Shadow Habitats Regulations Assessment (Air Quality)

Coder Road, Ludlow

Client: Shropshire Council

Reference: 8820-1r1

Date: 21st January 2025

Report Issue

Report Title: Shadow Habitats Regulations Assessment (Air Quality) - Coder Road, Ludlow

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Field	Report Version			
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1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by Shropshire Council to undertake a Shadow Habitats Regulations Assessment (HRA) (Air Quality) in support of a proposed pyrolysis plant off Coder Lane, Ludlow.

1.1.2 The proposal has the potential to cause changes in pollution levels at sensitive ecological locations as a result of atmospheric emissions associated with the operation of the plant. A Shadow HRA (Air Quality) was therefore undertaken in order to consider potential effects.

1.2 Site Location and Context

1.2.1 The site is located off Coder Lane, Ludlow, at approximate National Grid Reference (NGR): 352718, 274710. Reference should be made to Figure 1 for a site location plan.

1.2.2 It is proposed to operate one Woodtek C1000 pyrolysis unit. The plant will be installed within a dedicated building and process emissions will be released to atmosphere through a dispersion stack at a height of 10m.

1.2.3 The proposal has the potential to cause changes in pollution levels at sensitive ecological locations as a result of atmospheric emissions associated with the operation of the plant. A Shadow HRA (Air Quality) was therefore undertaken in order to consider potential effects. This is detailed in the following report.

2.0 METHODOLOGY

2.1 Introduction

2.1.1 The proposal has the potential to cause changes in pollution levels at sensitive ecological locations as a result of atmospheric emissions associated with the operation of the plant. An assessment was therefore undertaken in order to assess potential effects. The associated methodology is outlined in the following Sections.

2.2 Guidance

2.2.1 The following guidance was utilised throughout the assessment:

- Air quality risk assessment interim guidance, Natural England (NE), 2022;
- Air emissions risk assessment for your environment permit, Environment Agency (EA), 2016;
- Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations, NE, 2018; and,
- Habitats regulations assessments: protecting a European site, Department for Environment, Food and Rural Affairs (DEFRA), NE, Welsh Government and Natural Resources Wales, 2021.

2.3 Assessment Stages

2.3.1 The assessment was undertaken in accordance with the stages outlined within the Habitat Regulations Assessment (HRA) guidance[1] produced by DEFRA. This is summarised as follows, though it should be noted that completion of all elements is not always necessary, depending on the findings of each stage:

- Stage 1 - Screening: Plans or projects with no likely significant effect on an ecological designation can be 'screened out' of the need for further assessment;

[1] Habitats regulations assessments: protecting a European site, DEFRA, NE, Welsh Government and Natural Resources Wales, 2021.

- Stage 2 - Appropriate Assessment: Detailed assessment to consider the likely significant effects of the proposal in more detail and identify ways to avoid or minimise any effects; and,
- Stage 3 - Derogation: To assess the likely significant effects of the proposal in more detail and identify ways to avoid or minimise any effects.

2.3.2 The methodology adopted for each stage is summarised in the following Sections.

2.3.3 It should be noted that although the HRA methodology only applies to European sites, the approach has also been adopted when considering effects on Sites of Special Scientific Interest (SSSIs) in lieu of alternative guidance.

Stage 1: Screening

2.3.4 Stage 1: Screening utilised the following steps, as derived from relevant guidance[2] [3] and information provided within consultation responses from NE on similar projects:

- Step 1: Does the proposal give rise to emissions which are likely to reach an ecological site? If there are no designations within 10km of the project, then a screening conclusion of no likely significant effect can be reached with regard to air quality;
- Step 2: Are the qualifying features of the designation sensitive to air pollution? If there are no sensitive qualifying features, then a screening conclusion of no likely significant effect on the site can be reached with regard to air quality;
- Step 3: Could the sensitive qualifying features of the site be exposed to emissions? If the qualifying features could not be exposed to emissions, as they are greater than 10km from the project, then a screening conclusion of no likely significant effect on the site can be reached with regard to air quality;
- Step 4: Application of the following screening thresholds to determine potential risk of effects alone and in-combination with emissions from other plans and projects:
    - 4a) Alone: Risk of significant effect if a Predicted Concentration (PC) is 1% of the critical load or level or greater as a result of the proposal in isolation; and,

2 Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations, NE, 2018.

3 Air quality risk assessment interim guidance, NE, 2022.

- 4b) In-combination: Risk of significant effect if a PC is 1% of the critical load or level or greater as a result of the proposal in-combination with other relevant plans or projects.

2.3.5 If the above steps indicate a screening conclusion of no likely significant effects on the relevant designations can be reached with regard to air quality, then the assessment can be concluded. If potential effects cannot be screened out, then the assessment should proceed to Stage 2: Appropriate Assessment.

Stage 2: Appropriate Assessment

2.3.6 Having identified a risk of a significant effect from a plan or project either alone or in-combination, the purpose of Stage 2: Appropriate Assessment is to more precisely assess the likely effects and to inform a conclusion as to whether an adverse effect on site integrity can be ruled out. It should be noted that the assessment should be 'appropriate' in terms of its scope, content, length and complexity to the plan or project under assessment. This was reiterated by the Supreme Court[4], which clarified:

> "'Appropriate' is not a technical term. It indicates no more than that the assessment should be appropriate to the task in hand: that task being to satisfy the authority that the project will not adversely affect the integrity of the site concerned."

2.3.7 It should not be assumed that an Appropriate Assessment will necessarily involve detailed and complex monitoring or modelling work. Whilst this may be necessary in fully understanding what will happen to a site if the plan or project goes ahead, it is equally possible that a fairly concise and straightforward assessment might be entirely 'appropriate'.

2.3.8 A number of factors are identified in the NE guidance[5] for further consideration during an Appropriate Assessment. These are summarised as follows:

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4 Champion v North Norfolk DC, UK Supreme Court, 2015.

5 Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations, NE, 2018.

- Consider whether the sensitive qualifying features of the site would be exposed to emissions;
- Consider the European Site's Conservation Objectives;
- Consider background pollution;
- Consider the designated site in its national context;
- Consider the best available evidence on small incremental impacts from nitrogen deposition;
- Consider the spatial scale and duration of the predicted impact and the ecological functionality of the affected area;
- Consider site survey information;
- Consider national, regional and local initiatives or measures which can be relied upon to reduce background levels at the site;
- Consider measures to avoid or reduce the harmful effects of the plan or project on site integrity; and,
- Consider any likely in-combination effects with other live plans and projects from other sectors.

2.3.9 It should be noted that in accordance with the above definition of an Appropriate Assessment, not all factors may be relevant to a specific plan or project and only those which aid in forming a conclusion as to whether an adverse effect on site integrity can be ruled out need to be considered.

3.0 ASSESSMENT

3.1 Introduction

3.1.1 A Stage1: Screening Assessment of potential effects on sensitive ecological designations as result of emissions from the development was undertaken in accordance with the stages outlined in Section 2.3. The results are provided in the following Sections.

3.2 Step 1

3.2.1 Step 1 required identification of any sensitive designations within the vicinity of the site that may be affected by emissions from the development. A pre-application request was submitted to the EA in order to identify any sites of ecological or nature conservation importance that required consideration within the assessment. The response indicated the following should be included:

- River Teme SSSI;
- Temeside SSSI;
- Teme Bank SSSI; and,
- Downton Gorge Special Area of Conservation (SAC);

3.2.2 As shown above, four designations were identified that may be affected by emissions associated with the development. As such, the assessment proceeded to Step 2.

3.3 Step 2

3.3.1 In order to identify whether the designations are sensitive to air pollution, the critical loads and levels for the qualifying features were obtained from the Air Pollution Information System (APIS)[6] website. The relevant data is summarised in Appendix 1.

3.3.2 Review of the relevant data indicated that Temeside SSSI and Teme Bank SSSI are designated for geological features, which are not sensitive to air pollution. As such, a screening conclusion of no likely significant effect can be reached with regard to air quality for these designations.

6 APIS, www.apis.ac.uk.

3.3.3 Critical levels and loads have been identified for qualifying features in the remaining two designations. As such, these are considered sensitive to air pollution and the assessment proceeded to Step 3.

3.4 Step 3

3.4.1 For the purpose of Stage 1: Screening, and in order to provide a worst-case assessment, it was assumed that the most sensitive feature of each designation is located at the boundary closest to the development as this is the area where impacts are most likely. Discrete receptors were subsequently defined to represent these locations. The relevant positions are shown in Table 1.

Table 1 Discrete Receptor Locations

Receptor		NGR (m)	
		X	Y
E1	River Teme SSSI	352175.1	274139.9
E2	River Teme SSSI	351822.6	274293.0
E3	River Teme SSSI	352203.9	273767.1
E4	Downton Gorge SAC	346169.9	275438.3
E5	Downton Gorge SAC	346020.0	275019.6

3.4.2 Reference should be made to Figure 2 for a map of the discrete receptor locations.

3.4.3 The relevant features and critical levels for oxides of nitrogen (NO_x) at the identified receptors are presented in Table 2.

Table 2 Features and Critical Levels for NO_x

Receptor		Feature	Annual Mean Critical Level for NO_x ($\mu g/m^3$)
E1	River Teme SSSI	Flowing waters	30
E2	River Teme SSSI	Flowing waters	30
E3	River Teme SSSI	Flowing waters	30

Receptor		Feature	Annual Mean Critical Level for NO_x (μg/m³)
E4	Downton Gorge SAC	Tilio-Acerion forests of slopes, screes and ravines	30
E5	Downton Gorge SAC	Tilio-Acerion forests of slopes, screes and ravines	30

3.4.4 The relevant features and critical levels for sulphur dioxide (SO_2) at the identified receptors are presented in Table 3.

Table 3 Features and Critical Levels for SO_2

Receptor		Feature	Annual Mean Critical Level for SO_2 (μg/m³)
E1	River Teme SSSI	Flowing waters	10
E2	River Teme SSSI	Flowing waters	10
E3	River Teme SSSI	Flowing waters	10
E4	Downton Gorge SAC	Tilio-Acerion forests of slopes, screes and ravines	10
E5	Downton Gorge SAC	Tilio-Acerion forests of slopes, screes and ravines	10

3.4.5 The relevant features and nitrogen deposition critical loads at the identified receptors are presented in Table 3.

Table 4 Features and Critical Loads for Nitrogen Deposition

Receptor		Feature	Relevant Nitrogen Critical Load Class	Critical Load (kgN/ha/yr)	
				Low	High
E1	River Teme SSSI	Flowing waters	-(a)	-	-
E2	River Teme SSSI	Flowing waters	-(a)	-	-
E3	River Teme SSSI	Flowing waters	-(a)	-	-
E4	Downton Gorge SAC	Tilio-Acerion forests of slopes, screes and ravines	Carpinus and Quercus mesic deciduous forest	15	20

Receptor		Feature	Relevant Nitrogen Critical Load Class	Critical Load (kgN/ha/yr)	
				Low	High
E5	Downton Gorge SAC	Tilio-Acerion forests of slopes, screes and ravines	Carpinus and Quercus mesic deciduous forest	15	20

Note: (a) No comparable habitat with established critical load estimate available on APIS.

3.4.6 The relevant features and acid deposition critical loads at the identified receptors are presented in Table 4.

Table 5 Features and Critical Loads for Acid Deposition

Receptor		Feature	Relevant Acid Critical Load Class	Critical Load (keq/ha/yr)		
				CLMinN	CLMaxS	CLMaxN
E1	River Teme SSSI	Flowing waters	-(a)	-	-	-
E2	River Teme SSSI	Flowing waters	-(a)	-	-	-
E3	River Teme SSSI	Flowing waters	-(a)	-	-	-
E4	Downton Gorge SAC	Tilio-Acerion forests of slopes, screes and ravines	Unmanaged Broadleafed/ Coniferous Woodland	0.142	1.536	1.678
E5	Downton Gorge SAC	Tilio-Acerion forests of slopes, screes and ravines	Unmanaged Broadleafed/ Coniferous Woodland	0.142	1.536	1.678

Note: (a) No comparable habitat with established critical load estimate available on APIS.

3.4.7 A review of the relevant data indicated the qualifying features within the identified designations could be exposed to emissions. As such, a screening conclusion of no likely significant effects on the sites could not be reached with regard to air quality and the assessment proceeded to Step 4.

3.5 Step 4a

3.5.1 Dispersion modelling was undertaken in order to quantify the predicted PC as a result of emissions from the development alone as a proportion of the relevant critical load or level at the identified receptors with subsequent comparison against the screening threshold. Reference should be made to Appendix 2 for the dispersion modelling inputs.

3.5.2 Predicted annual mean NO_x concentrations are summarised in Table 6.

Table 6 Predicted Annual Mean NO_x Concentrations - Development Alone

Receptor		Predicted Annual Mean NO_x Conc. PC (µg/m³)	PC as Proportion of CL (%)
E1	River Teme SSSI	0.14	0.5
E2	River Teme SSSI	0.17	0.6
E3	River Teme SSSI	0.06	0.2
E4	Downton Gorge SAC	0.00	0.0
E5	Downton Gorge SAC	0.00	0.0

3.5.3 As shown in Table 6, the predicted PC as a result of emissions from the development alone was below 1% of the relevant critical level at all receptors. As such, a screening conclusion of no likely significant effect as a result of the development alone can be reached with regard to annual mean NO_x concentrations.

3.5.4 Predicted annual mean SO_2 concentrations are summarised in Table 7.

Table 7 Predicted Annual Mean SO_2 Concentrations - Development Alone

Receptor		Predicted Annual Mean SO_2 Conc. PC (µg/m³)	PC as Proportion of CL (%)
E1	River Teme SSSI	0.03	0.3
E2	River Teme SSSI	0.04	0.4
E3	River Teme SSSI	0.02	0.2
E4	Downton Gorge SAC	0.00	0.0
E5	Downton Gorge SAC	0.00	0.0

3.5.5 As shown in Table 7, the predicted PC as a result of emissions from the development alone was below 1% of the relevant critical level at all receptors. As such, a screening conclusion of no likely significant effect as a result of the development alone can be reached with regard to annual mean SO_2 concentrations.

3.5.6 Predicted annual nitrogen deposition rates are summarised in Table 8.

Table 8 Predicted Annual Nitrogen Deposition - Development Alone

Receptor		Predicted Annual Nitrogen Deposition PC (kgN/ha/yr)	PC as Proportion of CL (%)
E1	River Teme SSSI	0.028	-
E2	River Teme SSSI	0.035	-
E3	River Teme SSSI	0.013	-
E4	Downton Gorge SAC	0.001	0.01
E5	Downton Gorge SAC	0.001	0.01

3.5.7 As shown in Table 8, the predicted PC as a result of emissions from the development alone was below 1% of the relevant critical load at all receptors. As such, a screening conclusion of no likely significant effect as a result of the development alone can be reached with regard to nitrogen deposition.

3.5.8 Predicted annual acid deposition rates are summarised in Table 9.

Table 9 Predicted Annual Acid Deposition - Development Alone

Receptor		Predicted Annual Acid Deposition PC (keq/ha/yr)	PC as Proportion of CL (%)
E1	River Teme SSSI	0.010	-
E2	River Teme SSSI	0.025	-
E3	River Teme SSSI	0.010	-
E4	Downton Gorge SAC	0.001	0.04
E5	Downton Gorge SAC	0.001	0.04

3.5.9 As shown in Table 9, the predicted PC as a result of emissions from the development alone was below 1% of the relevant critical load at all receptors. As such, a screening conclusion of no likely significant effect as a result of the development alone can be reached with regard to acid deposition.

3.6 Step 4b

3.6.1 Step 4b required consideration of potential effects in-combination with other plans or projects. A review of the following information sources was therefore undertaken in order to identify any schemes that may act in-combination, as required by NE guidance[7]:

- Planning Portals to locate applications awaiting permissions;
- Environmental Permits Register of Applications and Register of Issued Permits; and,
- Local Plans (including brownfield registers with permission in principle) and any allocations not yet permitted.

3.6.2 A review of planning applications submitted since 2021 was undertaken to identify any industrial proposals with associated NO_x or SO_2 emissions within 10km of the site.

3.6.3 A review of the Environmental Permit register[8] was also undertaken in order to identify any industrial proposals with associated NO_x or SO_2 emissions within 10km of the site which had received an Environmental Permit or Variation since 2021.

3.6.4 Additionally, review of the site allocations in the relevant Local Plans was undertaken in order to identify any further proposals potentially coming forward within the relevant plan period.

3.6.5 A review period of 2021 onwards was selected to correlate with the latest background pollution data information available from APIS, as well as the expiration timescale for any planning consents that had not been implemented.

3.6.6 A review of the above information sources identified no relevant plans or projects for consideration of in-combination effects with the proposed development. As such, a screening conclusion of no likely significant effect as a result of the development in-

7 Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations, NE, 2018.

8 https://environment.data.gov.uk/public-register/view/index.

combination could be reached with regard to NO_x and SO_2 concentrations, and nitrogen and acid deposition on the ecological designations.

3.7 Summary

3.7.1 The results of Stage 1: Screening can be summarised as follows:

- Four ecological designations were identified that may be affected by emissions from the development;
- Of the identified designations, two have features that are considered sensitive to air pollution. As such, these sites were progressed through the assessment;
- No relevant live applications were identified for consideration of in-combination effects with the development; and,
- The results indicated that a screening conclusion of no likely significant effect as a result of the development alone and in-combination could be reached with regard to NO_x and SO_2 concentrations, and nitrogen and acid deposition on the identified ecological designations.

3.7.2 As shown above, a screening conclusion of no likely significant effect as a result of the development both alone and in-combination could be reached for the identified ecological designations. As such, a Stage 2: Appropriate Assessment was not required.

4.0 CONCLUSION

4.1.1 Redmore Environmental Ltd was commissioned by Shropshire Council to undertake a Shadow HRA (Air Quality) in support of the installation of a proposed pyrolysis plant off Coder Lane, Ludlow.

4.1.2 The proposal has the potential to cause changes in pollution levels at sensitive ecological locations as a result of atmospheric emissions associated with the operation of the plant. A Shadow HRA (Air Quality) was therefore undertaken in order to consider potential effects.

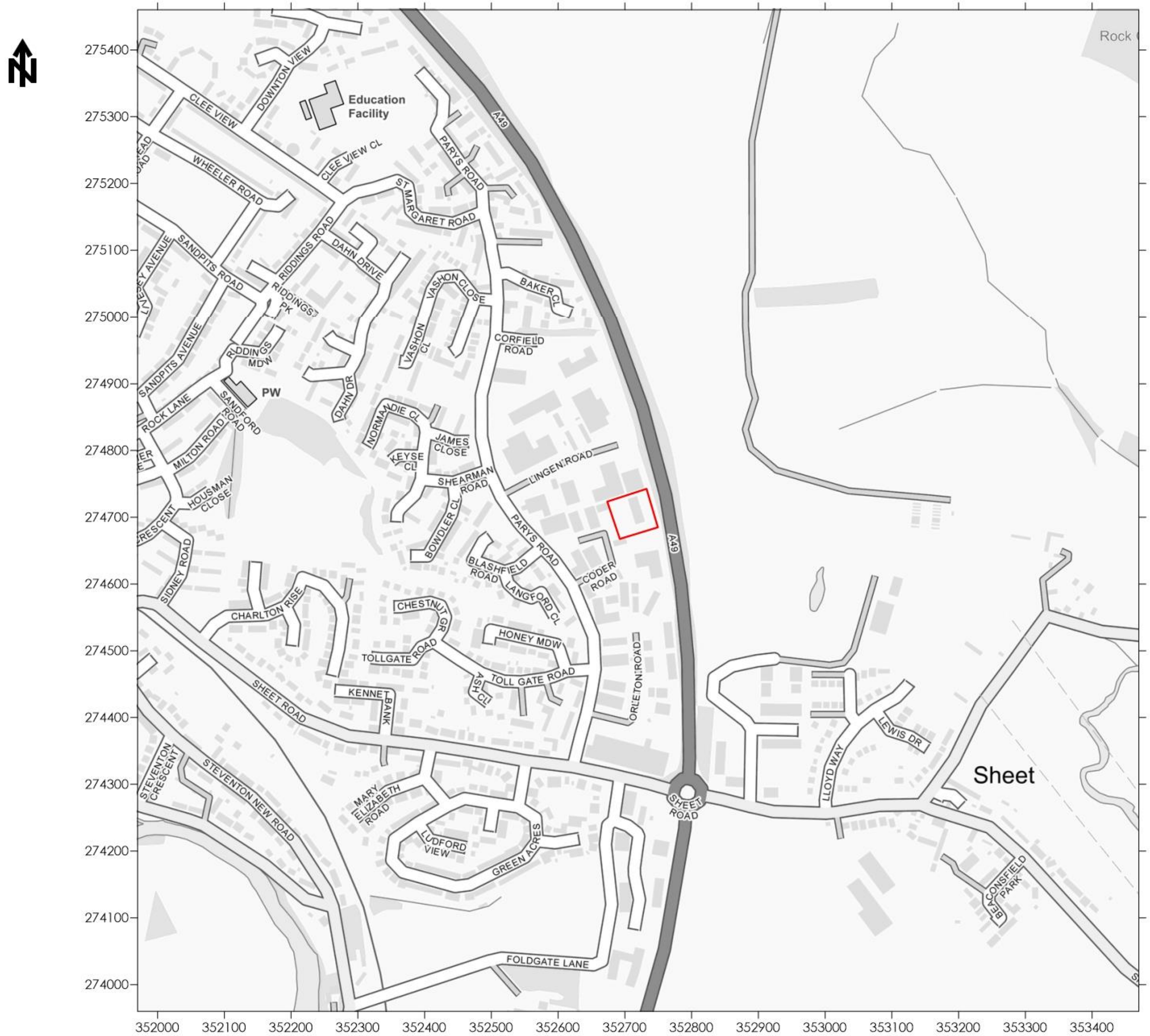
4.1.3 A staged assessment was undertaken with reference to relevant NE guidance. This considered emissions from the development alone and in-combination with other plans and projects.

4.1.4 The results of the assessment indicated a screening conclusion of no likely significant effect as a result of the development in relation to NO_x and SO_2 concentrations, and nitrogen and acid deposition both alone and in-combination could be reached for the identified ecological designations. As such, a Stage 2: Appropriate Assessment was not required.

5.0 ABBREVIATIONS

APIS	Air Pollution Information System
CERC	Cambridge Environmental Research Consultants
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
ELV	Emission Limit Value
HCl	Hydrochloric acid
HRA	Habitats Regulations Assessment
MAGIC	Multi-Agency Geographic Information for the Countryside
NE	Natural England
NGR	National Grid Reference
NO_x	Oxides of Nitrogen
PC	Predicted Concentration
SAC	Special Area of Conservation
SO_2	Sulphur dioxide
SSSI	Site of Special Scientific Interest
z_0	Surface Roughness

Figures



Legend

Site Boundary

Title
Figure 1 - Site Location

Project
Shadow Habitats Regulations Assessment (Air Quality)
Coder Road, Ludlow

Project Reference
8820-1

Client
Shropshire Council

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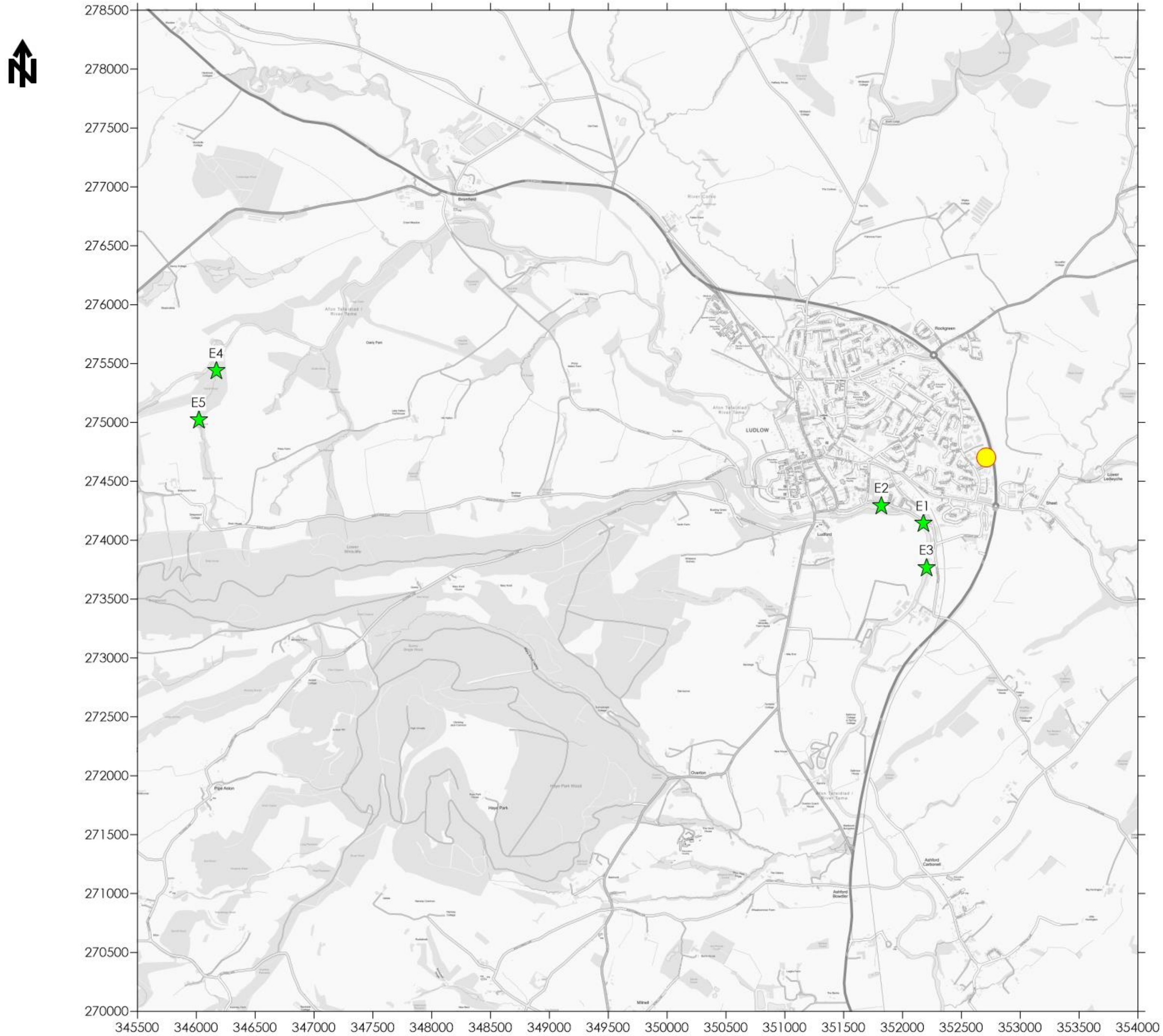

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Site Location

Receptor

Title
Figure 2 - Discrete Receptor Locations

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Legend

Site Boundary

Stack

Building

Title
Figure 3 - ADMS-6 Inputs

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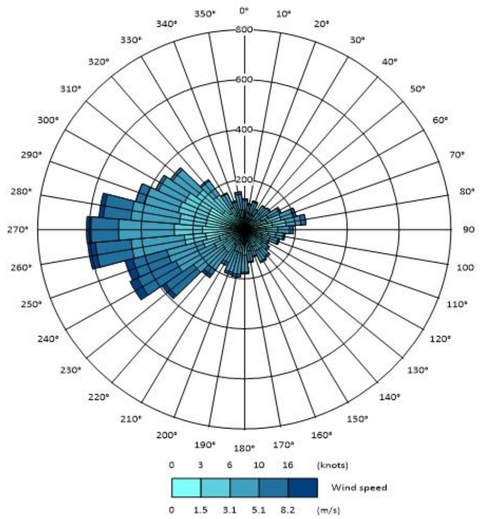
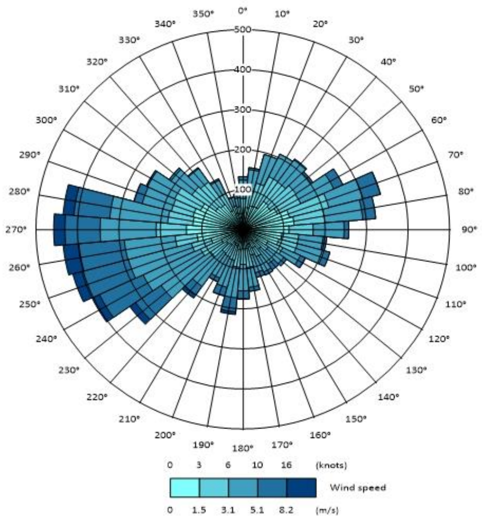
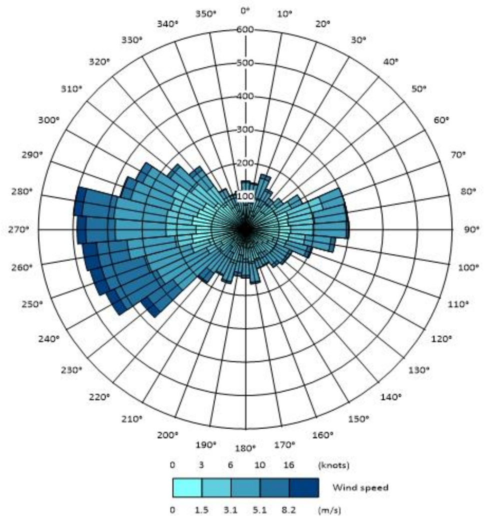


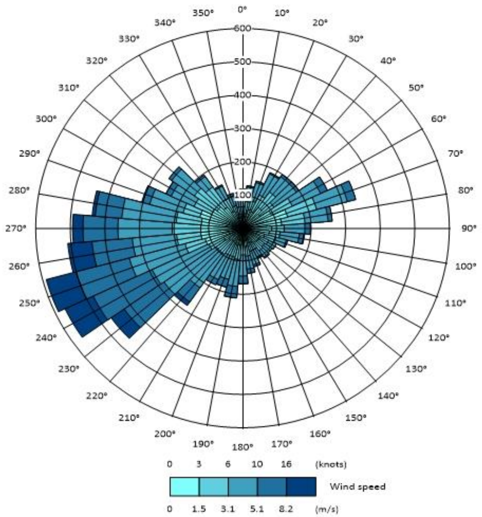
2017 Meteorological Data



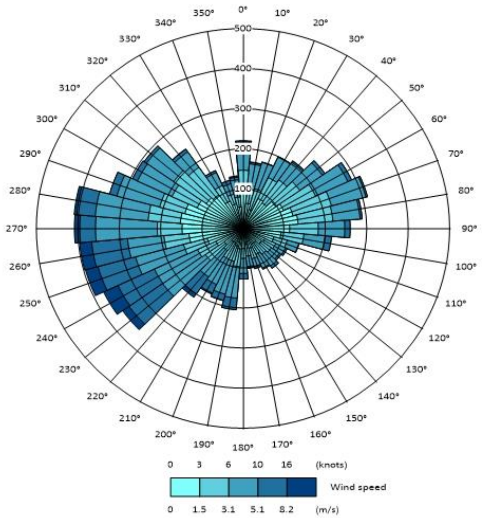
2018 Meteorological Data



2019 Meteorological Data



2020 Meteorological Data



2021 Meteorological Data

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Title
Figure 4 - Wind Roses of 2017 to 2021 Shobdon Airfield Meteorological Station Data

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Coder Road, Ludlow

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Appendix 1 - Critical Loads and Levels

Critical Levels

The NO_x critical levels for all vegetative features within the identified ecological designations are presented in Table A1.1.

Table A1.1 Critical Levels for NO_x

Pollutant	Critical Level	
	Concentration (µg/m³)	Averaging Period
NO_x	30	Annual mean

The SO_2 critical levels for all vegetative features within the identified ecological designations are presented in Table A1.2.

Table A1.2 Critical Levels for SO_2

Pollutant	Critical Level	
	Concentration (µg/m³)	Averaging Period
SO_2	20	Annual mean for higher plants
	10	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity

Nitrogen Critical Loads

The nitrogen critical loads for River Teme SSSI are presented in Table A1.3.

Table A1.3 Nitrogen Critical Loads - River Teme SSSI

Feature	Is the Feature Sensitive to Nitrogen?	Nitrogen Critical Load Class	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
Flowing waters - Type VI: base-rich, mesotrophic rivers in western and northern Britain, with a moderate to fast current.	Yes	No comparable habitat with established critical load estimate available	-[a]	-[a]

Feature	Is the Feature Sensitive to Nitrogen?	Nitrogen Critical Load Class	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
Flowing waters - Type VII: low-gradient streams at a relatively high altitude/latitude, flowing over a moderately basic geology	Yes	No comparable habitat with established critical load estimate available	-(a)	-(a)
Alosa fallax	Yes	No comparable habitat with established critical load estimate available	-(a)	-(a)
Austropotamobius pallipes	Yes	No comparable habitat with established critical load estimate available	-(a)	-(a)
Invertebrate assemblage	Yes	No comparable habitat with established critical load estimate available	-(a)	-(a)
Lutra lutra	Yes	No comparable habitat with established critical load estimate available	-(a)	-(a)
Margaritifera margaritifera	Yes	No comparable habitat with established critical load estimate available	-(a)	-(a)

Note: (a) Critical load not assigned for feature on APIS.

The nitrogen critical loads for Downton Gorge SAC are presented in Table A1.4.

Table A1.4 Nitrogen Critical Loads - Downton Gorge SAC

Feature	Is the Feature Sensitive to Nitrogen?	Nitrogen Critical Load Class	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
Tilio-Acerion forests of slopes, screes and ravines	Yes	Carpinus and Quercus mesic deciduous forest	15	20
Austropotamobius pallipes	Yes	No comparable habitat with established critical load estimate available	-(a)	-(a)
Cottus gobio	Yes	No comparable habitat with established critical load estimate available	-(a)	-(a)

Feature	Is the Feature Sensitive to Nitrogen?	Nitrogen Critical Load Class	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
Lampetra planeri	Yes	No comparable habitat with established critical load estimate available	-[a]	-[a]
Lutra lutra	Yes	No comparable habitat with established critical load estimate available	-[a]	-[a]
Salmo salar	Yes	No comparable habitat with established critical load estimate available	-[a]	-[a]

Note: (a) Critical load not assigned for feature on APIS.

Acid Critical Loads

The acid critical loads for River Teme SSSI are presented in Table A1.5.

Table A1.5 Acid Critical Loads - River Teme SSSI

Feature	Is the Feature Sensitive to Acidity?	Relevant Acid Critical Load Class	Acid Critical Load (keq/ha/yr)		
			CLMinN	CLMaxS	CLMaxN
Flowing waters - Type VI: base-rich, mesotrophic rivers in western and northern Britain, with a moderate to fast current.	Yes	Freshwater	-[a]	-[a]	-[a]
Flowing waters - Type VII: low-gradient streams at a relatively high altitude/latitude, flowing over a moderately basic geology	Yes	Freshwater	-[a]	-[a]	-[a]
Alosa fallax	Yes	Freshwater	-[a]	-[a]	-[a]
Austropotamobius pallipes	Yes	Freshwater	-[a]	-[a]	-[a]
Invertebrate assemblage	Yes	No Comparable Acidity Class	-[a]	-[a]	-[a]
Lutra lutra	Yes	Freshwater	-[a]	-[a]	-[a]
Margaritifera margaritifera	Yes	Freshwater	-[a]	-[a]	-[a]

Feature	Is the Feature Sensitive to Acidity?	Relevant Acid Critical Load Class	Acid Critical Load (keq/ha/yr)		
			CLMinN	CLMaxS	CLMaxN
Flowing waters - Type VI: base-rich, mesotrophic rivers in western and northern Britain, with a moderate to fast current.	Yes	Freshwater	-[a]	-[a]	-[a]
Flowing waters - Type VII: low-gradient streams at a relatively high altitude/latitude, flowing over a moderately basic geology	Yes	Freshwater	-[a]	-[a]	-[a]

Note: (a) Critical load not assigned for feature on APIS.

The acid critical loads for Downton Gorge SAC are presented in Table A1.6.

Table A1.6 Acid Critical Loads - Downton Gorge SAC

Feature	Is the Feature Sensitive to Acidity?	Relevant Acid Critical Load Class	Acid Critical Load (keq/ha/yr)		
			CLMinN	CLMaxS	CLMaxN
Tilio-Acerion forests of slopes, screes and ravines	Yes	Unmanaged Broadleafed/Coniferous Woodland	0.142	1.536	1.678
Austropotamobius pallipes	Yes	Freshwater	-[a]	-[a]	-[a]
Cottus gobio	Yes	Freshwater	-[a]	-[a]	-[a]
Lampetra planeri	Yes	Freshwater	-[a]	-[a]	-[a]
Lutra lutra	Yes	Freshwater	-[a]	-[a]	-[a]
Salmo salar	Yes	Freshwater	-[a]	-[a]	-[a]

Note: (a) Critical load not assigned for feature on APIS.

Appendix 2 - Dispersion Model Input Data

Dispersion Model

Dispersion modelling was undertaken using ADMS-6.0 (v6.0.2.0). ADMS-6 is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from atmospheric emission sources. Modelling predictions from this software package are accepted within the UK by the EA, Natural Resource Wales and DEFRA.

Baseline Pollution Levels

Baseline pollutant concentrations and deposition rates at the ecological receptor were obtained from the APIS[9] website and are summarised in Table A2.1.

Table A2.1 Baseline Pollution Levels

Receptor		Annual Mean NO_x Concentration ($\mu g/m^3$)	Annual Mean SO_2 Concentration ($\mu g/m^3$)	Baseline Deposition Rate	
				Nitrogen (kgN/ha/yr)	Acid (keq/ha/yr)
E1	River Teme SSSI	6.10	1.29	18.50	1.38
E2	River Teme SSSI	6.04	1.15	18.57	1.38
E3	River Teme SSSI	4.99	0.76	18.66	1.39
E4	Downton Gorge SAC	3.87	0.63	31.33	2.33
E5	Downton Gorge SAC	3.87	0.63	31.33	2.33

Model Inputs

Emissions from the proposed stack of the pyrolysis plant were represented by a point source within the model. The relevant inputs are summarised in Table A2.2. These were obtained from information provided from the equipment supplier (Woodtek), an Air Quality Assessment[10] for a pyrolysis plant produced by Ricardo-AEA Ltd and The Industrial Emissions Directive[11] which

9 APIS, www.apis.ac.uk.

10 'Bioccus Phase 2 Air Quality Assessment Report' Ricardo-AEA, 2022.

11 Directive 2010/75/EU Of The European Parliament And Of The Council, November 2010.

specifies a number of Emission Limit Values (ELVs) for pollutants that are applicable to the operation of the plant.

Table A2.2 Model Inputs

Parameter	Unit	Value
Stack height	m	10
Stack diameter	m	0.35
Stack exhaust gas temperature	°C	60
Stack exhaust moisture content	%	13.6
Stack exhaust oxygen (O_2) content	%	8.1
Stack exhaust volume flow rate	m^3/s	0.73
Stack exhaust gas efflux velocity	m/s	7.58
NO_x emission concentration	mg/m^3 [(a)]	400[(b)]
NO_x emission rate	g/s	0.2667
SO_2 emission concentration	mg/m^3 [(a)]	50
SO_2 emission rate	g/s	0.0333
HCl emission concentration	mg/m^3 [(a)]	10
HCl emission rate	g/s	0.0067

Note: (a) Stated at 11% O_2, dry gas, 273K.
(b) 100% compliance required at all times. An ELV of 200mg/m^3 over a 24-hour period is to be achieved for a minimum of 97% of the time.

The maximum average annual NO_x emission concentration for the plant is 206mg/m^3 based on the relevant ELVs and associated compliance periods. The model output for NO_x was therefore factored to provide an accurate representation of ground level concentrations at the identified ecological designations.

Emissions from the proposed pyrolysis plant were assumed to be constant, with the plant in operation for 24-hours per day, 365-days per year. This is considered to provide a worst-case assessment scenario as plant shutdown or periods of reduced work-load are not reflected in the modelled emissions.

Reference should be made to Figure 3 for a map of the emission source location.

Terrain Data

Ordnance Survey OS Terrain 50 data was included in the model for the site and surrounding area in order to take account of the specific flow field produced by variations in ground height throughout the assessment extents. This was pre-processed using the method suggested by CERC[12].

Building Effects

The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission points. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.

Analysis of the site layout indicated that a number of structures should be included within the model in order to take account of effects on pollutant dispersion. Input geometries are shown in Table A2.3.

Table A2.3 Building Geometries

Building	NGR (m)		Height (m)	Length / diameter (m)	Width (m)	Angle (°)
	X	Y				
Main building	352715.9	274710.0	8.2	40.4	15.0	162.2
Tank 1	352726.9	274730.0	11.2	10.7	-	-
Tank 2	352725.9	274715.7	4.6	4.9	-	-
Tank 3	352733.5	274710.0	11.2	10.5	-	-
Tank 4	352733.8	274699.0	7.0	7.0	-	-
North building	352710.2	274754.5	8.3	30.7	27.1	162.1
North-west building 1	352679.5	274756.1	8.2	51.2	23.5	162.2
North-west building 2	352662.4	274734.0	8.2	19.6	22.5	162.3
West building	352665.5	274714.3	7.3	11.1	18.7	162.1

12 Note 105: Setting up Terrain Data for Input to CERC Models, CERC, 2016.

Reference should be made to Figure 3 for a map of the building locations.

Meteorological Data

Meteorological data used in the assessment was taken from Shobdon Airfield meteorological station over the period 1st January 2017 to 31st December 2021 (inclusive). This observation station is located at NGR: 340192, 260797, which is approximately 18.7km south-west of the facility. All meteorological files used in the assessment were provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 4 for wind roses of the utilised meteorological records.

Roughness Length

The surface roughness (z_0) is a modelling parameter applied to allow consideration of surface height roughness elements A z_0 of 0.5m was used to describe the modelling extents. This value is considered appropriate for the morphology of the area and is suggested within ADMS-6 as being suitable for 'parkland, open suburbia'.

A z_0 of 0.3m was used to describe the meteorological site. This value is considered appropriate for the morphology of the area and is suggested within ADMS-6 as being suitable for 'agricultural areas (max)'.

Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used to describe the modelling extents. This value is considered appropriate for the nature of the area and is suggested within ADMS-6 as being suitable for 'mixed urban/industrial'.

A minimum Monin-Obukhov length of 1m was used to describe the meteorological site. This value is considered appropriate for the nature of the area and is suggested within ADMS-6 as being suitable for 'rural areas'.

Deposition

Nitrogen deposition rates were calculated using the conversion factors provided within EA document 'Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06'[13]. Predicted pollutant concentrations were multiplied by the relevant deposition velocity and conversion factor to calculate the speciated dry deposition flux. The conversion factors used for the determination of nitrogen deposition are presented within Table A2.4.

Table A2.4 Conversion Factors to Determine Dry Deposition Flux for Nitrogen Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (µg/m²/s to kg/ha/yr of pollutant species)
	Grassland	Forest	
NO_x	0.0015	0.003	95.9

The relevant deposition velocity for each ecological receptor was selected from Table A2.4 based on the vegetation type of the qualifying feature.

Acid deposition occurs as a result of NO_2, SO_2 and HCl. Predicted ground level pollutant concentrations of all these species were converted to kilo-equivalent ion depositions (keq/ha/yr) for comparison with the critical load for acid deposition at each of the identified ecological receptors. The conversion to units of equivalents, a measure of the potential acidifying effect of a species, was undertaken using the standard conversion factors shown in Table A2.5.

Table A2.5 Conversion Factors to Determine Dry Deposition Flux for Acid Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (µg/m²/s to keq/ha/yr of pollutant species)
	Grassland	Forest	
NO_2	0.0015	0.003	6.84
SO_2	0.012	0.024	9.84
HCl	0.025	0.06	8.63

13 Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06, EA, 2014.

The following formula was used to calculate predicted PCs as a proportion of the critical load function:

PC as %CL function = ((PC of N deposition)/CLmaxN) x 100

The above formula was obtained from APIS[14].

It should be noted that in accordance with the AQTAG 06 guidance[15], the PC of HCl and SO_2 was added to the PC of nitrogen and treated as N in the above formula.

14 http://www.apis.ac.uk/.

15 Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06, EA, 2014.