggests that in the vicinity of the monitoring site the background maps may be over-estimating the baseline concentration.

Data from the Fenn's Moss monitoring site will include a contribution from the Befesa operations previously undertaken at the site; however, due to the 3 km distance to the monitoring site it is considered that any contribution would be small and no adjustment to the baseline concentrations has been made to account for the reduction in concentrations due to the cessation of activities.

3.3 Summary

The maximum ammonia concentration from within 5 km of the Facility obtained from the APIS background maps (3.40 µg/m³) has been used as the baseline concentration for the assessment of impacts on human health. Receptor-specific ammonia concentrations have been obtained from APIS for any impacts on ecological receptors that cannot be screened out as 'insignificant' (refer to section 5). For the assessment of impacts in close proximity to Fenn's Moss, consideration has been given to the monitored concentrations.

4 Sensitive Receptors

4.1 Human sensitive receptors

The general approach to the assessment is to evaluate the highest predicted process contribution (PC) across the grid of output points. In addition, the predicted PC at sensitive receptors at areas of relevant exposure has been evaluated. The locations of the receptors included in this assessment are shown in Figure 2 and listed in Table 5. The receptors have been modelled at a height of 1.5 m to represent a typical breathing height.

Table 5: Human sensitive receptors

ID	Receptor Name	Location		Distance from stack (m)
		X (m)	Y (m)	
R1	Park Farm Cottages, Fenn's Bank Road	350891	339166	281
R2	Fenn's Bank Road 2	350922	339100	322
R3	Fenn's Bank Road 3	350928	339018	357
R4	Residence near Mereside Industrial Park	350821	338955	308
R5	The Conery, Conery Lane	349892	338730	847
R6	Woodlands Farm, Conery Lane	350026	339207	585
R7	Conery Lane Farm, Conery Lane	349879	339573	830
R8	Pinfold Cottage, Long Lane	350115	339862	843
R9	The View, Fenn's Bank Road	350572	339584	406

There are additional receptors where 24-hour and 1-hour EALs apply, for example gardens and footpaths. Odour benchmarks also apply at residential properties, and at gardens and footpaths. If necessary, consideration has been given to impacts at locations other than the receptors above using contour plot files.

4.2 Ecological sensitive receptors

A study has been undertaken to identify the following sites of ecological importance in accordance with the following screening distances laid out in the Air Emissions Guidance, which have been applied in lieu of any guidance specific to Wales:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs), or Ramsar sites within 10 km of the Site;
- Sites of Special Scientific Interest (SSSIs) within 2 km of the Site; and
- National Nature Reserves (NNR), Local Nature Reserves (LNRs), local wildlife sites (LWSs) and ancient woodlands (AWs) within 2 km of the Site. These are collectively referred to as local nature sites.

The ecological receptors identified are displayed in Figure 3 and are listed in Table 6. The Midland Meres and Mosses Phase 1 and Phase 2 Ramsar sites comprise a number of separate sites, each of which is also designated as a SSSI. Although these lie outside of the screening distances for SSSIs, the SSSI names have been listed to identify each site.

Table 6: Ecological Sensitive Receptors

ID	Site	Designation	Closest point to stack		Distance from stack at closest point (km)
			X (m)	Y (m)	
European and UK Designated Sites					
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	SSSI, SAC, Ramsar	350405	338878	0.4
E2	Brown Moss	SAC, Ramsar	355950	339320	5.3
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Ramsar	356230	343450	7.1
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	Ramsar	354580	345280	7.3
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Ramsar	347170	339010	3.4
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Ramsar	345600	339320	5.0
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	SAC, Ramsar	343560	334250	8.6
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Ramsar	343800	333370	9.0
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Ramsar	345940	330390	9.9
Local Nature Sites					
E10	Fenn's, Whixall & Bettisfield Mosses	NNR	350350	338760	0.5
E11	Fenn's Rough Ancient Woodland	AW	351185	339342	0.6
E12	Fenn's Wood Ancient Woodland North	AW	350750	338198	1.0
E13	Fenn's Wood Ancient Woodland Mid	AW	350650	337750	1.4
E14	Fenn's Wood Ancient Woodland South	AW	350680	337390	1.8
E15	Unnamed Ancient Woodland 1	AW	350785	337872	1.3
E16	Unnamed Ancient Woodland 2	AW	349940	340640	1.6
E17	Unnamed Ancient Woodland 3	AW	350112	340885	1.8

As all sites considered are designated as mosses (i.e. bogs) or ancient woodlands, lichens or bryophytes are likely to be an important part of each ecosystem's integrity, and the more stringent Critical Level for ammonia has been applied at all sites in the first instance.

Site-specific data on APIS has been reviewed to determine the applicable Critical Loads, which are presented in Appendix B. In the first instance, the most sensitive habitat in each site featuring aquatic habitats, short vegetation and woodland have been included in the assessment. For any impacts that cannot be screened out, consideration has been given to the impact on all designated features at the affected site.

5 Assessment Criteria

5.1 Air quality

5.1.1 Human health

The Air Emissions Guidance states that to screen out 'insignificant' process contributions (PCs):

- *the long-term PC must be less than 1% of the long-term environmental standard; and*
- *the short-term PC must be less than 10% of the short-term environmental standard.*

As part of this assessment, predicted PCs have been compared to the EALs presented in section 2.1.

If the above criteria are achieved, it can be concluded that it is not likely that emissions would lead to significant environmental impacts and the PCs can be screened out.

The long-term 1% PC threshold is based on the judgement that:

- it is unlikely that an emission at this level will make a significant contribution to air quality; and
- the threshold provides a substantial safety margin to protect health and the environment.

The short-term 10% PC threshold is based on the judgement that:

- spatial and temporal conditions mean that short-term PCs are transient and limited in comparison with long-term PCs; and
- the threshold provides a substantial safety margin to protect health and the environment.

For the purpose of this assessment, if the impact can be screened out as 'insignificant' at the point of maximum impact, further assessment is not required. If PCs cannot be screened out, assessment will be undertaken for the following:

- the Predicted Environmental Concentration (PEC, defined as the PC plus the background concentration) at the point of maximum impact; and
- the PC and PEC at areas of public exposure.

If the long-term PEC is below 70% of the EAL, or the short-term PC is less than 20% of the headroom[2], it can be concluded that there is little risk of the PEC exceeding the EAL, and the impact can be considered to be 'not significant'.

5.1.2 Ecology

The Air Emissions Guidance states that to screen out impacts as 'insignificant' at European and UK statutory designated sites:

- the long-term PC must be less than 1% of the long-term environmental standard (i.e., the Critical Level or Load); and
- the short-term PC must be less than 10% of the short-term environmental standard.

If the above criteria are met, no further assessment is required. If the long-term PC exceeds 1% of the long-term environmental standard, the PEC must be calculated and compared to the standard. If the resulting PEC is less than 70% of the long-term environmental standard, the Air Emissions Guidance states that the emissions are 'insignificant' and further assessment is not required. In accordance with the guidance, calculation of the PEC for short-term standards is not required.

[2] Calculated as the AQAL minus twice the long-term background concentration

The Air Emissions Guidance states further that to screen out impacts as 'insignificant' at local nature sites[3]:

- the long-term PC must be less than 100% of the long-term environmental standard; and
- the short-term PC must be less than 100% of the short-term environmental standard.

In accordance with the guidance, calculation of the PEC for local nature sites is not required.

5.2 Odour

Odour impacts are dependent on various factors, weather conditions, individual perceptions and are temperamental in their nature. Odours are characterised in terms of European odour units, OU_E, and odour concentrations, OU_E/m^3.

The OU_E strength of a release is the number of times the mixture must be diluted, at standard temperature and pressure, to reach the detection limit by 50% of the members of an olfactory panel.

5.2.1 Odour assessment criteria

The main requirement with respect to odour control from industrial activities is the Environmental Permitting (England and Wales) Regulations (2016). Typically, the EP will include a condition to ensure that "*emissions from the activities shall be free from odour at levels likely to cause pollution outside the site, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved odour management plan, to prevent or where that is not practicable to minimise the odour.*"

There is no statutory limit in the UK for ambient odour concentrations. However, the EA's H4 Odour Management guidance (2011) sets benchmark levels which are commonly used for assessing odour impacts. These are as below:

- 1.5 OU_E/m^3 as the 98th percentile of hourly mean concentrations for the most offensive odours (e.g. decaying animal or fish remains, septic effluent or sludge, biological landfill);
- 3.0 OU_E/m^3 as the 98th percentile of hourly mean concentrations for moderately offensive odours (e.g. intensive livestock rearing, fat frying or food processing, green waste composting); and
- 6.0 OU_E/m^3 as the 98th percentile of hourly mean concentrations for less offensive odours (e.g. brewery, confectionery, coffee).

In accordance with the H4 guidance these criteria are primarily for application at sensitive receptors such as housing.

As a conservative screening assumption, this assessment has been carried out using the most stringent assessment criterion/benchmark i.e. assuming the Facility could have the potential to produce the 'most offensive odours'.

[3] National Nature Reserves (NNR), Local Nature Reserves (LNRs), local wildlife sites and ancient woodlands

6 Dispersion Modelling Methodology

6.1 Selection of dispersion model

Detailed dispersion modelling was undertaken using the model ADMS 6, developed and supplied by Cambridge Environmental Research Consultants (CERC). This is a new generation dispersion model, which characterises the atmospheric boundary layer in terms of the atmospheric stability and the boundary layer height. In addition, the model uses a skewed Gaussian distribution for dispersion under convective conditions, to take into account the skewed nature of turbulence. The model also includes modules to take account of the effect of buildings and complex terrain, and is capable of modelling atmospheric chemical reactions, odour, and plume visibility. ADMS is routinely used for modelling of emissions for planning and environmental permitting purposes to the satisfaction of the NRW, the EA and local authorities.

6.2 Model inputs

6.2.1 Source and emissions data

The biofilter stack for the Facility is designed to release a maximum of 120,000 m³/h of air. The technology provider has advised that the flow rate will vary, being typically 70% of the maximum during the day (07:00 – 19:00) and 40% of the maximum overnight (19:00 – 07:00). This has been accounted for in the modelling by the use of a time varying emissions file.

The emission limit values (ELVs) for ammonia and odour are the taken from the Waste Treatment Best Available Techniques Reference (BREF) document. Typically, the upper end of the BAT-associated emission levels (BAT-AELs) are applied, which are 20 mg/m³ for ammonia and 1,000 OU_E/m³ for odour. However, preliminary modelling identified that the ELV for ammonia would need to be set below the upper end of the BAT-AEL range, even when accounting for anticipated airflows through the biofilters. It is proposed to apply an ELV of 3.5 mg/m³ for ammonia, which the technology provider has confirmed is achievable.

In addition, the technology provider has advised that ammonia emissions are likely to vary seasonally, being highest in winter and lowest in summer (refer to Table 8). This is due to the expected ratio of food waste to green waste, with food waste which has the highest potential to generate ammonia emissions making up a greater proportion of the waste during the winter months. A time-varying emissions file has been used to represent the expected seasonal changes in ammonia emission concentration.

In summary, modelling has been undertaken for the following scenarios:

- Scenario 1: Ammonia emission concentrations at the proposed ELV of 3.5 mg/Nm³.
  - Flow at 70% of maximum during the day (07:00 – 19:00) and 40% of the maximum overnight (19:00 – 07:00) for the assessment of annual mean impacts; and
  - Flow at 100% of maximum for the assessment of short-term impacts.
- Scenario 2: Daily varying flow as per Scenario 1 (for both annual mean and short-term impacts), and seasonally varying ammonia emission concentrations as detailed in Table 8.

The model input parameters are presented in Table 7 and Table 8.

Table 7: Biofilter stack source data

Item	Unit	Value		
Stack Data				
Height	m	20 – see stack height assessment (section 7.1)		
Internal diameter	m	1.46		
Location	m, m	350631, 339158		
Flue Gas Conditions				
Temperature	°C	30		
		100% flow	70% flow	40% flow
Volume at reference conditions(1)	Nm^3/s	30.0	21.0	12.1
Volume at actual conditions	Am^3/s	33.3	23.3	13.3
Flue gas exit velocity	m/s	20.0	14.0	8.0

Note:
(1) Reference conditions of 273K, no correction for oxygen or water vapour.

Table 8: Biofilter stack emissions data

Pollutant	Concentration (OU_E/m^3 or mg/Nm^3)	Release rate (OU_E/m^3 or g/s)		
		100% flow	70% flow	40% flow
Odour	1,000	30,033	21,023	12,013
Ammonia – at ELV	3.50	0.1051	0.0736	0.0420
Ammonia – max (winter)	3.50	0.1051	0.0736	0.0420
Ammonia – min (summer)	1.40	0.0420	0.0294	0.0168
Ammonia – average (spring and autumn)	2.45	0.0736	0.0515	0.0294

Note:
'Winter' means December to February, 'spring' means March to May, 'summer' means June to August and 'autumn' means September to November.

6.2.2 Modelling domain

Modelling has been undertaken using a grid of 1.5 x 1.5 km with a grid spacing of 15 m nested within a wider grid of 9 x 9 km with a grid spacing of 90 m. The minimum grid spacing is less than 1.5 times the stack height in accordance with LAQM.TG(22) guidance and is considered fine enough to accurately capture the maximum concentrations. The results for the fine grid have been output at 0 m height (for assessment of ecological impacts) and 1.5 m height (for assessment of impacts on human health and odour concentrations). For the wide grid only results at 0 m for assessment of ecological impacts have been output.

The grid parameters are detailed in Table 9 and the modelling domain shown in Figure 4.

Table 9: Modelling Domain

Parameter	Fine grid	Wide grid
Grid spacing (m)	15	90
Grid height (m)	0 and 1.5	0
Grid start X	350005	346000
Grid finish X	351505	355000
Grid start Y	338510	333500
Grid finish Y	340010	342500

6.2.3 Meteorological data and surface characteristics

The impact of meteorological data was taken into account by using weather data from the Shawbury meteorological station for the years 2018 – 2022. Shawbury is located approximately 17 km to the south of the Facility and is the closest and most representative meteorological site available. The data was obtained from Enviro Data Services. Five years of data have been used to take into account inter-annual fluctuations in weather conditions. Wind roses from Shawbury for each year are presented in Figure 5.

6.2.3.1 Minimum Monin-Obukhov length

The minimum Monin-Obukhov length can be selected in ADMS for both the dispersion site and the meteorological site. This is a measure of the minimum stability of the atmosphere and can be adjusted to account for urban heat island effects which prevent the atmosphere in urban areas from ever becoming completely stable. The minimum Monin-Obukhov length has been set to 1 m for the dispersion and meteorological sites, as recommended by CERC for “rural” areas.

6.2.3.2 Surface roughness

The surface roughness length can be selected in ADMS for the dispersion and the meteorological site, which are both located in rural, relatively open settings. The surface roughness length has been set to 0.2 m for the dispersion site, which is the minimum value recommended by CERC for “agricultural areas” and is considered representative of the mainly open land around the dispersion site. The surface roughness length has been set to 0.3 m for the meteorological site, which is the maximum value recommended by CERC for “agricultural areas”. The surface roughness length for the meteorological site has been set at a slightly higher value than for the dispersion site to account for the proximity of Shawbury village.

6.2.3.3 Summary of meteorological parameters

A summary of the meteorological parameters used in the dispersion modelling is shown in Table 10.

Table 10: Meteorological parameters

Parameter	Dispersion site value (m)	Met site value (m)
Surface roughness length	0.2	0.3
Minimum Monin-Obukhov length	1	1

The sensitivity of the modelling results to the choice of surface roughness length has been considered in Section 7.1.

6.2.4 Terrain

It is recommended that, where gradients within 500 m of the modelling domain are greater than 1 in 10, the complex terrain module within ADMS (FLOWSTAR) should be used. A review of the local area indicates that some small sections of the modelling domain may have such gradients. A sensitivity analysis has been undertaken to determine the effect of terrain (refer to section 7.3). This shows that terrain does not have a significant effect on the dispersion modelling results, so it is not considered necessary to include a terrain file in the dispersion modelling.

6.2.5 Buildings

The presence of adjacent buildings can significantly affect the dispersion of the atmospheric emissions in the following ways.

- Wind blowing around a building distorts the flow and creates zones of turbulence. The increased turbulence can cause greater plume mixing.
- The rise and trajectory of the plume may be depressed slightly by the flow distortion. This downwash leads to higher ground level concentrations closer to the stack than those which would be present without the building.

The EA recommends that buildings should be included in the modelling if they are both:

- Within 5L of the stack (where L is the smaller of the building height and maximum projected width of the building); and
- Taller than 40% of the stack.

The ADMS 6 user guide also states that buildings less than one third of the stack height are ignored within the model as they will not have a significant effect on dispersion.

A review of the surroundings of the Facility has been undertaken. Details of the buildings modelled are presented in Table 11 and a site plan is presented in Figure 6.

Table 11: Building Details

Buildings	Centre point		Height (m)	Width (m)	Length (m)	Angle (°)
	X (m)	Y (m)				
Existing building(1)	350626	339113	12.8	55.0	96.0	55
Biofilters	350625	339171	7.8	25.0	48.5	55

Note:
(1) Selected as the main building in the model; as this is the taller and larger building it is expected to have the greatest effect on dispersion.

The sensitivity of the results to the inclusion of the building effects has been considered in section 7.4.

6.3 Baseline concentrations

Background concentrations for the assessment have been derived from national mapping and monitoring as presented in section 3. For short term averaging periods, the background concentration has been assumed to be twice the long term ambient concentration in accordance with EA guidance.

7 Sensitivity Analysis

7.1 Stack height justification

A stack height assessment has been run for a range of stack heights from 14 m to 30 m, although it is noted that the building can support a stack of up to 20 m tall, with taller stacks requiring additional costs to install.

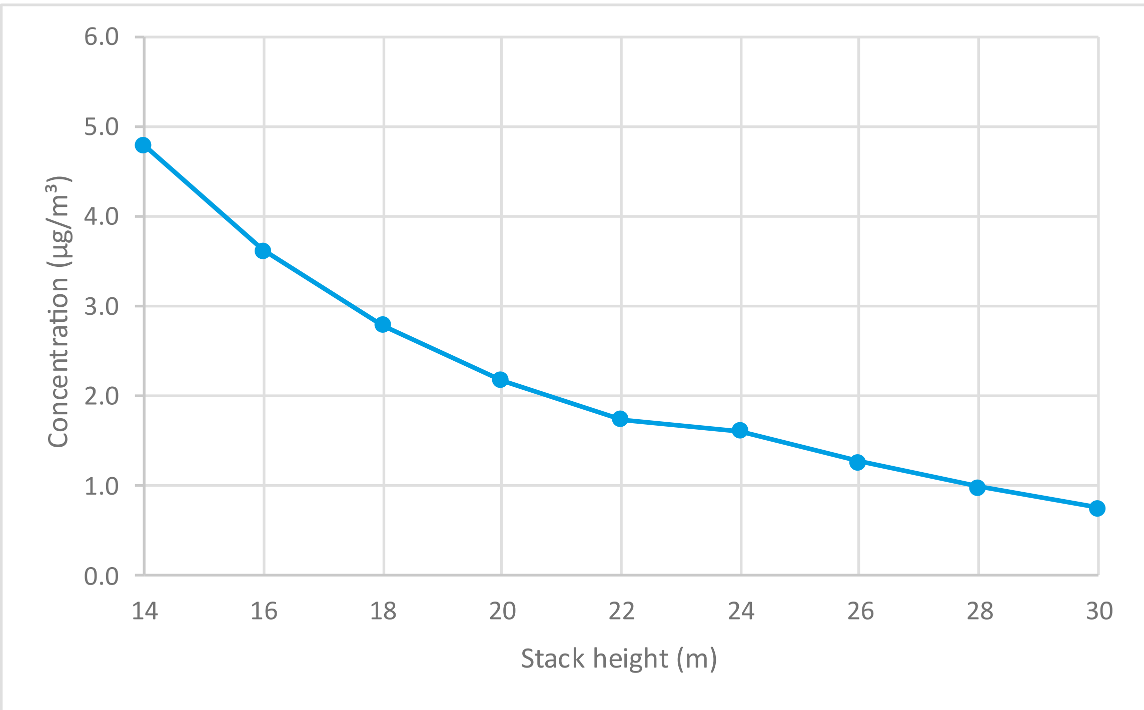
The results are shown on the graphs below on which the maximum predicted concentration outside of the installation boundary for a nominal 1 g/s release has been plotted against stack height for annual mean and maximum hourly concentrations. This assumes operation at maximum flow rate, as this results in the maximum annual mean and short-term concentrations outside of the installation boundary (refer to section 7.5).

Typically, the minimum recommended stack height is determined by identifying any step changes in the angle of the slope, which would indicate reduced benefit to increasing the stack height beyond the height at which the step change in angle occurs.

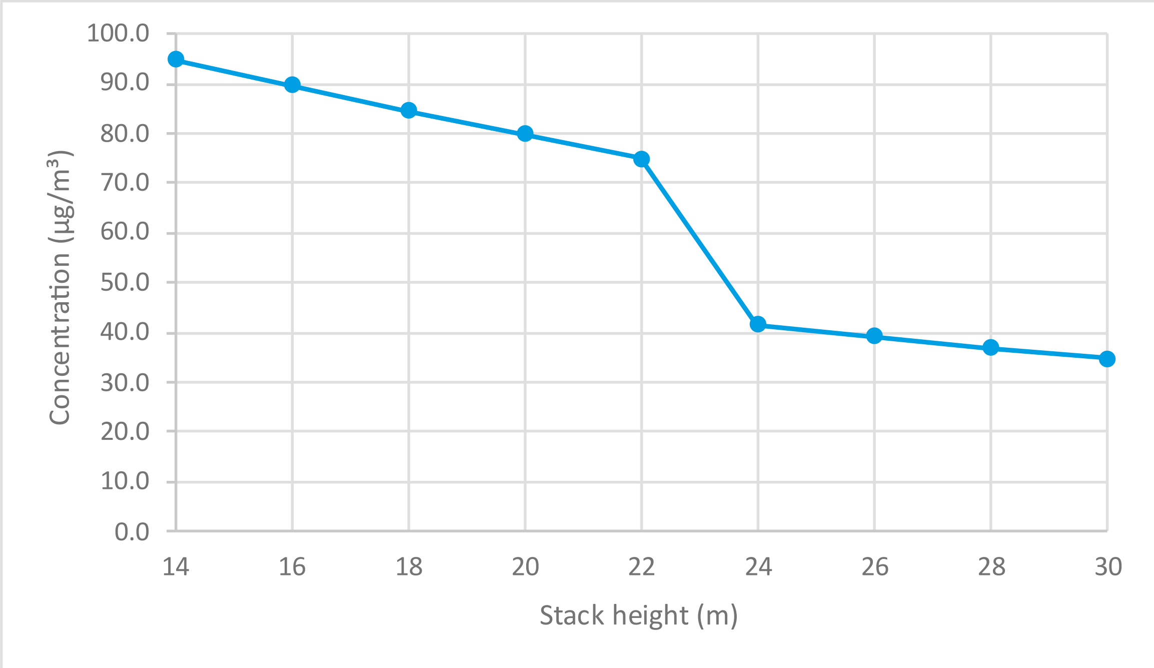
The following parameters have been kept constant:

- emissions scenario – 100% flow rate;
- buildings – included;
- terrain – excluded;
- dispersion site surface roughness length – 0.2 m;
- meteorological surface roughness length – 0.3 m;
- dispersion and meteorological site Minimum Monin-Obukhov length – 1 m;
- meteorological data used – Shawbury 2018 - 2022.

Graph 1: Annual Mean Stack Height Analysis



Graph 2: Short-Term Stack Height Analysis



As shown, for annual mean concentrations there is a levelling-off in the slope of the graph for stack heights of 22 – 24 m. For stack heights above 24 m maximum concentrations then continue to decrease. For short-term (maximum 1-hour) impacts there is a significant decrease in impacts at a stack height of 24 m. This is the stack height above which there are no building downwash effects due to the new 7.8 m tall biofilter building.

Although there is some benefit to increasing the stack height above the maximum of 20 m that can be supported by the building, this would only be required if the impact of emissions with a 20 m stack are unacceptable. The above results are based on the point of maximum impact outside of the installation boundary. There is no relevant exposure at this point and the impact assessment presented in section 8 and section 9 has not identified any significant impacts due to emissions from a 20 m stack. Therefore, a 20 m stack height is considered sufficiently tall to provide adequate dispersion of emissions.

7.2 Surface roughness length

The sensitivity of the results to surface roughness length has been considered by running the model with a range of surface roughness lengths for the dispersion site.

The following parameters have been kept constant:

- stack height – 20 m;
- emissions scenario – seasonally varying profile;
- buildings – included;
- terrain – excluded;
- meteorological site surface roughness length – 0.3 m;
- dispersion site and meteorological Minimum Monin-Obukhov length – 1 m;
- meteorological data used – Shawbury 2020.

Table 12 presents the concentration at the point of maximum impact outside of the installation boundary and at the maximum impacted receptor for each surface roughness value.

Table 12: Choice of Surface Roughness Length

Dispersion site surface roughness length (m)	Ammonia PC (µg/m³)			
	Point of maximum impact		Maximum impacted receptor	
	Annual mean	Max 1-hour	Annual mean	Max 1-hour
0.02	0.13	5.61	0.10	2.01
0.1	0.15	5.68	0.10	1.87
0.2	**0.17**	**5.70**	**0.10**	**1.78**
0.3	0.18	5.70	0.10	1.78
0.5	0.20	5.22	0.10	1.76
% Change from 0.2 m				
0.02	-23.4%	-1.4%	5.3%	13.0%
0.1	-13.4%	-0.2%	1.5%	5.3%
0.3	6.1%	0.0%	-1.0%	0.2%
0.5	19.4%	-8.4%	-2.2%	-1.2%

As shown, the maximum annual mean results are sensitive to the choice of surface roughness length, but short-term results and the annual mean impact at the maximum impacted receptor are less sensitive. The selected value of 0.2 m is considered appropriate given the relatively open rural surroundings of the Facility.

7.3 Terrain

The sensitivity of the results to the effect of terrain has been considered by running the model with and without a complex terrain file at 64 x 64 resolution.

The following parameters have been kept constant:

- stack height – 20 m;
- emissions scenario – seasonally varying profile;
- buildings – included;
- dispersion site surface roughness length – 0.2 m;
- meteorological surface roughness length – 0.3 m;
- dispersion and meteorological site Minimum Monin-Obukhov length – 1 m;
- meteorological data used – Shawbury 2020.

Table 13 presents the concentration at the point of maximum impact outside of the installation boundary and at the maximum impacted receptor for each scenario.

Table 13: Effect of Terrain

Scenario	Ammonia PC (µg/m³)			
	Point of maximum impact		Maximum impacted receptor	
	Annual mean	Max 1-hour	Annual mean	Max 1-hour
Excluding terrain	**0.17**	**5.70**	**0.10**	**1.78**
Including terrain	0.17	5.85	0.09	1.85
% change	1.7%	2.7%	-3.8%	4.1%

Modelling the effect of terrain results in very small changes to the modelled concentrations. As terrain effects are negligible and the surrounding landscape is relatively flat, terrain effects have not been applied in the main model runs.

7.4 Building parameters

The sensitivity of the results to the effect of the modelled building has been considered by running the model with and without the building.

The following parameters have been kept constant:

- stack height – 20 m;
- emissions scenario – seasonally varying profile;
- terrain – excluded;
- dispersion site surface roughness length – 0.2 m;
- meteorological surface roughness length – 0.3 m;
- dispersion site and meteorological Minimum Monin-Obukhov length – 1 m;
- meteorological data used – Shawbury 2020.

Table 14 presents the concentration at the point of maximum impact outside of the installation boundary and at the maximum impacted receptor for each scenario.

Table 14: Effect of Buildings

Scenario	Ammonia PC (µg/m³)			
	Point of maximum impact		Maximum impacted receptor	
	Annual mean	Max 1-hour	Annual mean	Max 1-hour
Including buildings	**0.17**	**5.70**	**0.10**	**1.78**
Excluding buildings	0.09	2.62	0.06	1.24
% change	-46.4%	-53.9%	-40.8%	-30.2%

Modelling the presence of the buildings results in significantly higher annual mean and short-term concentrations. The buildings have been included in the dispersion model as this represents a realistic approach.

7.5 Operating below maximum load

It has been assumed that the Facility will operate as per the expected daily operational profile described in section 6.2. It is considered appropriate to base the assessment of annual mean impacts on the model results using the expected daily operational profile. However, for the assessment of short-term impacts it is possible that the range of meteorological conditions modelled and the operational profile do not combine to assess the worst-case combination of emissions and meteorological conditions. Therefore, the model has been run with the flow rate at 100%, 70% and 40% of full load and ammonia emissions at the proposed ELV. This has considered all five years of weather data to account for worst-case weather conditions for dispersion.

The following parameters have been kept constant:

- stack height – 20 m;
- terrain – excluded;
- dispersion site surface roughness length – 0.2 m;
- meteorological surface roughness length – 0.3 m;
- dispersion site and meteorological Minimum Monin-Obukhov length – 1 m;
- meteorological data used – Shawbury 2018 - 2022.

Table 15 presents the concentration at the point of maximum impact outside of the installation boundary and at the maximum impacted receptor for each scenario. This has considered the effect on short-term concentrations only.

Table 15: Effect of Flow Rate

Scenario	Maximum 1-hour ammonia PC (µg/m³)	
	Point of maximum impact	Maximum impacted receptor
100% flow rate	**8.41**	**2.30**
70% flow rate	8.24	2.07
40% flow rate	8.52	1.70
% Change from 100% flow rate		
70% flow rate	-2.0%	-10.3%
40% flow rate	1.3%	-26.1%

The differing loads result in minimal changes in the predicted short-term concentration at the point of maximum impact outside of the installation boundary, with the 40% flow rate resulting in the highest concentration by a small margin. At the maximum impacted receptor location the 100% flow rate scenario clearly results in the greatest impact. As there is no relevant exposure at the point of maximum impact, the full load scenario is considered to represent the worst-case scenario overall for short-term concentrations. The varying flow scenario described in section 6.2.1 has been used to assess long-term impacts.

7.6 Summary

In summary, the remainder of this assessment has been based on the following assumptions:

- stack height – 20 m;
- buildings – included;

- terrain – excluded;
- dispersion site surface roughness length – 0.2 m;
- meteorological surface roughness length – 0.3 m;
- dispersion and meteorological site Minimum Monin-Obukhov length – 1 m;
- meteorological data used – Shawbury 2018 to 2022.

8 Results

8.1 Human health

8.1.1 At the point of maximum impact outside of the installation boundary

Table 16 presents the results of the dispersion modelling at the point of maximum impact of the Facility outside of the installation boundary. The maximum predicted concentrations are based on the following:

- Grid spacing – 15 m fine grid nested within a wider grid of 90 m resolution;
- The maximum impact over five years of weather data from 2018 to 2022 from the Shawbury meteorological recording station;
- Two scenarios:
  - Ammonia emission concentrations at the proposed ELV of 3.5 mg/Nm³; and
  - Seasonally varying ammonia emission concentrations as detailed in section 6.2.1;
- Operation at 70% load during daytime and 40% during nighttime (07:00 – 19:00) and 40% of the maximum overnight (19:00 – 07:00); and
- Operation at 100% load and at the proposed ELV of 3.5 mg/Nm³ during the worst-case weather conditions for dispersion, for the assessment of short-term impacts (scenario 1 only).

The baseline concentrations are taken from the review of baseline data contained in section 3.

Table 16: Dispersion Modelling Results – Point of Maximum Impact Outside of Installation Boundary

Pollutant	Quantity	Units	EAL	Bg Conc.	PC at point of max impact outside installation boundary						Max as % of EAL	PEC (PC +Bg)	PEC as % of EAL
					2018	2019	2020	2021	2022	Max			
Scenario 1: Emissions at ELV													
Ammonia	Annual mean	µg/m³	180	3.40	0.20	0.21	0.24	0.19	0.23	0.24	0.13%	3.64	2.02%
	Hourly mean	µg/m³	2,500	6.80	8.06	7.09	8.41	6.52	6.80	8.41	0.34%	15.21	0.61%
Scenario 2: Seasonally Varying Emissions													
Ammonia	Annual mean	µg/m³	180	3.40	0.13	0.14	0.17	0.14	0.16	0.17	0.09%	3.57	1.98%
	Hourly mean	µg/m³	2,500	6.80	4.54	4.80	5.70	4.84	4.95	5.70	0.23%	12.50	0.50%

As shown, with regard to human health the PC of ammonia is less than 1% of the long-term and 10% of the short-term EALs for both scenarios. Therefore, all impacts on human health can be screened out as 'insignificant'.

For completeness, the annual mean and maximum 1-hour PC at each receptor location identified in Table 5 are presented in Table 17 and Table 18.

Table 17: Annual Mean Ammonia Impacts at Human Receptor Locations

Receptor	Scenario 1 – at ELV		Scenario 2 – seasonally varying	
	µg/m³	% of EAL	µg/m³	% of EAL
R1	0.14	0.08%	0.10	0.05%
R2	0.08	0.04%	0.05	0.03%
R3	0.05	0.03%	0.04	0.02%
R4	0.08	0.04%	0.05	0.03%
R5	0.01	0.01%	0.01	<0.01%
R6	0.03	0.02%	0.02	0.01%
R7	0.01	0.01%	0.01	0.01%
R8	0.01	0.01%	0.01	0.01%
R9	0.07	0.04%	0.05	0.03%

Table 18: Maximum Hourly Mean Ammonia Impacts at Human Receptor Locations

Receptor	Scenario 1 – at ELV		Scenario 2 – seasonally varying	
	µg/m³	% of EAL	µg/m³	% of EAL
R1	2.30	0.09%	1.89	0.08%
R2	2.04	0.08%	1.71	0.07%
R3	2.03	0.08%	1.51	0.06%
R4	2.16	0.09%	1.76	0.07%
R5	0.92	0.04%	0.49	0.02%
R6	1.37	0.05%	0.83	0.03%
R7	1.05	0.04%	0.66	0.03%
R8	1.00	0.04%	0.69	0.03%
R9	1.83	0.07%	1.48	0.06%

8.2 Ecology

8.2.1 Airborne ammonia emissions – assessment against Critical Levels

The impact of emissions has been compared to the Critical Levels listed in Table 1. Further assessment has been undertaken where the PC is greater than 1% of the long Critical Level at European and UK designated sites, or greater than 100% of the Critical Level at local nature sites.

The maximum annual mean ammonia PCs from the Facility at each identified ecological receptor are presented in Table 19. Impacts that cannot be screened out as 'insignificant' are highlighted.

Table 19: Airborne Ammonia Impacts at Ecological Receptors

Receptor	Scenario 1 – at ELV		Scenario 2 – seasonally varying	
	µg/m³	% of Critical Level	µg/m³	% of Critical Level
European and UK designated sites				
E1	0.033	**3.31%**	0.021	**2.06%**
E2	0.002	0.16%	0.001	0.12%
E3	0.001	0.14%	0.001	0.10%
E4	0.001	0.12%	0.001	0.08%
E5	0.003	0.26%	0.002	0.17%
E6	0.002	0.17%	0.001	0.11%
E7	<0.001	0.05%	<0.001	0.03%
E8	0.001	0.05%	<0.001	0.03%
E9	<0.001	0.04%	<0.001	0.02%
Local nature sites				
E10	0.022	2.24%	0.014	1.37%
E11	0.056	5.58%	0.040	3.99%
E12	0.016	1.59%	0.010	0.99%
E13	0.007	0.73%	0.005	0.46%
E14	0.005	0.54%	0.003	0.34%
E15	0.010	1.02%	0.006	0.64%
E16	0.008	0.78%	0.006	0.56%
E17	0.008	0.81%	0.006	0.58%

As shown, in both scenarios the annual mean ammonia impact is less than the screening criteria and is 'insignificant' at all receptor locations, with the exception of E1 (Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses SAC). An illustrative plot file of the annual mean ammonia PC is provided as Figure 7 of Appendix A, which shows the extent of impacts greater than 1% of the Critical Level.

At E1 the maximum impact is predicted to be 3.31% of the Critical Level of 1 µg/m³, assuming ammonia is continually emitted at the ELV, and 2.06% of the Critical Level in the more likely scenario that emissions vary seasonally. As detailed in section 3, annual mean baseline ammonia concentrations monitored at Fenn's Moss range from 1.53 µg/m³ to 2.67 µg/m³, and the maximum mapped background concentration within 5 km of the Facility as taken from APIS is 3.40 µg/m³. As such, the PEC is a minimum of 1.55 µg/m³, which exceeds the Critical Level.

As the PC exceeds 1% of the Critical Level and the PEC exceeds the Critical Level, the impact cannot be screened out as 'insignificant'. One pathway via which ammonia emissions could have an impact is due to the eutrophying effect of nitrogen deposition, which is considered in section 8.2.2. In addition to this, the following considerations can be made:

- Operation at the ELV is a worst-case scenario, with emissions typically expected to be below this level all year;

- As detailed in section 6.2.1, ammonia emissions are expected to be highest in winter and lowest in summer. Ammonia impacts on vegetation are likely to be highest during the growing season in spring and summer, when emissions are not at their highest;
- As shown on Figure 7, the area of impacts greater than 1% of the Critical Level is limited to a small section in the north-east of the SAC;
- Although no activities are currently undertaken at the site, an impact assessment undertaken by Befesa in 2018 for the previous activities predicted a maximum ammonia PC at E1 of 0.149 µg/m³ (for operation at 90% of the ELV for the Befesa operations; the ammonia ELV for the four scrubbers at the Befesa facility is 9 mg/m³, compared to 3.5 mg/m³ for the proposed Facility). These activities remain permitted. The PC of 0.149 µg/m³ is 15% of the Critical Level, much higher than the 0.033 µg/m³ (3.3%) maximum impact predicted due to emissions from the proposed Facility.

As such, it is considered that ammonia emissions from the Facility would not have a significant effect and would have a much smaller impact than the activities currently permitted.

8.2.2 Deposition of emissions – assessment against Critical Loads

In addition to the Critical Levels for the protection of ecosystems, habitat specific Critical Loads for nature conservation sites at risk from acidification and nitrogen deposition (eutrophication) are outlined in APIS. In terms of acid deposition, the APIS Database contains a maximum Critical load for sulphur (ClmaxS), a minimum Critical Load for nitrogen (CLminN) and a maximum Critical Load for nitrogen (ClmaxN). These components define the Critical Load function for acid deposition. Where the acid deposition flux falls within the area under the Critical Load function, no exceedances are predicted.

The APIS database does not include site-specific data for local nature sites. The Critical Loads applied in this assessment have been determined based on a review of the habitats likely to be present at each local nature site.

The relevant Critical Loads for each site are presented in Appendix B.

8.2.2.1 Nitrogen deposition calculation

The impact of deposition has been assessed using the methodology detailed within the Habitats Directive AQTAG 6 (March 2014). The steps to this method are as follows.

1. Determine the annual mean ground level concentrations of ammonia at each site.
2. Calculate the dry deposition flux (µg/m^2/s) at each site by multiplying the annual mean ground level concentration by the relevant deposition velocity presented in Table 20.
3. Convert the dry deposition flux into units of kgN/ha/yr using the conversion factors presented in Table 20.
4. Compare this result to the nitrogen deposition Critical Load.

Table 20: Deposition Factors

Pollutant	Deposition velocity (m/s)		Conversion factor (µg/m^2/s to kg/ha/year)
	Grassland	Woodland	
Ammonia	0.02	0.03	259.7

Source: AQTAG 6 (March 2014)

8.2.2.2 Acid deposition calculation

Deposition of ammonia can cause acidification and should be taken into consideration when assessing the impact of the Facility.

The steps to determine the acid deposition flux are as follows.

1. Determine the dry deposition rate in kg/ha/yr of nitrogen using the methodology outlined in section 8.2.2.1.
2. Apply the conversion factor for N outlined in Table 21 to the nitrogen deposition rate in kg/ha/year to determine the total keq N/ha/year.
3. Plot the results against the Critical Load functions.

Table 21: Conversion Factors

Pollutant	Conversion factor (kg/ha/year to keq/ha/year)
Nitrogen	Divide by 14

Source: AQTAG (March 2014)

The contribution from the Facility has been calculated using APIS formula:

Where PEC N Deposition < CLminN:

PC as % of CL function = PC S deposition / ClmaxS

Where PEC N Deposition > CLminN:

PC as % of CL function = (PC S + N deposition) / ClmaxN

8.2.2.3 Deposition results

The detailed deposition analysis and results are presented in Appendix C. The results are summarised in Table 22. The results summary is based on the following approach:

- the seasonally varying emissions concentrations scenario (i.e. scenario 2) has been applied, which is considered to be the most realistic emissions scenario;
- the maximum impact within the Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses where the designated habitats (bogs and heaths) have been identified has been presented; this location is the same as modelled for E10 (Fenn's, Whixall & Bettisfield Mosses NNR);
- where more than one sensitive habitat is present in the designated site, the impact has been presented for the habitat that experiences the greatest impact; and
- the average over five years of weather data has been presented; this is considered appropriate as the effects of deposition impacts occur over multi-year timescales.

Full results for all habitats assessed and a comparison with the results assuming continual operation at the proposed ELV and for the worst-case year of weather data are presented in Appendix C.

Table 22: Deposition results summary – Scenario 2, Average

Ref	Receptor name	Nitrogen deposition			Acid deposition		
		Min CL kgN/ha/yr	PC kgN/ha/yr	PC %CL	Min CLmaxN keq/ha/yr	PC keq/ha/yr	PC %CL
European and UK designated sites							
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	5	0.044	0.88%	0.534	0.0031	0.59%
E2	Brown Moss	2	0.005	0.27%	0.545	0.0004	0.07%
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	10	0.007	0.07%	1.806	0.0005	0.03%
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	15	0.004	0.03%	-(1)	-	-
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	2	0.008	0.38%	1.661	0.0008	0.05%
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	-(1)	-	-	-(1)	-	-
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	5	0.001	0.02%	0.511	0.0001	0.02%
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	10	0.002	0.02%	1.607	0.0001	0.01%
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	5	0.001	0.02%	1.6	0.0001	0.01%
Local nature sites							
E10	Fenn's, Whixall & Bettisfield Mosses	5	0.044	0.88%	0.534	0.0031	0.59%
E11	Fenn's Rough Ancient Woodland	10	0.286	2.86%	1.672	0.0204	1.22%
E12	Fenn's Wood Ancient Woodland North	10	0.064	0.64%	0.546	0.0046	0.84%

Ref	Receptor name	Nitrogen deposition			Acid deposition		
		Min CL kgN/ha/yr	PC kgN/ha/yr	PC %CL	Min CLmaxN keq/ha/yr	PC keq/ha/yr	PC %CL
E13	Fenn's Wood Ancient Woodland Mid	10	0.030	0.30%	0.547	0.0021	0.39%
E14	Fenn's Wood Ancient Woodland South	10	0.022	0.22%	0.547	0.0016	0.29%
E15	Unnamed Ancient Woodland 1	10	0.041	0.41%	0.547	0.0030	0.54%
E16	Unnamed Ancient Woodland 2	10	0.040	0.40%	1.75	0.0028	0.16%
E17	Unnamed Ancient Woodland 3	10	0.039	0.39%	1.777	0.0028	0.16%

Note:
(1) No Critical Loads defined.

As shown, nitrogen and acid deposition impacts on sensitive habitats are all less than the screening criteria and are ‘insignificant’ at all receptor locations. The detailed results in Appendix C show that the impact at Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses is predicted to exceed 1% of the Critical Load and cannot be screened out as ‘insignificant’ for Scenario 1 and Scenario 2, with the impact falling below 1% when interannual variability is taken into account by taking the average impact over five years of weather data. However, it is considered the most realistic scenario to take the seasonally varying emissions profile and the average impact over five years of weather data. Under this scenario, the impact can be screened out as ‘insignificant’ and no significant impacts are predicted.

9 Odour

As detailed in section 5.2.1, the applicable odour assessment criterion is that odour concentrations should be below 1.5 OU_E/m^3 as the 98th percentile of hourly means for the most offensive odours; it has conservatively been assumed that odours from the process would fall into this 'most offensive' category.

The odour concentrations due to emissions from the biofilters have been assessed at the point of maximum impact outside of the installation boundary and at areas of relevant exposure. Table 23 presents the results of the modelling. This has assumed continual operation of the biofilter at 100% flow rate with emissions at the BAT-AEL of 1,000 OU_E/m^3, although it is noted that in accordance with BAT 34 of the Waste Treatment BAT Conclusions, for channelled emissions to air either the BAT-AEL for ammonia or odour applies. As a BAT-AEL for ammonia is being applied for, it is anticipated that the BAT-AEL for odour will not be included as an emission limit in the EP..

Table 23: Odour Modelling Results

ID	Receptor name	98th percentile of hourly mean odour concentration	
		OU_E/m^3	% of assessment criterion
Point of maximum impact		0.73	49%
R1	Park Farm Cottages, Fenn's Bank Road	0.51	34%
R2	Fenn's Bank Road 2	0.41	27%
R3	Fenn's Bank Road 3	0.34	22%
R4	Residence near Mereside Industrial Park	0.42	28%
R5	The Conery, Conery Lane	0.09	6%
R6	Woodlands Farm, Conery Lane	0.18	12%
R7	Conery Lane Farm, Conery Lane	0.10	7%
R8	Pinfold Cottage, Long Lane	0.11	7%
R9	The View, Fenn's Bank Road	0.34	23%

As shown, the maximum impact at any location outside of the installation boundary, considering maximum flow rate and the worst-case of the five years of modelled weather data, is only 49% of the assessment criterion. The impact at receptor locations is lower at 34% of the assessment criterion. Therefore, no significant odour impacts are expected due to emissions from the biofilter. Figure 8 of Appendix A illustrates the dispersion pattern.

These results show that an odour emission concentration of less than 2,040 OU_E/m^3 is required for the impact to be less than the 1.5 OU_E/m^3 criterion at the point pf maximum impact outside of the installation boundary. The odour emission concentration would need to be less than 2,940 OU_E/m^3 for the impact to be less than 1.5 OU_E/m^3 criterion at the receptor with the highest impact.

In addition, there is the potential for odour emissions from waste reception and handling, and from the maturation pads which will utilise a forced aeration system which means there is no need to turn the piles. Waste reception and handling procedures will be developed as part of the Odour Management Plan (OMP) for the Facility, while the forced aeration used in the maturation process will ensure aerobic conditions are maintained thereby preventing the formation of highly odourous compounds. As such, no significant odour impacts are anticipated due to odour emissions from either the biofilter (as assessed above) or any other sources.

10 Conclusions

This Air Quality Assessment has been undertaken to support the EP application for an in-vessel composting facility to be installed at the former Befesa salt slag processing facility, Fenn's Bank, near Whitchurch.

The primary conclusions of the assessment are presented below.

1. In relation to the impact of ammonia emissions on human health:
    a. No exceedance of an EAL is predicted.
    b. All impacts can be screened out as 'insignificant'.
2. In relation to the impact of ammonia emissions on ecological sensitive sites:
    a. The impact on annual mean airborne ammonia concentrations can be screened out as 'insignificant', except at the Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses SAC. Taking into account the site context including historical ammonia emissions (from activities for which the site is still permitted), the predicted impact is small and is considered unlikely to have a significant effect.
    b. Taking into account the likely emissions profile and average impact over five years of modelled weather data, the nitrogen and acid deposition impact at all receptors can be screened out as 'insignificant'.
3. In relation to odour emissions:
    a. Odour dispersion modelling has shown that the maximum odour impact due to emissions from the biofilters will be well below the assessment criterion of 1.5 OU_E/m^3.
    b. An Odour Management Plan will be implemented, which will effectively manage other sources of odour associated with the operation of the Facility to ensure there are no significant odour impacts.

Based on the above, it is concluded that the operation of the Facility will not have a significant effect on local air quality, the general population or the local community. As such there should be no air quality constraint in granting an EP to operate the Facility.

Appendices

A Figures

Legend

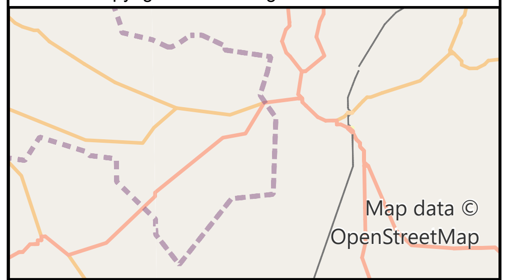
Site location

Client:	Veolia
Site:	Shropshire IVC EP Application
Project:	Air Quality Assessment

Title:

Figure 1. Site Location

Drawn by: SMN	Date:



0 0.25 0.5 1 km

N

Scale: 1:25,000

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Kingsgate, Wellington Road North,
Stockport, Cheshire, SK4 1LW
Tel: 0161 476 0032
Fax: 0161 474 0618

Legend

- Installation boundary
- Stack
- Human receptors

Client:	Veolia
Site:	Shropshire IVC EP Application
Project:	Air Quality Assessment

Title:

Figure 2. Human Receptors

Drawn by: SMN	Date:

Whitchurch

Map data © OpenStreetMap

0 0.05 0.1 0.2 km

Scale: 1:7,000

N

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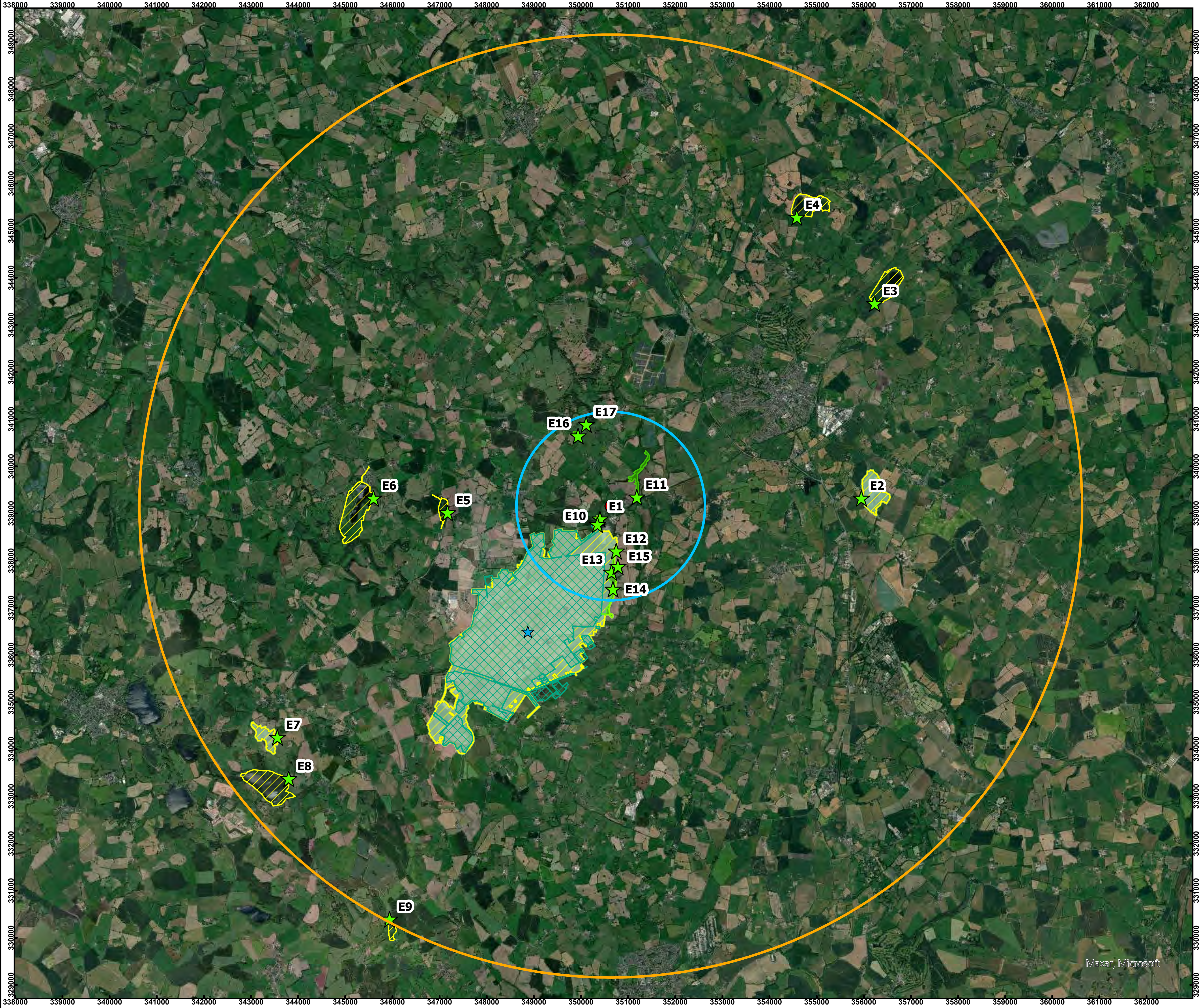


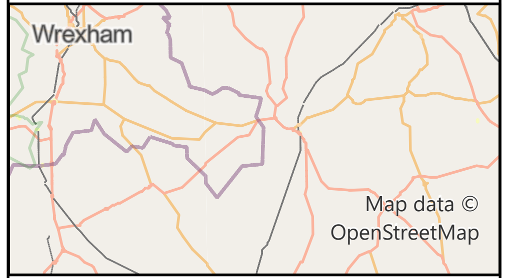
Legend

- Stack
- 10 km screening distance
- 2 km screening distance
- Ecological Receptors
- Ancient Woodlands
- National Nature Reserves
- Ramsars
- SACs
- Fenns Bank Ammonia Monitoring Site

Client:	Veolia
Site:	Shropshire IVC EP Application
Project:	Air Quality Assessment
Title:	

Figure 3. Ecological Receptors

Drawn by: SMN	Date:



0 0.75 1.5 3 km

N

Scale: 1:75,000

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Legend

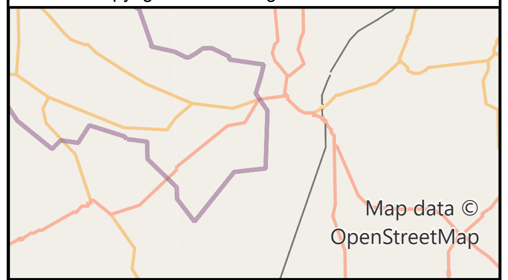
- Site location
- Wide grid extent
- Fine grid extent

Client:	Veolia
Site:	Shropshire IVC EP Application
Project:	Air Quality Assessment

Title:

Figure 4. Modelling Domain

Drawn by: SMN	Date:



0 0.4 0.8 1.6 km

Scale: 1:40,000

N

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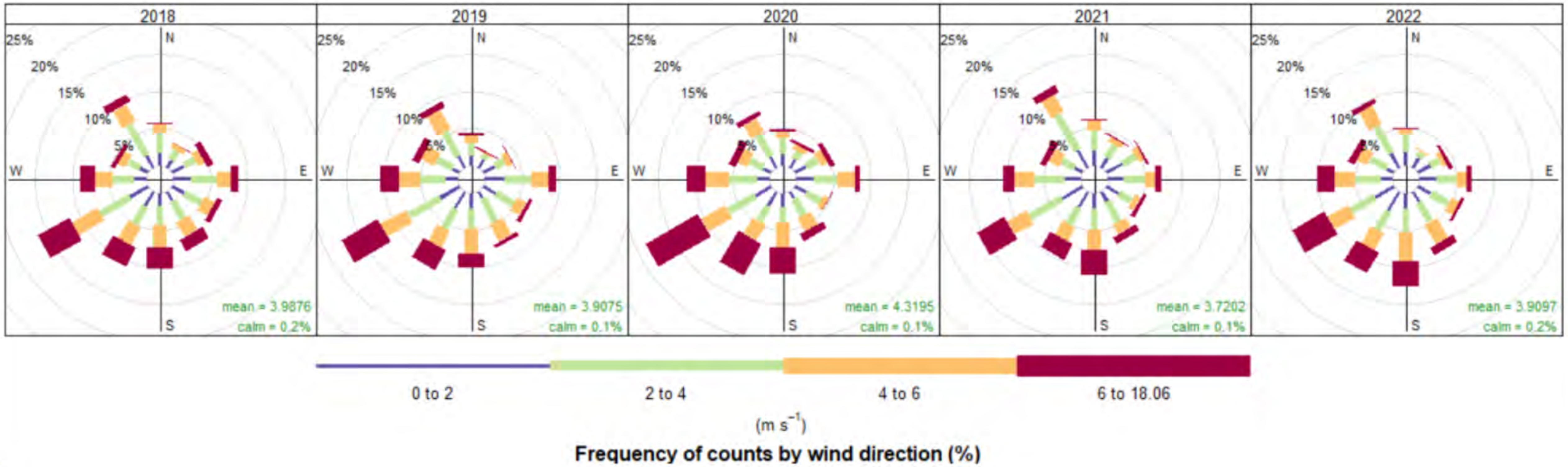
Tel: 0161 476 0032
Fax: 0161 474 0618



Legend

Client:	Veolia
Site:	Shropshire IVC EP Application
Project:	Air Quality Assessment
Title:	

Figure 5. Wind Roses Shawbury 2018 - 2022

Drawn by: SMN	Date: 02/05/2025

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Fax: 0161 474 0618

Legend

Installation boundary

Stack

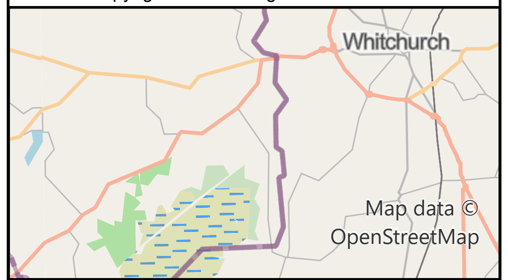
Buildings modelled

Client:	Veolia
Site:	Shropshire IVC EP Application
Project:	Air Quality Assessment

Title:

Figure 6. Buildings Modelled

Drawn by: SMN	Date:



0 0.02 0.04 0.08 km

N

Scale: 1:2,000

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Tel: 0161 476 0032
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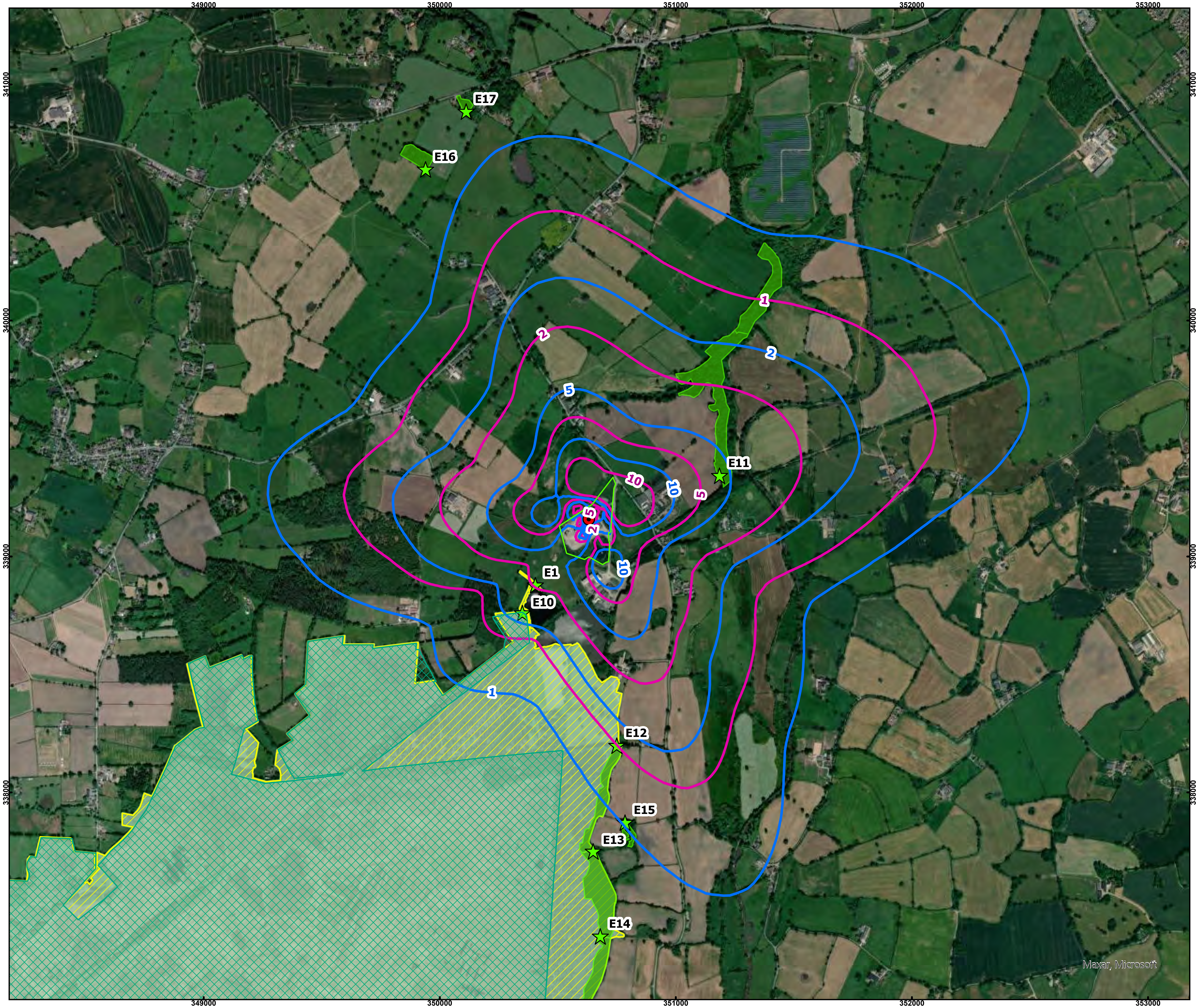


Legend

- Installation boundary
- Stack
- Ecological Receptors
- Ancient Woodlands
- Ramsars
- SACs
- Ammonia as % of Critical Level - Scenario 1
- Ammonia as % of Critical Level - Scenario 2

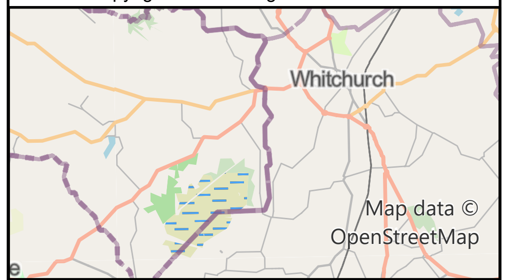
Notes: Impact as % of lower Critical Level of 1 µg/m³

Client:	Veolia
Site:	Shropshire IVC EP Application
Project:	Air Quality Assessment

Title:

Figure 7. Ammonia Impact at Ecological Receptors

Drawn by: SMN	Date:



0 0.15 0.3 0.6 km

Scale: 1:15,000

N

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Legend

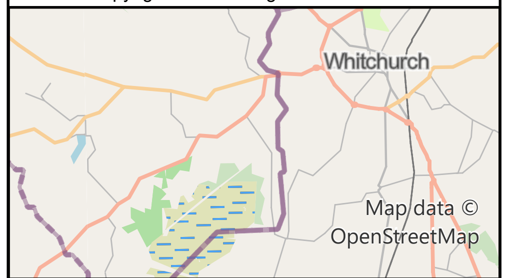
- Installation boundary
- Stack
- Human receptors
- 98th percentile of hourly mean odour concentrations - OUe/m³

Client:	Veolia
Site:	Shropshire IVC EP Application
Project:	Air Quality Assessment

Title:

Figure 8. Odour Impact

Drawn by: SMN	Date:



0 0.05 0.1 0.2 km

Scale: 1:7,000

N

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Tel: 0161 476 0032
Fax: 0161 474 0618

B APIS Critical Loads

Table 24: Nitrogen deposition critical loads

Ref	Site name	Species/habitat type	NCL class[1]	Lower Critical Load (kgN/ha/yr)	Upper Critical Load (kgN/ha/yr)	Background (kgN/ha/yr)
European and UK statutory designated sites						
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	Active raised bogs	Raised and blanket bogs	5	10	22.5
E2	Brown Moss	Luronium natans	Permanent oligotrophic lakes, ponds and pools (including softwater lakes)	2	10	24.8
		Transition mires and quaking bogs	Valley mires, poor fens and transition mires	5	15	24.8
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Phragmites Australis Swamp And Reed-Beds	Rich fens	15	25	23.8
		Alnus glutinosa - Carex paniculata Woodland	Broadleaved deciduous woodland	10	15	43.3
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	Juncus Effusus / Acutiflorus - Galium Palustre Rush Pasture	Moist or wet mesotrophic to eutrophic hay meadow	15	25	23.4
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Standing water -Oligotrophic	Permanent oligotrophic lakes, ponds and pools (including softwater lakes)	2	10	21.7
		Semi-natural woodland (Alnus glutinosa-Urtica dioica woodland: Typical subcommunity)	Broadleaved deciduous woodland	10	15	39.6

Ref	Site name	Species/habitat type	NCL class[1]	Lower Critical Load (kgN/ha/yr)	Upper Critical Load (kgN/ha/yr)	Background (kgN/ha/yr)
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	-	No Critical Load defined	-	-	-
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	Sphagnum Cuspidatum/recurvum (Fallax) Bog Pool Community	Raised and blanket bogs	5	10	20.2
		Quercus Spp.-Betula Spp.-Deschampsia Flexuosa Woodland	Acidophilous Quercus forest	10	20	37.3
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Cynosurus Cristatus - Centaurea Nigra Grassland	Low and medium altitude hay meadows	10	20	20.2
		Alnus glutinosa - Carex paniculata Woodland	Broadleaved deciduous woodland	10	15	37.2
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Carex Rostrata - Potentilla Palustris Swamp	Valley mires, poor fens and transition mires	5	15	20.5
		Alnus glutinosa - Carex paniculata Woodland	Broadleaved deciduous woodland	10	15	37.9
Local nature sites						
E10	Fenn's, Whixall & Bettisfield Mosses	Active raised bogs	Raised and blanket bogs	5	10	22.5
E11	Fenn's Rough Ancient Woodland	Woodland	Broadleaved deciduous woodland	10	15	40.9
E12	Fenn's Wood Ancient Woodland North	Woodland	Broadleaved deciduous woodland	10	15	41.0
E13	Fenn's Wood Ancient Woodland Mid	Woodland	Broadleaved deciduous woodland	10	15	41.6
E14	Fenn's Wood Ancient Woodland South	Woodland	Broadleaved deciduous woodland	10	15	41.6
E15	Unnamed Ancient Woodland 1	Woodland	Broadleaved deciduous woodland	10	15	41.6
E16	Unnamed Ancient Woodland 2	Woodland	Broadleaved deciduous woodland	10	15	39.6

Ref	Site name	Species/habitat type	NCL class[1]	Lower Critical Load (kgN/ha/yr)	Upper Critical Load (kgN/ha/yr)	Background (kgN/ha/yr)
E17	Unnamed Ancient Woodland 3	Woodland	Broadleaved deciduous woodland	10	15	40.0

Note:

(1) For sites where multiple sensitive habitats are present, the most sensitive of the habitats present that can be categorised as *aquatic habitats, short vegetation and woodland have been included in the assessment. If any potentially significant deposition impacts are identified, the full range of habitats present will be considered.*

Table 25: Acid deposition critical loads

Ref	Site name	Species/ habitat type	Acidity class[1]	Critical Load Function (keq/ha/yr)			Background (keq/ha/yr)
				CLminN	CLmaxN	CLmaxS	N + S
European and UK designated sites							
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	Active raised bogs	Bogs	0.321	0.534	0.213	1.7
E2	Brown Moss	Transition mires and quaking bogs	Bogs	0.321	0.545	0.224	1.8
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Alnus glutinosa - Carex paniculata Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.357	1.806	1.449	3.2
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	-	No Critical Load defined	-	-	-	-
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Semi-natural woodland (Alnus glutinosa-Urtica dioica woodland: Typical subcommunity)	Unmanaged Broadleafed/ Coniferous Woodland	0.142	1.661	1.393	2.9
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	-	No Critical Load defined	-	-	-	-
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	Sphagnum Cuspidatum/recurvum (Fallax) Bog Pool Community	Bogs	0.321	0.511	0.19	1.5
		Bog woodland	Bogs	0.321	0.511	0.19	2.7
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Cynosurus Cristatus - Centaurea Nigra Grassland	Calcareous grassland (using base cation)	0.856	4.856	4	1.5
		Alnus glutinosa - Carex paniculata Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.142	1.607	1.465	2.7

Ref	Site name	Species/ habitat type	Acidity class[(1)]	Critical Load Function (keq/ha/yr)			Background (keq/ha/yr)
				CLminN	CLmaxN	CLmaxS	N + S
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Alnus glutinosa - Carex paniculata Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.142	1.6	1.333	2.8
Local nature sites							
E10	Fenn's, Whixall & Bettisfield Mosses	Active raised bogs	Bogs	0.321	0.534	0.213	1.7
E11	Fenn's Rough Ancient Woodland	Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.142	1.672	1.53	3.0
E12	Fenn's Wood Ancient Woodland North	Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.285	0.546	0.261	3.0
E13	Fenn's Wood Ancient Woodland Mid	Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.285	0.547	0.262	3.1
E14	Fenn's Wood Ancient Woodland South	Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.285	0.547	0.262	3.1
E15	Unnamed Ancient Woodland 1	Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.285	0.547	0.262	3.1
E16	Unnamed Ancient Woodland 2	Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.357	1.75	1393	2.9
E17	Unnamed Ancient Woodland 3	Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.357	1.777	1.42	3.0

Note:

(1) For sites where multiple sensitive habitats are present, the most sensitive of the habitats present that can be categorised as aquatic habitats, short vegetation and woodland have been included in the assessment. If any potentially significant deposition impacts are identified, the full range of habitats present will be considered.

C Deposition Analysis

Table 26: Annual mean process contribution used for deposition calculation

Ref	Site name	Annual mean ammonia PC (µg/m³)		
		Scenario 1	Scenario 2	Scenario 2 – average of met data
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	0.0224	0.0137	0.0085
E2	Brown Moss	0.0016	0.0012	0.0010
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	0.0014	0.0010	0.0010
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	0.0012	0.0008	0.0007
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	0.0026	0.0017	0.0015
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	0.0017	0.0011	0.0009
E7	Clarepool Moss SSSI (Midland Meres and Mosses Phase 1 Ramsar)	0.0005	0.0003	0.0002
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	0.0005	0.0003	0.0002
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	0.0004	0.0002	0.0002
E10	Fenn's, Whixall & Bettisfield Mosses	0.0224	0.0137	0.0085
E11	Fenn's Rough Ancient Woodland	0.0558	0.0399	0.0367
E12	Fenn's Wood Ancient Woodland North	0.0159	0.0099	0.0082
E13	Fenn's Wood Ancient Woodland Mid	0.0073	0.0046	0.0038
E14	Fenn's Wood Ancient Woodland South	0.0054	0.0034	0.0028
E15	Unnamed Ancient Woodland 1	0.0102	0.0064	0.0053
E16	Unnamed Ancient Woodland 2	0.0078	0.0056	0.0051
E17	Unnamed Ancient Woodland 3	0.0081	0.0058	0.0050

Note: Scenario 1 = emissions at proposed ELV, Scenario 2 = seasonally varying emissions. Average of met data = average concentration over five years of modelled weather data.

Table 27: Detailed results – nitrogen deposition – Scenario 1

Ref	Site	NCL class	Deposition velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
European and UK designated sites									
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	Raised and blanket bogs	Grassland	0.116	**2.32%**	**1.16%**	22.6	**452.3%**	**226.2%**
E2	Brown Moss	Permanent oligotrophic lakes, ponds and pools (including softwater lakes)	Grassland	0.008	0.42%	0.08%	24.8	1,240.4%	248.1%
		Valley mires, poor fens and transition mires	Grassland	0.008	0.17%	0.06%	24.8	496.2%	165.4%
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Rich fens	Grassland	0.007	0.05%	0.03%	23.8	158.7%	95.2%
		Broadleaved deciduous woodland	Woodland	0.011	0.11%	0.07%	43.3	433.1%	288.7%
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	Moist or wet mesotrophic to eutrophic hay meadow	Grassland	0.006	0.04%	0.02%	23.4	156.0%	93.6%
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Permanent oligotrophic lakes, ponds and pools (including softwater lakes)	Grassland	0.013	0.67%	0.13%	21.7	1,085.7%	217.1%
		Broadleaved deciduous woodland	Woodland	0.020	0.20%	0.13%	39.6	396.2%	264.1%
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	No Critical Load defined	-	-	-	-	-	-	-
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	Raised and blanket bogs	Grassland	0.003	0.05%	0.03%	20.2	404.1%	202.0%
		Acidophilous Quercus forest	Woodland	0.004	0.04%	0.02%	37.3	373.0%	186.5%

Ref	Site	NCL class	Deposition velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Low and medium altitude hay meadows	Grassland	0.003	0.03%	0.01%	20.2	202.0%	101.0%
		Broadleaved deciduous woodland	Woodland	0.004	0.04%	0.03%	37.2	372.0%	248.0%
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Valley mires, poor fens and transition mires	Grassland	0.002	0.04%	0.01%	20.5	410.0%	136.7%
		Broadleaved deciduous woodland	Woodland	0.003	0.03%	0.02%	37.9	379.0%	252.7%
Local nature sites									
E10	Fenn's, Whixall & Bettisfield Mosses	Raised and blanket bogs	Grassland	0.116	2.32%	1.16%	22.6	452.3%	226.2%
E11	Fenn's Rough Ancient Woodland	Broadleaved deciduous woodland	Woodland	0.435	4.35%	2.90%	41.3	413.3%	275.6%
E12	Fenn's Wood Ancient Woodland North	Broadleaved deciduous woodland	Woodland	0.124	1.24%	0.83%	41.1	411.2%	274.2%
E13	Fenn's Wood Ancient Woodland Mid	Broadleaved deciduous woodland	Woodland	0.057	0.57%	0.38%	41.7	416.6%	277.7%
E14	Fenn's Wood Ancient Woodland South	Broadleaved deciduous woodland	Woodland	0.042	0.42%	0.28%	41.6	416.4%	277.6%
E15	Unnamed Ancient Woodland 1	Broadleaved deciduous woodland	Woodland	0.080	0.80%	0.53%	41.7	416.8%	277.9%
E16	Unnamed Ancient Woodland 2	Broadleaved deciduous woodland	Woodland	0.061	0.61%	0.40%	39.7	396.6%	264.4%
E17	Unnamed Ancient Woodland 3	Broadleaved deciduous woodland	Woodland	0.063	0.63%	0.42%	40.1	400.6%	267.1%

Table 28: Detailed results – nitrogen deposition – Scenario 2

Ref	Site	NCL class	Deposition velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
European and UK designated sites									
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	Raised and blanket bogs	Grassland	0.071	**1.42%**	0.71%	22.6	451.4%	225.7%
E2	Brown Moss	Permanent oligotrophic lakes, ponds and pools (including softwater lakes)	Grassland	0.006	0.30%	0.06%	24.8	1240.3%	248.1%
		Valley mires, poor fens and transition mires	Grassland	0.006	0.12%	0.04%	24.8	496.1%	165.4%
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Rich fens	Grassland	0.005	0.04%	0.02%	23.8	158.7%	95.2%
		Broadleaved deciduous woodland	Woodland	0.008	0.08%	0.05%	43.3	433.1%	288.7%
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	Moist or wet mesotrophic to eutrophic hay meadow	Grassland	0.004	0.03%	0.02%	23.4	156.0%	93.6%
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Permanent oligotrophic lakes, ponds and pools (including softwater lakes)	Grassland	0.009	0.45%	0.09%	21.7	1085.4%	217.1%
		Broadleaved deciduous woodland	Woodland	0.013	0.13%	0.09%	39.6	396.1%	264.1%
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	No Critical Load defined	-	-	-	-	-	-	-
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	Raised and blanket bogs	Grassland	0.002	0.03%	0.02%	20.2	404.0%	202.0%
		Acidophilous Quercus forest	Woodland	0.002	0.02%	0.01%	37.3	373.0%	186.5%

Ref	Site	NCL class	Deposition velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Low and medium altitude hay meadows	Grassland	0.002	0.02%	0.01%	20.2	202.0%	101.0%
		Broadleaved deciduous woodland	Woodland	0.002	0.02%	0.02%	37.2	372.0%	248.0%
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Valley mires, poor fens and transition mires	Grassland	0.001	0.02%	0.01%	20.5	410.0%	136.7%
		Broadleaved deciduous woodland	Woodland	0.002	0.02%	0.01%	37.9	379.0%	252.7%
Local nature sites									
E10	Fenn's, Whixall & Bettisfield Mosses	Raised and blanket bogs	Grassland	0.071	1.42%	0.71%	22.6	451.4%	225.7%
E11	Fenn's Rough Ancient Woodland	Broadleaved deciduous woodland	Woodland	0.311	3.11%	2.07%	41.2	412.1%	274.7%
E12	Fenn's Wood Ancient Woodland North	Broadleaved deciduous woodland	Woodland	0.077	0.77%	0.51%	41.1	410.8%	273.8%
E13	Fenn's Wood Ancient Woodland Mid	Broadleaved deciduous woodland	Woodland	0.035	0.35%	0.24%	41.6	416.4%	277.6%
E14	Fenn's Wood Ancient Woodland South	Broadleaved deciduous woodland	Woodland	0.026	0.26%	0.17%	41.6	416.3%	277.5%
E15	Unnamed Ancient Woodland 1	Broadleaved deciduous woodland	Woodland	0.050	0.50%	0.33%	41.6	416.5%	277.7%
E16	Unnamed Ancient Woodland 2	Broadleaved deciduous woodland	Woodland	0.043	0.43%	0.29%	39.6	396.4%	264.3%
E17	Unnamed Ancient Woodland 3	Broadleaved deciduous woodland	Woodland	0.046	0.46%	0.30%	40.0	400.5%	267.0%

Table 29: Detailed results – nitrogen deposition – Scenario 2, average over five years of weather data

Ref	Site	NCL class	Deposition velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
European and UK designated sites									
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	Raised and blanket bogs	Grassland	0.044	0.88%	0.44%	22.5	450.9%	225.4%
E2	Brown Moss	Permanent oligotrophic lakes, ponds and pools (including softwater lakes)	Grassland	0.005	0.27%	0.05%	24.8	1240.3%	248.1%
		Valley mires, poor fens and transition mires	Grassland	0.005	0.11%	0.04%	24.8	496.1%	165.4%
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Rich fens	Grassland	0.005	0.03%	0.02%	23.8	158.7%	95.2%
		Broadleaved deciduous woodland	Woodland	0.007	0.07%	0.05%	43.3	433.1%	288.7%
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	Moist or wet mesotrophic to eutrophic hay meadow	Grassland	0.004	0.03%	0.02%	23.4	156.0%	93.6%
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Permanent oligotrophic lakes, ponds and pools (including softwater lakes)	Grassland	0.008	0.38%	0.08%	21.7	1085.4%	217.1%
		Broadleaved deciduous woodland	Woodland	0.011	0.11%	0.08%	39.6	396.1%	264.1%
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	No Critical Load defined	-	0.007	-	-	0.0	-	-
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	Raised and blanket bogs	Grassland	0.001	0.02%	0.01%	20.2	404.0%	202.0%
		Acidophilous Quercus forest	Woodland	0.002	0.02%	0.01%	37.3	373.0%	186.5%

Ref	Site	NCL class	Deposition velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Low and medium altitude hay meadows	Grassland	0.001	0.01%	0.01%	20.2	202.0%	101.0%
		Broadleaved deciduous woodland	Woodland	0.002	0.02%	0.01%	37.2	372.0%	248.0%
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Valley mires, poor fens and transition mires	Grassland	0.001	0.02%	0.01%	20.5	410.0%	136.7%
		Broadleaved deciduous woodland	Woodland	0.001	0.01%	0.01%	37.9	379.0%	252.7%
Local nature sites									
E10	Fenn's, Whixall & Bettisfield Mosses	Raised and blanket bogs	Grassland	0.044	0.88%	0.44%	22.5	450.9%	225.4%
E11	Fenn's Rough Ancient Woodland	Broadleaved deciduous woodland	Woodland	0.286	2.86%	1.90%	41.2	411.9%	274.6%
E12	Fenn's Wood Ancient Woodland North	Broadleaved deciduous woodland	Woodland	0.064	0.64%	0.43%	41.1	410.6%	273.8%
E13	Fenn's Wood Ancient Woodland Mid	Broadleaved deciduous woodland	Woodland	0.030	0.30%	0.20%	41.6	416.3%	277.5%
E14	Fenn's Wood Ancient Woodland South	Broadleaved deciduous woodland	Woodland	0.022	0.22%	0.15%	41.6	416.2%	277.5%
E15	Unnamed Ancient Woodland 1	Broadleaved deciduous woodland	Woodland	0.041	0.41%	0.28%	41.6	416.4%	277.6%
E16	Unnamed Ancient Woodland 2	Broadleaved deciduous woodland	Woodland	0.040	0.40%	0.27%	39.6	396.4%	264.3%
E17	Unnamed Ancient Woodland 3	Broadleaved deciduous woodland	Woodland	0.039	0.39%	0.26%	40.0	400.4%	266.9%

Table 30: Detailed results – acid deposition – Scenario 1

Ref	Site	Acidity class	Deposition velocity	PC		PEC	
				N keq/ha/yr	% of CL Function	keq/ha/yr	% of CL Function
European and UK designated sites							
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	Bogs	Grassland	0.0083	**1.55%**	1.71	**319.9%**
E2	Brown Moss	Bogs	Grassland	0.0006	0.11%	1.80	330.4%
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Unmanaged Broadleafed/ Coniferous Woodland	Grassland	0.0008	0.04%	3.20	177.2%
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	No critical load defined	-	-	-	-	-
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Unmanaged Broadleafed/ Coniferous Woodland	Grassland	0.0014	0.09%	2.90	174.7%
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	No Critical Load defined	-	-	-	-	-
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	Bogs	Grassland	0.0002	0.04%	1.50	293.6%
		Bogs	Woodland	0.0003	0.05%	2.70	528.4%
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Calcareous grassland (using base cation)	Grassland	0.0002	<0.01%	1.50	30.9%
		Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0003	0.02%	2.70	168.0%
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0002	0.01%	2.80	175.0%
Local nature sites							

Ref	Site	Acidity class	Deposition velocity	PC		PEC	
				N keq/ha/yr	% of CL Function	keq/ha/yr	% of CL Function
E10	Fenn's, Whixall & Bettisfield Mosses	Bogs	Grassland	0.0083	1.55%	1.71	319.9%
E11	Fenn's Rough Ancient Woodland	Unmanaged Broadleafed/	Woodland	0.0310	1.86%	3.03	181.3%
E12	Fenn's Wood Ancient Woodland North	Coniferous Woodland	Woodland	0.0088	1.62%	3.01	551.1%
E13	Fenn's Wood Ancient Woodland Mid	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0040	0.74%	3.10	567.5%
E14	Fenn's Wood Ancient Woodland South	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0030	0.55%	3.10	567.3%
E15	Unnamed Ancient Woodland 1	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0057	1.04%	3.11	567.8%
E16	Unnamed Ancient Woodland 2	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0043	0.25%	2.90	166.0%
E17	Unnamed Ancient Woodland 3	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0045	0.25%	3.00	169.1%

Table 31: Detailed results – acid deposition – Scenario 2

Ref	Site	Acidity class	Deposition velocity	PC		PEC	
				N keq/ha/yr	% of CL Function	keq/ha/yr	% of CL Function
European and UK designated sites							
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	Bogs	Grassland	0.0051	0.95%	1.71	319.3%
E2	Brown Moss	Bogs	Grassland	0.0004	0.08%	1.80	330.4%
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Unmanaged Broadleafed/ Coniferous Woodland	Grassland	0.0006	0.03%	3.20	177.2%
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	No critical load defined	-	-	-	-	-
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Unmanaged Broadleafed/ Coniferous Woodland	Grassland	0.0010	0.06%	2.90	174.7%
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	No Critical Load defined	-	-	-	-	-
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	Bogs	Grassland	0.0001	0.02%	1.50	293.6%
		Bogs	Woodland	0.0002	0.03%	2.70	528.4%
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Calcareous grassland (using base cation)	Grassland	0.0001	<0.01%	1.50	30.9%
		Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0002	0.01%	2.70	168.0%
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0001	0.01%	2.80	175.0%
Local nature sites							

Ref	Site	Acidity class	Deposition velocity	PC		PEC	
				N keq/ha/yr	% of CL Function	keq/ha/yr	% of CL Function
E10	Fenn's, Whixall & Bettisfield Mosses	Bogs	Grassland	0.0051	0.95%	1.71	319.3%
E11	Fenn's Rough Ancient Woodland	Unmanaged Broadleafed/	Woodland	0.0222	1.33%	3.02	180.8%
E12	Fenn's Wood Ancient Woodland North	Coniferous Woodland	Woodland	0.0055	1.01%	3.01	550.5%
E13	Fenn's Wood Ancient Woodland Mid	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0025	0.46%	3.10	567.2%
E14	Fenn's Wood Ancient Woodland South	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0019	0.34%	3.10	567.1%
E15	Unnamed Ancient Woodland 1	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0036	0.65%	3.10	567.4%
E16	Unnamed Ancient Woodland 2	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0031	0.18%	2.90	165.9%
E17	Unnamed Ancient Woodland 3	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0033	0.18%	3.00	169.0%

Table 32: Detailed results – acid deposition – Scenario 2 – average over five years of weather data

Ref	Site	Acidity class	Deposition velocity	PC		PEC	
				N keq/ha/yr	% of CL Function	keq/ha/yr	% of CL Function
European and UK designated sites							
E1	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	Bogs	Grassland	0.0031	0.59%	1.70	318.9%
E2	Brown Moss	Bogs	Grassland	0.0004	0.07%	1.80	330.3%
E3	Oss Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Unmanaged Broadleafed/ Coniferous Woodland	Grassland	0.0005	0.03%	3.20	177.2%
E4	Quoisley Meres SSSI (Midland Meres and Mosses Phase 1 Ramsar)	No critical load defined	-	-	-	-	-
E5	Llyn Bedydd SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Unmanaged Broadleafed/ Coniferous Woodland	Grassland	0.0008	0.05%	2.90	174.6%
E6	Hanmer Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	No Critical Load defined	-	-	-	-	-
E7	West Midland Mosses SAC (Midland Meres and Mosses Phase 1 and Clarepool Moss SSSI)	Bogs	Grassland	0.0001	0.02%	1.50	293.6%
		Bogs	Woodland	0.0001	0.02%	2.70	528.4%
E8	Cole Mere SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Calcareous grassland (using base cation)	Grassland	0.0001	<0.01%	1.50	30.9%
		Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0001	0.01%	2.70	168.0%
E9	Brownheath Moss SSSI (Midland Meres and Mosses Phase 2 Ramsar)	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0001	0.01%	2.80	175.0%
Local nature sites							

Ref	Site	Acidity class	Deposition velocity	PC		PEC	
				N keq/ha/yr	% of CL Function	keq/ha/yr	% of CL Function
E10	Fenn's, Whixall & Bettisfield Mosses	Bogs	Grassland	0.0031	0.59%	1.70	318.9%
E11	Fenn's Rough Ancient Woodland	Unmanaged Broadleafed/	Woodland	0.0204	1.22%	3.02	180.6%
E12	Fenn's Wood Ancient Woodland North	Coniferous Woodland	Woodland	0.0046	0.84%	3.00	550.3%
E13	Fenn's Wood Ancient Woodland Mid	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0021	0.39%	3.10	567.1%
E14	Fenn's Wood Ancient Woodland South	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0016	0.29%	3.10	567.0%
E15	Unnamed Ancient Woodland 1	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0030	0.54%	3.10	567.3%
E16	Unnamed Ancient Woodland 2	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0028	0.16%	2.90	165.9%
E17	Unnamed Ancient Woodland 3	Unmanaged Broadleafed/ Coniferous Woodland	Woodland	0.0028	0.16%	3.00	169.0%

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