

Air Quality Assessment
Taw Valley Creamery

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Executive Summary

Redmore Environmental Ltd was commissioned by EHS Projects Ltd to undertake an Air Quality Assessment in support of an Environmental Permit Variation Application for Taw Valley Creamery.

Atmospheric emissions of combustion products from the proposed and existing plant have the potential to cause air quality impacts during normal operation. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and quantify potential effects.

Dispersion modelling was undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the site. The results indicated that impacts on pollutant concentrations were not predicted to be significant at any human or ecological receptor location in the vicinity of the site.

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1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by EHS Projects Ltd to undertake an Air Quality Assessment in support of an Environmental Permit Variation Application for Taw Valley Creamery.

1.1.2 Atmospheric emissions of combustion products from the proposed and existing plant have the potential to cause air quality impacts during normal operation. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and quantify potential effects.

1.2 Site Location and Context

1.2.1 The facility is located on land at North Tawton, Okehampton, Devon, at National Grid Reference (NGR): 265340, 101430. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 Activities at Taw Valley Creamery are currently regulated by the Environment Agency (EA) under the conditions of Environmental Permit reference: EPR/NP3638NN/V005.

1.2.3 The facility comprises of the following energy plant:

- One 10.9MW_{th} natural gas fired boiler - emission point A2;
- One 11.3MW_{th} natural gas fired boiler - emission point A3; and,
- One 4.6MW_{th} natural gas fired Combined Heat and Power (CHP) unit - emission point A7.

1.2.4 It is proposed to install a new 2.7MW_{th} natural gas fired boiler to complement the existing energy plant. Emissions will be released via a dedicated stack at a height of 21.6m.

1.2.5 Atmospheric emissions from the plant have the potential to cause air quality impacts at sensitive locations. These have therefore been quantified within the following report.

2.0 LEGISLATION AND POLICY

2.1 Legislation

2.1.1 The Air Quality Standards Regulations (2010) came into force on 11th June 2010 and include Air Quality Limit Values (AQLVs) for the following pollutants:

- Nitrogen dioxide (NO₂);
- Sulphur dioxide;
- Lead;
- Particulate matter with an aerodynamic diameter of less than 10µm;
- Particulate matter with an aerodynamic diameter of less than 2.5µm;
- Benzene; and,
- Carbon monoxide.

2.1.2 Air Quality Target Values (AQTV) were also provided for several additional pollutants.

2.1.3 The Air Quality Strategy (AQS) was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and published on 28th April 2023¹. The document contains standards, objectives and measures for improving ambient air quality, including a number of Air Quality Objectives (AQOs). These are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedences over a specified timescale. These are generally in line with the AQLVs, although the requirements for the determination of compliance vary.

2.1.4 Table 1 presents the AQOs for pollutants considered within this assessment.

Table 1 Air Quality Objectives

Pollutant	Air Quality Objective	
	Concentration (µg/m ³)	Averaging Period
NO ₂	40	Annual mean
	200	1-hour mean, not to be exceeded on more than 18 occasions per annum

¹ The AQS: Framework for Local Authority Delivery, DEFRA, 2023.

2.1.5 Table 2 summarises the advice provided in DEFRA guidance² on where the AQOs for pollutants considered within this report apply.

Table 2 Examples of Where the Air Quality Objectives Apply

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
Annual mean	<p>All locations where members of the public might be regularly exposed</p> <p>Building façades of residential properties, schools, hospitals, care homes etc.</p>	<p>Building façades of offices or other places of work where members of the public do not have regular access</p> <p>Hotels, unless people live there as their permanent residence</p> <p>Gardens of residential properties</p> <p>Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term</p>
1-hour mean	<p>All locations where the annual mean and 24-hour and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets)</p> <p>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</p> <p>Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer</p>	<p>Kerbside sites where the public would not be expected to have regular access</p>

2.2 Local Air Quality Management

2.2.1 Local Authorities (LAs) are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves comparing present and likely future pollutant concentrations against the AQOs. If it is predicted that levels at locations of relevant exposure, as summarised in Table 2, are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

² Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

2.3 Industrial Pollution Control Legislation

2.3.1 Atmospheric emissions from industry are controlled in England through the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. Activities at the site are included within the Regulations. As such the facility operates in accordance with an Environmental Permit issued by the EA. This includes a number of conditions and monitoring requirements in order to restrict environmental impacts as result of atmospheric emissions associated with the authorised activities.

2.4 Critical Loads and Levels

2.4.1 A critical load is defined by the UK Air Pollution Information System (APIS)³ as:

"A quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge."

2.4.2 A critical level is defined as:

"Concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge."

2.4.3 A critical load refers to deposition of a pollutant, while a critical level refers to pollutant concentrations in the atmosphere (which usually have direct effects on vegetation or human health).

2.4.4 When pollutant loads (or concentrations) exceed the critical load or level it is considered that there is a risk of harmful effects. The excess over the critical load or level is termed the exceedence. A larger exceedence is often considered to represent a greater risk of damage.

2.4.5 Maps of critical loads and levels and their exceedences have been used to show the potential extent of pollution damage and aid in developing strategies for reducing pollution. Decreasing deposition below the critical load is seen as means for preventing

³ UK APIS, www.apis.ac.uk.

the risk of damage. However, even a decrease in the exceedence may infer that less damage will occur.

2.4.6 Table 3 presents the critical levels for the protection of vegetation for pollutants considered within this assessment.

Table 3 Critical Levels for the Protection of Vegetation

Pollutant	Critical Level	
	Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Period
Oxides of nitrogen (NO_x)	30	Annual mean
	75	24-hour mean

2.4.7 Critical loads have been designated within the UK based on the sensitivity of the receiving habitat and have been identified for the relevant designations considered within the assessment in Section 3.5.

3.0 BASELINE

3.1 Introduction

3.1.1 Existing air quality conditions in the vicinity of the site were identified in order to provide a baseline for assessment. These are detailed in the following Sections.

3.2 Local Air Quality Management

3.2.1 As required by the Environment Act (1995), West Devon Borough Council (WDBC) has undertaken Review and Assessment of air quality within their area of jurisdiction. This process has indicated that concentrations of all pollutants considered within the AQS are currently below the relevant AQOs. As such, no AQMAs have been designated within the borough.

3.3 Air Quality Monitoring

3.3.1 Monitoring of pollutant concentrations is undertaken by WDBC throughout their area of jurisdiction. However, the closest survey site to the facility is located approximately 8.7km south-west of the boundary. Due to the distance between the locations, similar pollutant concentrations would not be anticipated at the two positions. As such, this source of information was not considered further in the context of the assessment.

3.4 Background Pollutant Concentrations

3.4.1 Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK to assist Local Authorities in their Review and Assessment of air quality. The site is located in grid square NGR: 265500, 101500. Data for this location was downloaded from the DEFRA website⁴ for the purpose of the assessment and is summarised in Table 4.

⁴ <http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html>.

Table 4 Background Pollutant Concentration Prediction

Pollutant	Predicted 2024 Background Pollutant Concentration ($\mu\text{g}/\text{m}^3$)
NO ₂	3.14

3.4.2 As shown in Table 4, the predicted annual mean NO₂ concentration is below the relevant AQO at the site.

3.5 Sensitive Receptors

3.5.1 A sensitive receptor is defined as any location which may be affected by changes in air quality. These have been defined for human and ecological receptors in the following Sections.

Human Receptors

3.5.2 A desk-top study was undertaken in order to identify any sensitive human receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in Table 5.

Table 5 Human Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Residential - Culm Cross	265207.0	101530.3
R2	Residential - Culm Cross	265413.2	101550.6
R3	Residential - Week	265378.4	101702.1
R4	Residential - Week	265328.9	101795.5
R5	Residential - Fore Street	265656.5	101681.0
R6	Residential - Mill Lane	265695.2	101657.1

3.5.3 Reference should be made to Figure 2 for a map of the sensitive human receptor locations.

Ecological Receptors

3.5.4 Atmospheric emissions from the facility have the potential to impact on receptors of ecological sensitivity within the vicinity of the site. The Conservation of Habitats and Species Regulations (2010) and subsequent amendments require competent authorities to review applications and consents that have the potential to impact on ecological designations. A study was therefore undertaken to identify the following sites of ecological or nature conservation importance:

- Special Areas of Conservation (SAC), Special Protection Areas or Ramsar sites within 10km of the facility; and,
- Sites of Special Scientific Interest, National Nature Reserves, Local Nature Reserves, Local Wildlife Sites (LWSs) and Ancient Woodland (AW) within 2km of the facility.

3.5.5 The study was completed using the Devon County Council Environment Viewer map and the Multi-Agency Geographic Information for the Countryside (MAGIC) web-based interactive mapping service⁵, which draws together information on key environmental schemes and designations. Sites of ecological or nature conservation importance have been identified and summarised in Table 6. It should be noted that for the purpose of the modelling assessment discrete receptors were placed at the closest points of each designation to the facility to ensure the maximum potential impact was predicted.

Table 6 Ecological Receptor Locations

Receptor		NGR (m)	
		X	Y
E1	Dartmoor SAC	263131.5	93752.34
E2	Oxenpark Marsh LWS	263370.9	101561.4
E3	Trecott Marsh LWS	263436.4	100740.5
E4	Cottles Wood AW	265337.1	103180.5
E5	Rook Wood / Western Copse AW	265836.2	103255.5

3.5.6 Reference should be made to Figure 3 for a map of the ecological receptor locations.

⁵ Multi-Agency Geographic Information for the Countryside, www.magic.gov.uk.

3.5.7 Critical loads have been designated within the UK based on the sensitivity and relevant features of the receiving habitat. A review of information provided by the APIS⁶ website and MAGIC web-based interactive mapping service⁷ was undertaken in order to identify the most sensitive habitat and associated critical load for each designation considered within the assessment.

3.5.8 The relevant nitrogen deposition critical loads are presented in Table 7.

Table 7 Critical Loads for Nitrogen Deposition

Feature		Feature	Nitrogen Critical Load Class	Nitrogen Critical Load (kgN/ha/yr)	
				Low	High
E1	Dartmoor SAC	Blanket bogs	Raised and blanket bogs	5	10
E2	Oxenpark Marsh LWS	Fen, Marsh and Swamp	Valley mires, poor fens and transition mires	5	15
E3	Trecott Marsh LWS	Fen, Marsh and Swamp	Valley mires, poor fens and transition mires	5	15
E4	Cottles Wood AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
E5	Rook Wood/ Western Copse AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15

3.5.9 The relevant acid deposition critical loads are presented in Table 8.

Table 8 Critical Loads for Acid Deposition

Receptor		Feature	Acid Critical Load Class	Acid Critical Load (keq/ha/yr)		
				CLMinN	CLMaxS	CLMaxN
E1	Dartmoor SAC	Blanket bogs	Bogs	0.321	0.509	0.83
E2	Oxenpark Marsh LWS	Fen, Marsh and Swamp	-(a)	-	-	-
E3	Trecott Marsh LWS	Fen, Marsh and Swamp	-(a)	-	-	-

⁶ <http://www.apis.ac.uk/>.

⁷ Multi-Agency Geographic Information for the Countryside, www.magic.gov.uk.

Receptor		Feature	Acid Critical Load Class	Acid Critical Load (keq/ha/yr)		
				CLMinN	CLMaxS	CLMaxN
E4	Cottles Wood AW	Broadleaved, Mixed and Yew Woodland	Broadleaved/Coniferous unmanaged woodland	0.285	1.265	1.55
E5	Rook Wood/ Western Copse AW	Broadleaved, Mixed and Yew Woodland	Broadleaved/Coniferous unmanaged woodland	0.285	1.265	1.55

Note: (a) Habitat is not sensitive to acidity.

3.5.10 Baseline pollutant concentrations and deposition rates at each ecological receptor were obtained from the APIS website⁸ and are summarised in Table 9.

Table 9 Baseline Pollution Levels at Ecological Receptors

Receptor		Annual Mean NO _x Conc. (µg/m ³)	Baseline Deposition Rate	
			Nitrogen (kgN/ha/yr)	Acid (keq/ha/yr)
E1	Dartmoor SAC	3.57	15.67	1.13
E2	Oxenpark Marsh LWS	3.73	16.03	1.17
E3	Trecott Marsh LWS	3.77	15.83	1.15
E4	Cottles Wood AW	3.66	30.67	2.24
E5	Rook Wood/ Western Copse AW	3.66	30.67	2.24

⁸ UK APIS, www.apis.ac.uk.

4.0 **METHODOLOGY**

4.1 **Introduction**

4.1.1 Combustion emissions from the proposed and existing plant have the potential to cause air quality impacts during normal operation. These have been quantified through dispersion modelling in accordance with the methodology outlined in the following Sections.

4.2 **Dispersion Model**

4.2.1 Dispersion modelling was undertaken using ADMS-6 (v6.0.2.0), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-6 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

4.2.2 The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages.

4.3 **Modelling Scenarios**

4.3.1 The scenarios considered for human receptors in the modelling assessment are summarised in Table 10.

Table 10 Human Receptor Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO ₂	99.8 th percentile (%ile) 1-hour mean	Annual mean

4.3.2 Some short-term air quality criteria are framed in terms of the number of occasions in a calendar year on which the concentration should not be exceeded. As such, the %ile shown in Table 10 was selected to represent the relationship between the permitted number of exceedences of short-period concentrations and the number of periods within a calendar year.

4.3.1 The scenarios considered for ecological receptors in the modelling assessment are summarised in Table 11.

Table 11 Ecological Receptor Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO _x	24-hour mean	Annual mean
Nitrogen deposition	-	Annual deposition
Acid deposition	-	Annual deposition

4.3.2 Predicted pollutant concentrations were summarised in the following formats:

- Process contribution (PC) - Predicted pollutant level as a result of emissions from the facility only; and,
- Predicted environmental concentration (PEC) - Total predicted pollutant level as a result of emissions from the facility and existing baseline conditions.

4.3.3 Predicted ground level pollutant concentrations and deposition rates were compared with the relevant AQOs, critical loads and critical levels. These criteria are collectively referred to as Environmental Quality Standards (EQSs).

4.4 Assessment Area

4.4.1 The assessment area was defined based on the facility location, anticipated pollutant dispersion patterns and the positioning of sensitive receptors. Ambient concentrations were predicted over NGR: 264595, 100590 to 266095, 102090. One Cartesian grid with a resolution of 10m was used within the model to produce data suitable for contour plotting using the Surfer software package.

4.4.2 Reference should be made to Figure 4 for a graphical representation of the assessment grid extents.

4.5 **Process Conditions**

4.5.1 A summary of the source parameters used in the assessment is provided in Table 12. These were provided by the Applicant.

Table 12 Source Parameters

Parameter	Unit	A2	A3	A7	New Boiler
Stack position	NGR	265311.3, 101378.4	265312.2, 101378.9	265387.3, 101299.4	265423.8, 101317.5
Stack height	m	36.0	36.0	10.0	21.60
Stack diameter	m	0.85	0.85	0.50	0.40
Exhaust gas temperature	°C	222	222	180	133
Exhaust gas oxygen (O ₂) content	%	4.7	4.7	10.0	4.7
Exhaust gas moisture content	%	-(a)	-(a)	9.6	-(a)
Exhaust gas flow rate (actual)	m ³ /s	5.20	5.20	6.13	1.25
Exhaust gas flow rate (reference)	Nm ³ /s	2.60 ^(b)	2.60 ^(b)	2.30 ^(c)	0.76 ^(b)
Exhaust gas efflux velocity	m/s	9.16	9.16	31.21	9.95

Note: (a) Information not available. However, the use of 0% moisture results in a lower efflux velocity than if an actual value was utilised. As such, the inputs are considered suitably robust.

(b) 273K, 3% O₂, dry.

(c) 273K, 5% O₂, dry.

4.5.2 Reference should be made to Figure 4 for a map of the source locations.

4.6 **Emissions**

4.6.1 Pollutant emission concentrations were provided by the Applicant. These are shown in Table 13 and comply with the requirements of the Medium Combustion Plant Directive.

Table 13 Pollutant Emission Concentrations

Pollutant	Pollutant Emission Concentration (mg/Nm ³)			
	A2	A3	A7	New Boiler
NO _x	200 ^(a)	100 ^(a)	250 ^(b)	100 ^(a)

Note: (a) 273K, 3% O₂, dry.

(b) 273K, 5% O₂, dry.

4.6.2 The pollutant mass emission rates for use in the assessment were derived from the concentrations shown in Table 13 and the flow rates shown in Table 12. These are summarised in Table 14.

Table 14 Pollutant Mass Emission Rates

Pollutant	Pollutant Mass Emission Rate (g/s)			
	A2	A3	A7	New Boiler
NO _x	0.5194	0.2597	0.5739	0.0761

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

4.7 NO_x to NO₂ Conversion

4.7.1 Emissions of total NO_x from combustion processes are predominantly in the form of nitric oxide (NO). Excess O₂ in the combustion gases and further atmospheric reactions cause the oxidation of NO to NO₂. Comparisons of ambient NO and NO₂ concentrations in the vicinity of point sources in recent years has indicated that it is unlikely that more than 30% of the NO_x is present at ground level as NO₂.

4.7.2 Ambient NO_x concentrations were predicted through dispersion modelling. Concentrations of NO₂ shown in the results section assume 70% conversion from NO_x to NO₂ for annual means and 35% conversion for 1-hour concentrations, based upon EA guidance⁹.

⁹ <https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports>.

4.8 **Building Effects**

4.8.1 The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. 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.

4.8.2 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. Building input geometries are shown in Table 15.

Table 15 Building Geometries

Building	NGR (m)		Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
	X	Y				
Building 1	265278.3	101443.9	8.0	22.2	22.6	151.8
Building 2	265339.7	101437.7	12.5	46.5	127.1	151.8
Building 3	265337.6	101381.0	13.0	51.7	67.5	151.8
Building 4	265330.3	101363.5	28.5	18.3	16.2	151.8
Building 5	265318.3	101357.1	17.9	18.3	10.9	151.8
CHP unit	265385.3	101303.2	4.0	10.0	4.0	151.8
Building 6	265390.7	101304.9	4.0	16.7	4.0	151.8
Tank	265381.3	101298.4	6.3	4.0	-	-
Building 7	265407.8	101369.1	15.5	35.8	71.4	151.8
Building 8	265434.6	101330.1	18.2	21.2	32.0	151.8
Building 9	265393.5	101397.1	15.0	27.3	46.0	151.8
Building 10	265400.8	101349.2	21.0	7.5	10.0	151.8
Building 11	265431.8	101351.0	15.5	18.4	46.3	151.8

4.8.3 Reference should be made to Figure 4 for a map of the building locations.

4.9 Meteorological Data

4.9.1 Meteorological data used in the assessment was taken from Exeter Meteorological Station over the period 1st January 2019 to 31st December 2023 (inclusive). This observation station is located at NGR: 300821, 93986, which is approximately 36.4km east of the facility. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

4.9.2 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 5 for wind roses of the utilised meteorological records.

4.10 Roughness Length

4.10.1 The z_0 is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 0.3m was used to describe the modelling extents and 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)'.

4.11 Monin-Obukhov Length

4.11.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 1m 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 'rural areas'.

4.11.2 A minimum Monin-Obukhov length of 10m 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 'small towns < 50,000'.

4.12 Terrain Data

4.12.1 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 CERC¹⁰.

4.13 **Nitrogen Deposition**

4.13.1 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 06'¹¹. 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 16.

Table 16 Conversion Factors to Determine Dry Deposition Flux for Nitrogen Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor ($\mu\text{g}/\text{m}^2/\text{s}$ to $\text{kg}/\text{ha}/\text{yr}$ of pollutant species)
	Grassland	Forest	
NO ₂	0.0015	0.003	95.9

4.13.2 The relevant deposition velocity for each ecological receptor was selected from Table 16 based on the vegetation type present within the designation.

4.14 **Acid Deposition**

4.14.1 Predicted ground level NO₂ concentrations 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 17.

¹⁰ Note 105: Setting up Terrain Data for Input to CERC Models, CERC, 2016.

¹¹ Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06, EA, 2014.

Table 17 Conversion Factors to Determine Dry Deposition Flux for Acid Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor ($\mu\text{g}/\text{m}^2/\text{s}$ to $\text{keq}/\text{ha}/\text{yr}$ of pollutant species)
	Grassland	Forest	
NO ₂	0.0015	0.003	6.84

4.14.2 The following formula was used to calculate predicted PCs as a proportion of the critical load function where PECs were identified to be greater than the CLminN value.

$$\text{PC as \%CL function} = ((\text{PC of N deposition})/\text{CLmaxN}) \times 100$$

4.14.3 The above formula was obtained from the APIS website¹².

4.15 Background Concentrations

4.15.1 Review of the data summarised in Section 3.0 was undertaken in order to identify suitable baseline values for use in the assessment. This indicated the closest monitors are positioned a significant distance from the facility and results are unlikely to be representative of the site location. The background concentrations predicted by DEFRA were therefore utilised to represent baseline levels in the vicinity of the site.

4.15.2 Background levels at the ecological receptors were obtained from the APIS website, as summarised in Table 9.

4.15.3 It is not possible to add short-term peak baseline and process concentrations. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different to the conditions which give rise to peak concentrations due to emissions from other sources. This point is addressed in EA guidance 'Air emissions risk assessment for your environmental permit'¹³, which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum predicted short-term concentration due to emissions from the source to twice the annual mean baseline concentration. This approach was adopted throughout the assessment.

¹² <http://www.apis.ac.uk/>.

¹³ <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>.

4.16 Assessment Criteria

Human Receptors

4.16.1 EA guidance 'Air emissions risk assessment for your environmental permit'¹⁴ states that PCs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard; and,
- The long-term PC is less than 1% of the long-term environmental standard.

4.16.2 If these criteria are exceeded the following guidance is provided on when whether PECs can be screened as insignificant:

- The short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration; and,
- The long-term PEC is less than 70% of the long-term environmental standards.

Ecological Receptors

4.16.3 EA guidance 'Air emissions risk assessment for your environmental permit'¹⁵ states that PCs at SACs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard for protected conservation areas;
- The long-term PC is less than 1% of the long-term environmental standard for protected conservation areas; and,
- The long-term PC is greater than 1% and the long term PEC is less than 70% of the long term environmental standard.

4.16.4 PCs at LWSs and AW can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 100% of the short-term environmental standard for protected conservation areas; and,

¹⁴ <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>.

¹⁵ <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>.

- The long-term PC is less than 100% of the long-term environmental standard for protected conservation areas.

4.16.5 Predicted PCs have been compared to the relevant EQSs and the criteria stated above. Where the impact is within these parameters, the EA concludes that impacts associated with an installation are acceptable.

4.17 Modelling Uncertainty

4.17.1 Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, operational procedures, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

4.17.2 Potential uncertainties in the model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS-6 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using five annual meteorological data sets from an observation station local to the site to account for inter-year variability. The assessment was based on the worst-case year to ensure maximum concentrations were considered;
- Surface characteristics - The z_0 and Monin-Obukhov length were determined for both the dispersion and meteorological sites based on the surrounding land uses and guidance provided by CERC. Terrain data was included and processed using the method outlined by CERC;
- Plant operating conditions - Operational parameters were provided by the Applicant based on the relevant energy plant specifications. As such, input parameters are considered to be representative of normal operating conditions;

- Emission rates - Emission rates were derived from the relevant Emission Limit Values (ELVs) for medium combustion plant. As such, they are considered to be representative of maximum anticipated emissions. Emissions were assumed to be constant throughout the modelling period, which does not allow for plant shutdown. This assumption is likely to overestimate actual emissions and therefore result in a worst-case assessment;
- Background concentrations - Background pollutant levels were obtained from the DEFRA and APIS websites. These are considered to provide a reasonable representation of existing conditions at receptors in the vicinity of the site;
- Receptor locations - A Cartesian Grid was included in the model in order to provide suitable data for contour plotting. Receptor points were also included at sensitive locations to provide additional consideration of these areas; and,
- Variability - All model inputs were as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

4.17.3 Results were considered in the context of the relevant EQSs. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

5.0 **RESULTS**

5.1 **Introduction**

5.1.1 Dispersion modelling was undertaken with the inputs described in Section 4.0. The results are outlined in the following Sections.

5.2 **Maximum Pollutant Concentrations**

5.2.1 The maximum predicted pollutant concentrations at any point within the modelling extents for any meteorological data set are summarised in Table 18.

Table 18 Maximum Predicted Pollutant Concentrations

Pollutant	Averaging Period	EQS ($\mu\text{g}/\text{m}^3$)	PC ($\mu\text{g}/\text{m}^3$)	PC Proportion of EQS (%)	PEC ($\mu\text{g}/\text{m}^3$)	PEC Proportion of EQS (%)
NO ₂	Annual	40	3.81	9.5	6.95	17.4
	99.8 th %ile 1-hour	200	18.33	9.2	24.61	12.3

5.2.2 As indicated in Table 18, there were no predicted exceedences of any EQS at any location for any pollutant or averaging period of interest.

5.2.3 Reference should be made to Figure 6 to Figure 7 for graphical representations of predicted pollutant concentrations, inclusive of background levels, throughout the assessment extents. It should be noted that the values shown in the Figures are predictions from the meteorological data set which resulted in the maximum pollutant concentration for that species. For example, the maximum annual mean NO₂ concentration was predicted using the 2020 meteorological data set. As such, the contours shown in Figure 6 were produced from the 2020 model outputs.

5.3 **Sensitive Human Receptors**

5.3.1 Predicted annual mean NO₂ PECs at the sensitive human receptor locations, inclusive of background levels, are summarised in Table 19.

Table 19 Predicted Annual Mean NO₂ Concentrations

Receptor		Predicted Annual Mean NO ₂ PEC (µg/m ³)				
		2019	2020	2021	2022	2023
R1	Residential - Culm Cross	4.09	4.19	4.15	4.12	3.90
R2	Residential - Culm Cross	4.96	4.71	4.86	4.99	4.96
R3	Residential - Week	4.42	4.19	4.36	4.41	4.40
R4	Residential - Week	4.15	3.94	4.11	4.10	4.12
R5	Residential - Fore Street	3.77	3.88	3.68	3.81	3.89
R6	Residential - Mill Lane	3.71	3.85	3.62	3.75	3.82

5.3.2 As indicated in Table 19, predicted NO₂ concentrations were below the annual mean EQS of 40µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.3 Maximum predicted annual mean NO₂ concentrations at the receptor locations are summarised in Table 20. Reference should be made to Figure 6 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 20 Maximum Predicted Annual Mean NO₂ Concentrations

Receptor		Maximum Predicted Annual Mean NO ₂ Concentration (µg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Residential - Culm Cross	1.05	4.19	2.6	10.5
R2	Residential - Culm Cross	1.85	4.99	4.6	12.5
R3	Residential - Week	1.28	4.42	3.2	11.1
R4	Residential - Week	1.01	4.15	2.5	10.4
R5	Residential - Fore Street	0.75	3.89	1.9	9.7
R6	Residential - Mill Lane	0.71	3.85	1.8	9.6

5.3.4 As indicated in Table 20, PECs were below 70% of the EQS at all receptor locations. As such, predicted effects on annual mean NO₂ concentrations are not considered to be significant, in accordance with the stated criteria.

5.3.5 Predicted 99.8th %ile 1-hour mean NO₂ PECs, inclusive of background levels, are summarised in Table 21.

Table 21 Predicted 99.8th %ile 1-hour Mean NO₂ Concentrations

Receptor		Predicted 99.8 th %ile 1-hour Mean NO ₂ PEC (µg/m ³)				
		2019	2020	2021	2022	2023
R1	Residential - Culm Cross	14.97	15.16	15.13	15.27	15.01
R2	Residential - Culm Cross	14.05	13.67	14.01	14.23	13.97
R3	Residential - Week	11.66	11.51	11.66	11.65	11.70
R4	Residential - Week	10.91	10.68	10.93	10.82	10.81
R5	Residential - Fore Street	10.65	10.69	10.60	10.89	10.87
R6	Residential - Mill Lane	10.80	10.77	10.57	10.84	10.82

5.3.6 As indicated in Table 21, predicted 99.8th %ile 1-hour mean NO₂ concentrations were below the EQS of 200µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.7 Maximum predicted 99.8th %ile 1-hour mean NO₂ concentrations at the receptor locations are summarised in Table 22. Reference should be made to Figure 7 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 22 Maximum Predicted 99.8th %ile 1-hour Mean NO₂ Concentrations

Receptor		Maximum Predicted 99.8 th %ile 1-hour Mean NO ₂ Concentration (µg/m ³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%) ^(a)
		PC	PEC		
R1	Residential - Culm Cross	8.99	15.27	4.5	4.6
R2	Residential - Culm Cross	7.95	14.23	4.0	4.1
R3	Residential - Week	5.42	11.70	2.7	2.8
R4	Residential - Week	4.65	10.93	2.3	2.4
R5	Residential - Fore Street	4.61	10.89	2.3	2.4

Receptor		Maximum Predicted 99.8 th %ile 1-hour Mean NO ₂ Concentration (µg/m ³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%) ^(a)
		PC	PEC		
R6	Residential - Mill Lane	4.56	10.84	2.3	2.4

Note: (a) PC proportion of EQS minus twice the long-term background concentration.

5.3.8 As indicated in Table 22, the PC proportion of the EQS was below 10% at all receptor locations. As such, predicted effects on 1-hour mean NO₂ concentrations are not considered to be significant, in accordance with the stated criteria.

5.4 Ecological Receptors

5.4.1 Predicted concentrations and deposition rates of each pollutant at the sensitive ecological receptor locations identified in Table 6 are summarised in the following Sections.

Nitrogen Oxides

5.4.2 Predicted annual mean NO_x PECs, inclusive of background levels, are summarised in Table 23.

Table 23 Predicted Annual Mean NO_x Concentrations

Receptor		Predicted Annual Mean NO _x PEC (µg/m ³)				
		2019	2020	2021	2022	2023
E1	Dartmoor SAC	3.60	3.60	3.60	3.61	3.60
E2	Oxenpark Marsh LWS	3.79	3.80	3.81	3.81	3.78
E3	Trecott Marsh LWS	3.83	3.82	3.84	3.86	3.83
E4	Cottles Wood AW	3.86	3.82	3.86	3.86	3.87
E5	Rook Wood/ Western Copse AW	3.81	3.81	3.81	3.82	3.83

5.4.3 As indicated in Table 23, predicted NO_x concentrations were below the annual mean EQS of 30µg/m³ at all sensitive receptor locations.

5.4.4 Maximum predicted annual mean NO_x concentrations at the receptor locations are summarised in Table 24.

Table 24 Maximum Predicted Annual Mean NO_x Concentrations

Receptor		Maximum Predicted Annual Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Dartmoor SAC	0.04	3.61	0.1	12.0
E2	Oxenpark Marsh LWS	0.08	3.81	0.3	12.7
E3	Trecott Marsh LWS	0.09	3.86	0.3	12.9
E4	Cottles Wood AW	0.21	3.87	0.7	12.9
E5	Rook Wood/ Western Copse AW	0.17	3.83	0.6	12.8

5.4.5 As indicated in Table 24, PCs were below 1% of the EQS at the SAC and 100% of the EQS at all LWSs and AWs. As such, predicted effects on annual mean NO_x concentrations are not considered to be significant, in accordance with the stated criteria.

5.4.6 Predicted 24-hour mean NO_x PECs, inclusive of background levels, are summarised in Table 25.

Table 25 Predicted 24-hour Mean NO_x Concentrations

Receptor		Predicted 24-hour Mean NO _x PEC (µg/m ³)				
		2019	2029	2021	2022	2023
E1	Dartmoor SAC	7.48	7.66	7.54	7.58	7.50
E2	Oxenpark Marsh LWS	8.31	8.28	8.29	8.68	8.16
E3	Trecott Marsh LWS	8.17	8.49	8.77	8.63	8.47
E4	Cottles Wood AW	8.61	8.39	8.69	8.52	8.61
E5	Rook Wood/ Western Copse AW	8.14	8.42	8.37	8.33	8.48

5.4.7 As indicated in Table 25, predicted NO_x concentrations were below the 24-hour mean EQS of 75µg/m³ at all sensitive receptor locations.

5.4.8 Maximum predicted 24-hour mean NO_x concentrations at the receptor locations are summarised in Table 26.

Table 26 Maximum Predicted 24-hour Mean NO_x Concentrations

Receptor		Maximum Predicted 24-hour Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Dartmoor SAC	0.52	7.66	0.7	10.2
E2	Oxenpark Marsh LWS	1.22	8.68	1.6	11.6
E3	Trecott Marsh LWS	1.23	8.77	1.6	11.7
E4	Cottles Wood AW	1.37	8.69	1.8	11.6
E5	Rook Wood/ Western Copse AW	1.16	8.48	1.5	11.3

5.4.9 As indicated in Table 26, PCs were below 10% of the EQS at the SAC and 100% of the EQS at all LWSs and AWs. As such, predicted effects on 24-hour mean NO_x concentrations are not considered to be significant, in accordance with the stated criteria.

Nitrogen Deposition

5.4.10 Predicted annual nitrogen PC deposition rates are summarised in Table 27.

Table 27 Predicted Annual Nitrogen Deposition Rates

Receptor		Predicted Annual PC Nitrogen Deposition Rate (kgN/ha/yr)				
		2019	2020	2021	2022	2023
E1	Dartmoor SAC	0.003	0.003	0.003	0.004	0.003
E2	Oxenpark Marsh LWS	0.006	0.007	0.008	0.008	0.005
E3	Trecott Marsh LWS	0.006	0.005	0.007	0.009	0.006
E4	Cottles Wood AW	0.041	0.033	0.040	0.040	0.042
E5	Rook Wood/ Western Copse AW	0.030	0.029	0.030	0.033	0.033

5.4.11 Maximum predicted annual nitrogen deposition rates at the receptor locations are summarised in Table 28.

Table 28 Maximum Predicted Annual Nitrogen Deposition Rates

Receptor		Maximum Predicted Annual PC Nitrogen Deposition Rate (kgN/ha/yr)	Proportion of EQS (%)	
			Low EQS	High EQS
E1	Dartmoor SAC	0.004	0.08	0.04
E2	Oxenpark Marsh LWS	0.008	0.16	0.05
E3	Trecott Marsh LWS	0.009	0.17	0.06
E4	Cottles Wood AW	0.042	0.42	0.28
E5	Rook Wood/ Western Copse AW	0.033	0.33	0.22

5.4.12 As indicated in Table 28, PCs were below 1% of the EQS at the SAC and 100% of the EQS at all LWSs and AWs. As such, predicted effects on nitrogen deposition are not considered to be significant, in accordance with the stated criteria.

Acid Deposition

5.4.13 Predicted annual acid PC deposition rates are summarised in Table 29.

Table 29 Predicted Annual PC Acid Deposition Rates

Receptor		Predicted Annual PC Acid Deposition Rate (keq/ha/yr)				
		2019	2020	2021	2022	2023
E1	Dartmoor SAC	0.0002	0.0002	0.0002	0.0003	0.0002
E2	Oxenpark Marsh LWS	0.0005	0.0005	0.0006	0.0005	0.0004
E3	Trecott Marsh LWS	0.0004	0.0004	0.0005	0.0006	0.0005
E4	Cottles Wood AW	0.0029	0.0023	0.0028	0.0028	0.0030
E5	Rook Wood/ Western Copse AW	0.0021	0.0021	0.0021	0.0024	0.0024

5.4.14 Maximum predicted annual acid deposition rates at the receptor locations are summarised in Table 30.

Table 30 Predicted Annual Acid Deposition Rates

Receptor		Maximum Predicted Annual Acid PC Deposition Rate (keq/ha/yr)	Proportion of EQS (%)
E1	Dartmoor SAC	0.0003	0.0
E2	Oxenpark Marsh LWS	0.0006	-
E3	Trecott Marsh LWS	0.0006	-
E4	Cottles Wood AW	0.0030	0.2
E5	Rook Wood/ Western Copse AW	0.0024	0.2

5.4.15 As indicated in Table 30, annual acid PCs were below 1% of the EQS at the SAC and 100% of the EQS at all LWSs and AWs. As such, predicted effects on acid deposition are not considered to be significant in accordance with the stated criteria.

5.5 Sensitivity Analysis

5.5.1 Dispersion model outputs can be affected by a number of variables, including:

- Meteorological data;
- Emission parameters;
- Receptor grid resolution;
- Treatment of terrain and buildings; and,
- Special model treatments.

5.5.2 As shown previously, maximum NO₂ concentrations at all points on the grid were well below the relevant EQSs. There is also a considerable difference between the predictions and the values required to result in a significant impact at the discrete receptors. As such, there is sufficient headroom to account for model uncertainty without any affect to the assessment conclusions. Further Sensitivity Analysis of specific variables is therefore not warranted for the project.

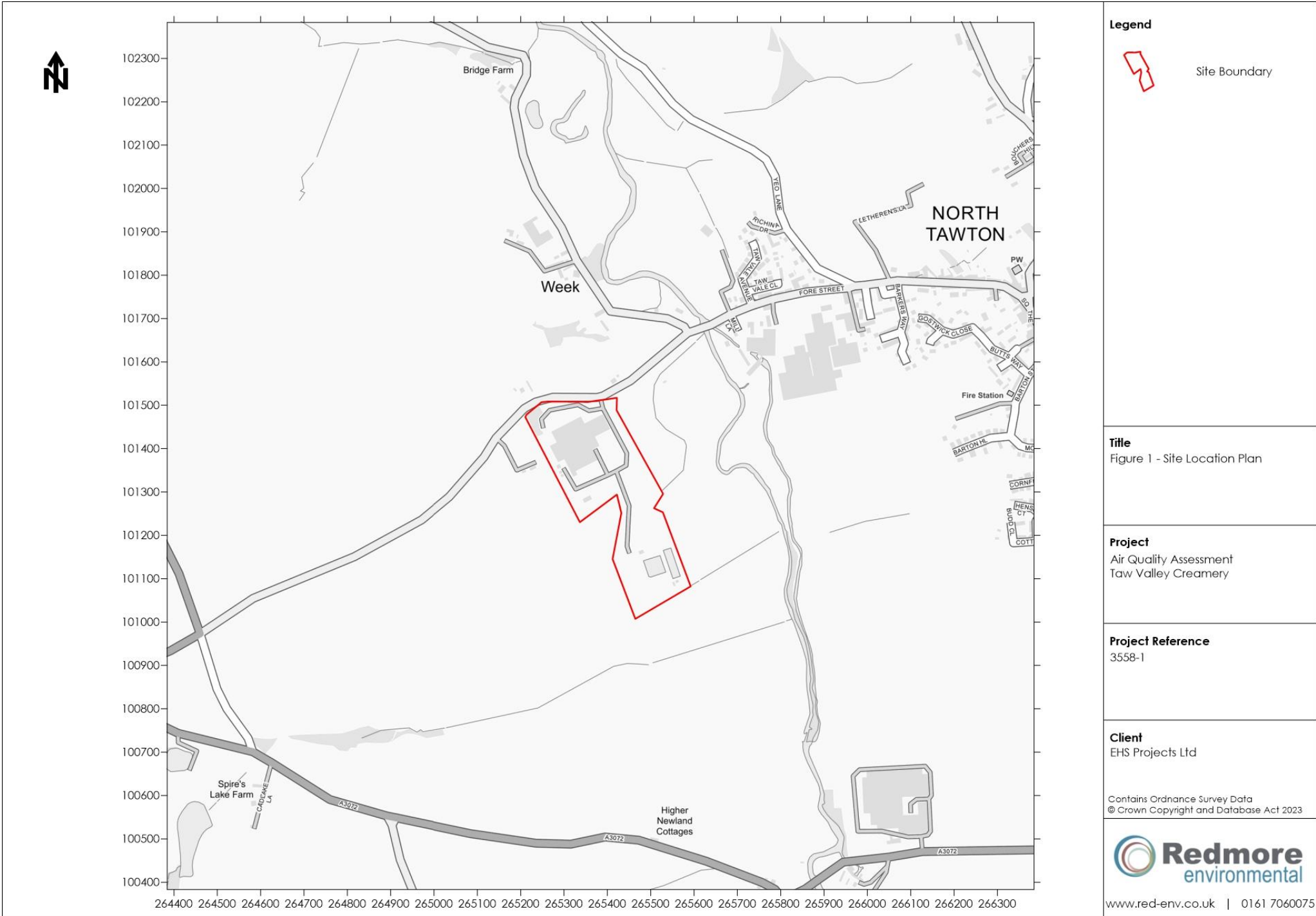
6.0 CONCLUSION

- 6.1.1 Redmore Environmental Ltd was commissioned by EHS Projects Ltd to undertake an Air Quality Assessment in support of an Environmental Permit Variation Application for Taw Valley Creamery.
- 6.1.2 Atmospheric emissions of combustion products from the proposed and existing plant have the potential to cause air quality impacts during normal operation. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and quantify potential effects.
- 6.1.3 Dispersion modelling of NO_x emissions was undertaken using ADMS-6. Impacts at sensitive receptors were quantified and the results compared with the relevant EQSs and significance criteria.
- 6.1.4 The results indicated that impacts on pollutant concentrations were not predicted to be significant at any human or ecological receptor location.

7.0 **ABBREVIATIONS**

APIS	Air Pollution Information System
AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
CERC	Cambridge Environmental Research Consultants
CHP	Combined Heat and Power
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
ELV	Emission Limit Value
EQS	Environmental Quality Standard
LAQM	Local Air Quality Management
LWS	Local Wildlife Site
MAGIC	Multi-Agency Geographic Information for the Countryside
NGR	National Grid Reference
NO	Nitric oxide
NO ₂	Nitrogen dioxide
NO _x	Oxides of nitrogen
O ₂	Oxygen
PC	Process Contribution
PEC	Predicted Environmental Concentration
SAC	Special Area of Conservation
WDBC	West Devon Borough Council
z ₀	Roughness length
%ile	Percentile

Figures



Legend

 Site Boundary

Title
Figure 1 - Site Location Plan

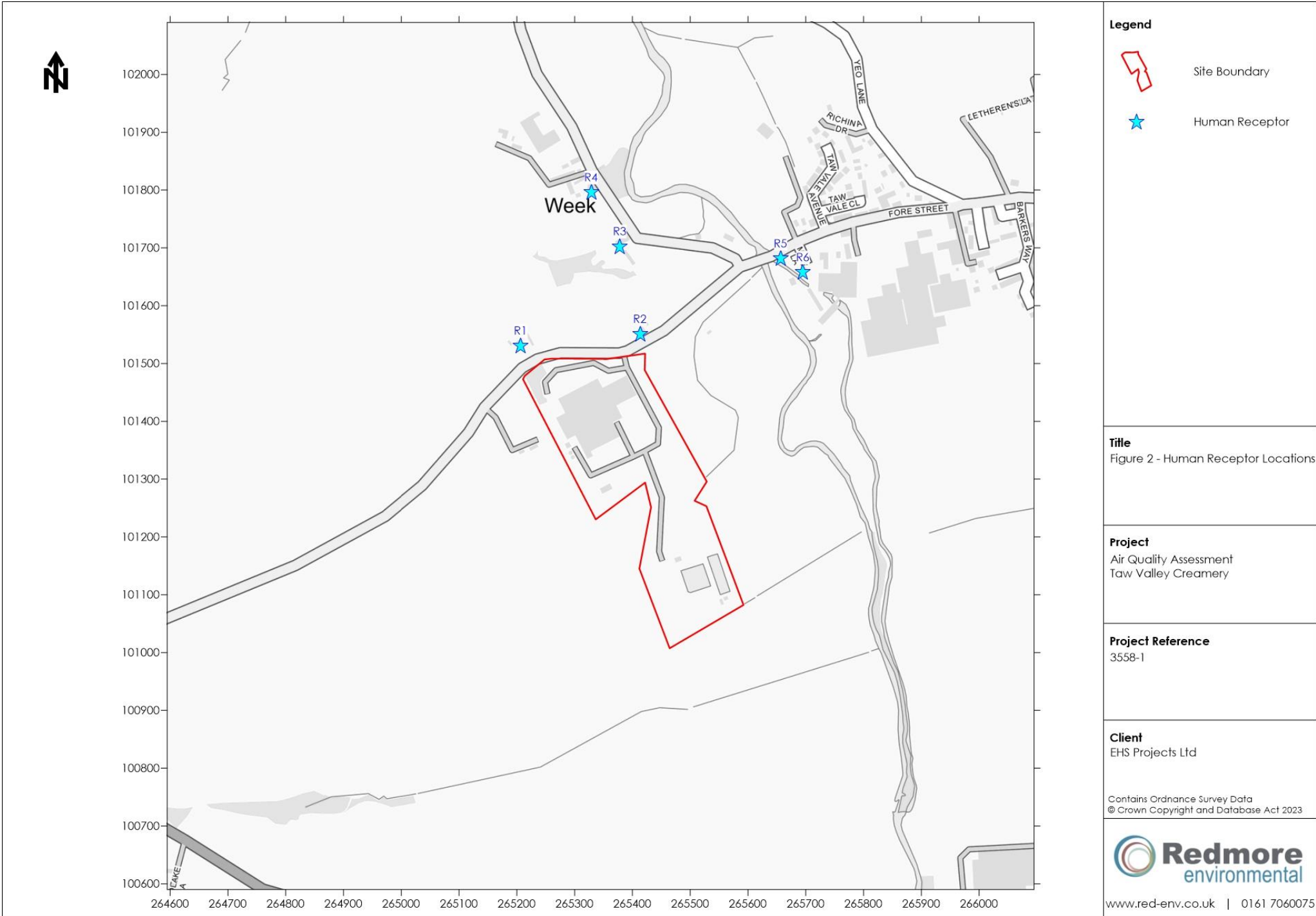
Project
Air Quality Assessment
Taw Valley Creamery

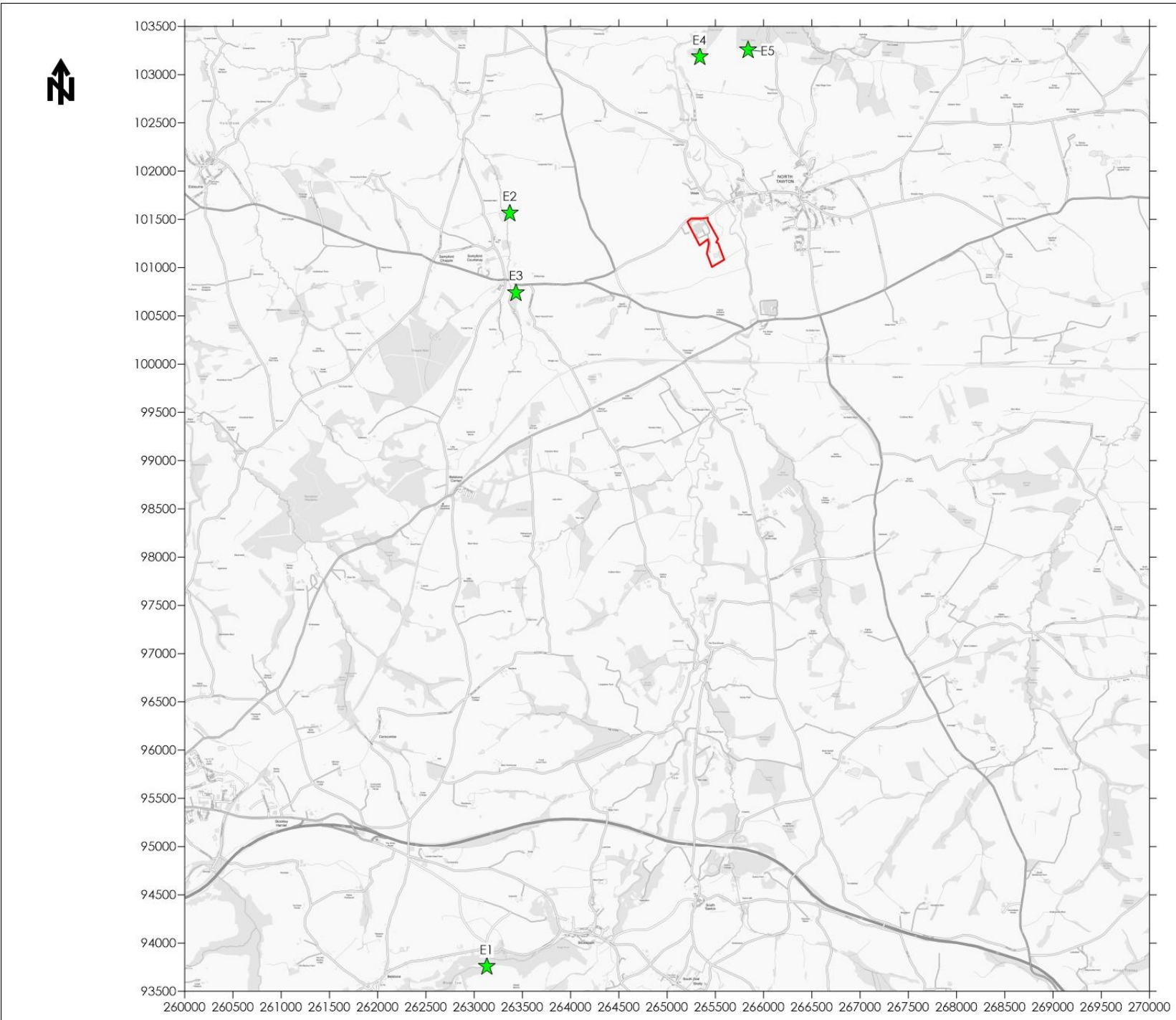
Project Reference
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Legend



Site Boundary



Ecological Receptor

Title

Figure 3 - Ecological Receptor Locations

Project

Air Quality Assessment
Taw Valley Creamery

Project Reference

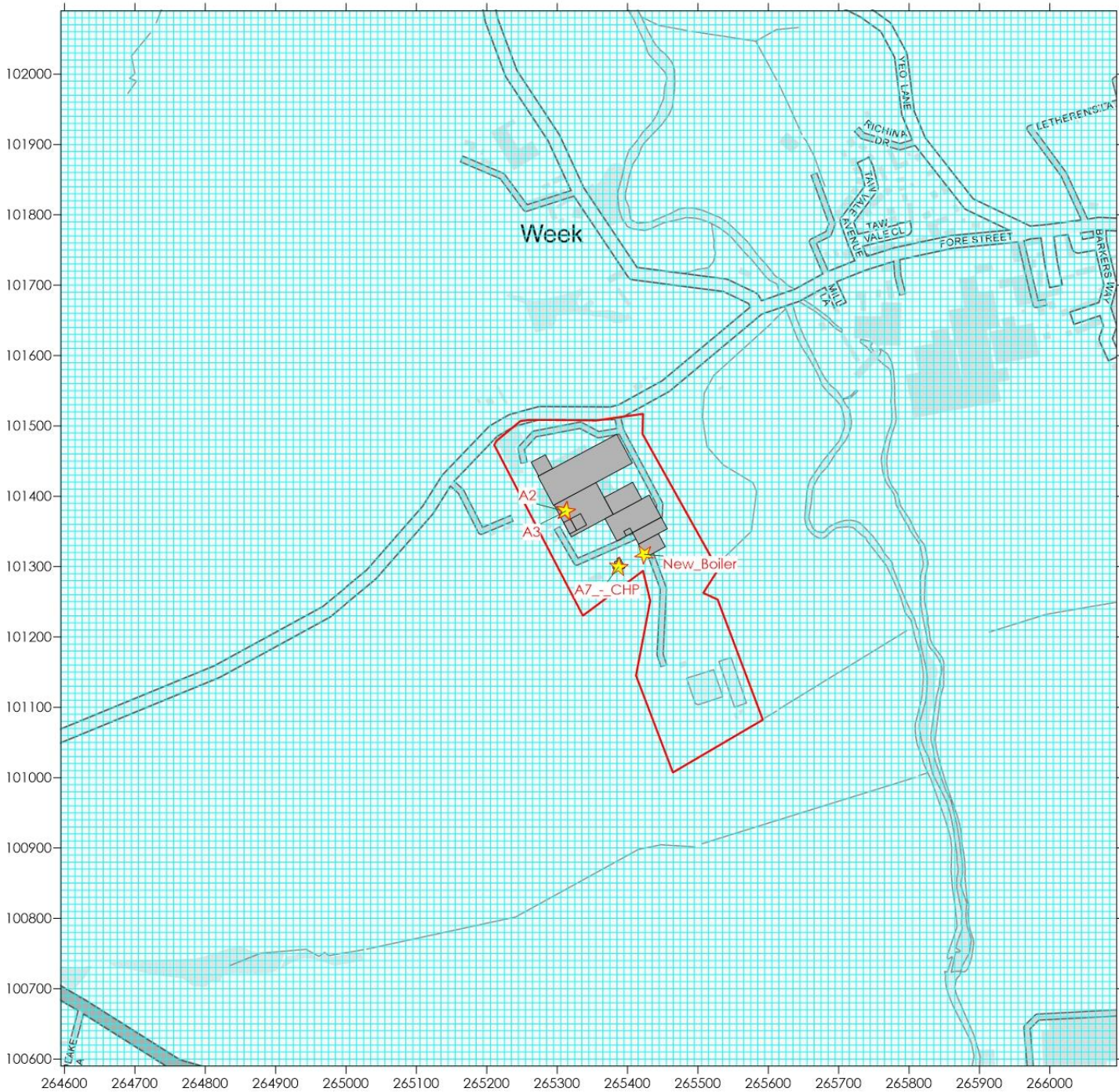
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Legend

-  Site Boundary
-  Stack
-  Assessment Grid
-  Building

Title

Figure 4 - ADMS-6 Inputs

Project

Air Quality Assessment
Taw Valley Creamery

Project Reference

3558-1

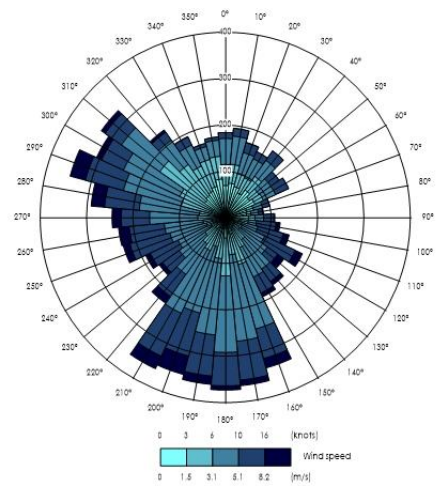
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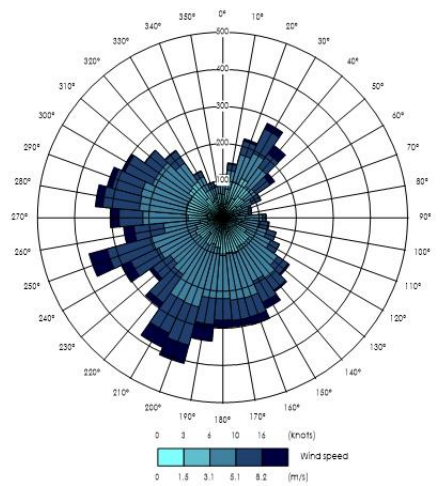
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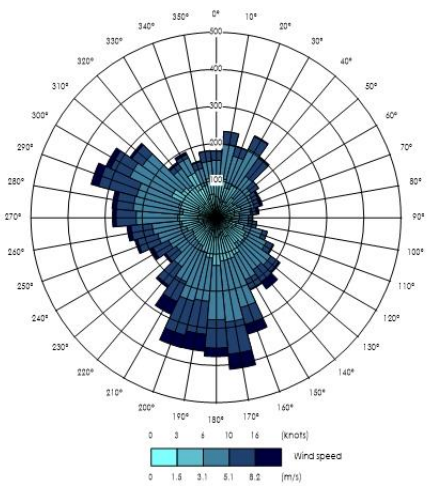
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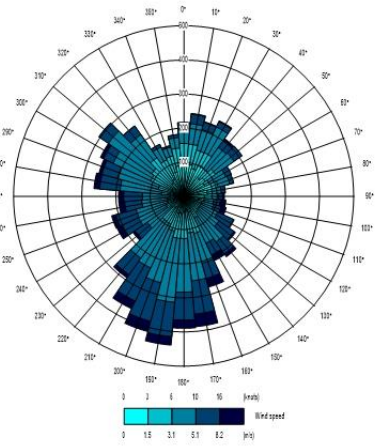
2019 Meteorological Data



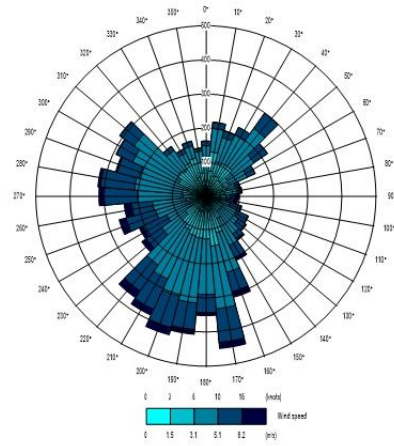
2020 Meteorological Data



2021 Meteorological Data



2022 Meteorological Data



2023 Meteorological Data

Legend

Title
Figure 5 - Wind Roses of 2019 to 2023
Exeter Meteorological Station Data

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