On behalf of
Cambrian Pet Foods Limited.

Intended for
Cambrian Pet Foods Limited.

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CAMBRIAN PET FOODS LTD, LLANGADOG
AIR QUALITY MODELLING REPORT

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EXECUTIVE SUMMARY

Ramboll UK Ltd (Ramboll) has been commissioned by Cambrian Pet Foods Ltd to undertake air dispersion modelling in support of an Environmental Permit application incorporating the operation of the existing boiler plant at The Tywi Valley Food Park, Llangadog. In addition, it is proposed to relocate the boiler plant to a new location in the east of the site, and an assessment has therefore been undertaken of the appropriate stack height for the relocation.

This report sets out the method and results of the dispersion modelling; broadly the scope of the air quality assessment includes:

- Review of local air quality data surrounding the Site;
- Desk study of the building arrangements and locations of human and ecological receptors sensitive to a change in local air quality resulting from the boiler emissions; and
- ADMS dispersion modelling of the operational boiler plant emissions to predict process contributions (PCs) at identified sensitive receptors for comparison against relevant ambient assessment levels.

The modelling has demonstrated that operation of the existing boiler plant would not lead to a breach of National Air Quality Strategy Objectives at the nearest human health receptors. The highest predicted annual mean NO_2 concentration at local human health receptors is 0.62μg/m^3 or 1.6% of the National Air Quality Strategy Objective for the existing site layout. The maximum Predicted Environmental Concentration is 4.0μg/m^3 or 10% of the National Air Quality Strategy Objective. Impacts of NO_x and nitrogen deposition on the Afon Tywi Special Area of Conservation and Site of Special Scientific Interest are considered to be insignificant.

For the relocation of the boiler plant, a stack height of 18m is recommended to ensure no significant off-site impacts. Minimum exit velocities for the main boiler and Wellman Robey boiler have been calculated as 10.2m/s and 11.5m/s respectively. The modelling predicts no significant effects on the residential and ecological receptors in accordance with criteria used for Environmental Permitting or planning applications. Due to the relocation of the boilers further from the Afon Tywi, impacts with the future site layout are lower than for the existing site layout.

1. INTRODUCTION

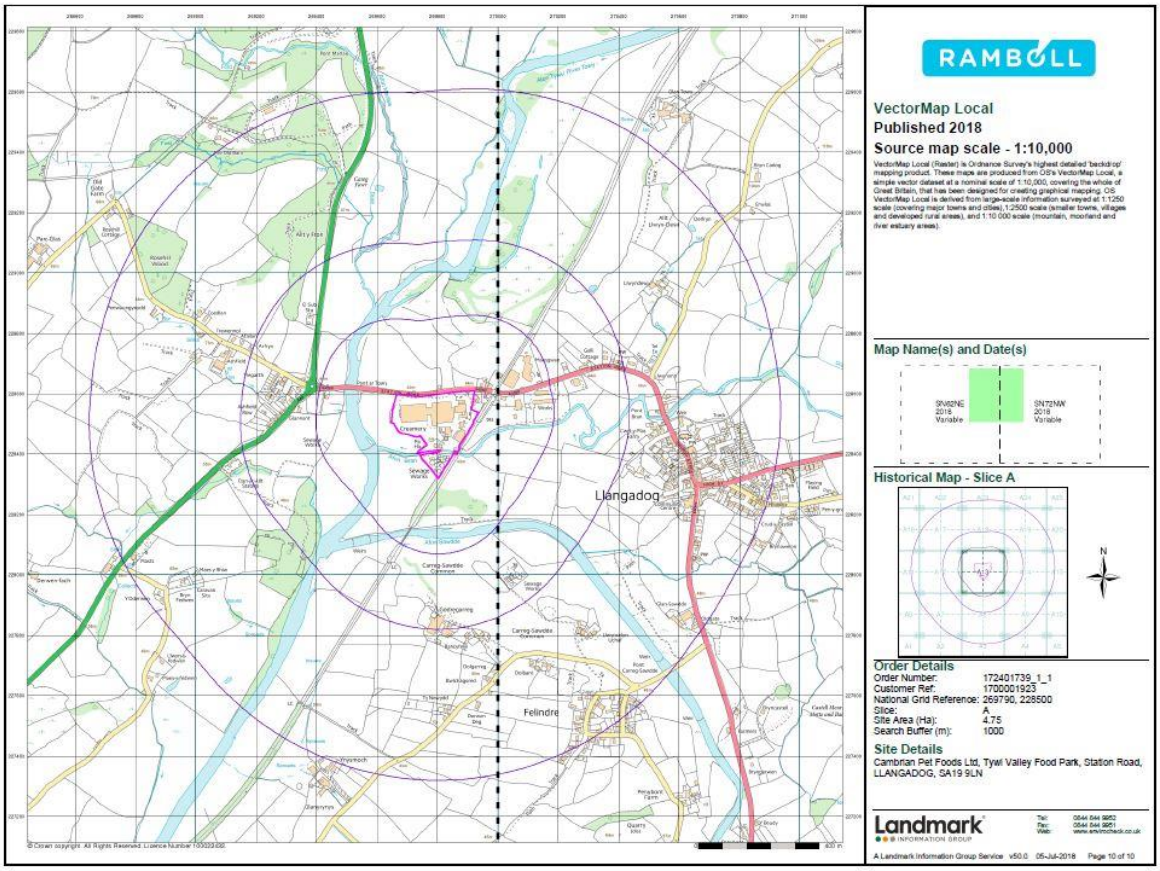
Ramboll UK Ltd (Ramboll) has been commissioned by Cambrian Pet Foods Ltd ('the client'), to undertake air dispersion modelling in support of an Environmental Permit application incorporating the operation of the existing boiler plant at The Tywi Valley Food Park, Llangadog ('the Site'). An assessment has also been undertaken of the appropriate stack height for a relocation of the boiler plant to a new location in the east of the site.

This report sets out the method and results of the dispersion modelling used to assess the air quality impacts of the boiler plant.

1.1 Site Description

The site lies to the south of the A4069 and is bounded to the south east by The Heart of Wales Railway line with Llangadog railway station approximately 40m to the east of the site. The site location is shown in **Error! Reference source not found.**.

Figure 1.1: Site Location



The Site is in a predominantly rural area with the nearest residential property adjacent to the north eastern boundary of the site and two further residential properties within approximately 40m of the site boundary. The site is not located within an Air Quality Management Area (AQMA) and given the predominantly rural nature of the surrounding land use, air quality is expected to be good.

The nearest ecological receptor is the Afon Tywi Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI). At the European level, the primary reason for the designation of the site is the presence of twaite chad and otters for which the water quality is important. Additional qualifying features of the site are the presence of five other fish species of conservation significance.

1.2 Scope

As the boiler plant is natural gas fired, the pollutant of concern is oxides of nitrogen (NO_x). Whilst the boilers will also emit carbon monoxide, emissions of CO are very unlikely to lead to breaches of environmental assessment levels and therefore the assessment has concentrated on the emissions of NO_x.

2. METHODOLOGY

2.1 Introduction

The scope of the assessment has been determined by consideration of the following:

- Review of local air quality data surrounding the Site, including air quality monitoring data from;
  - Carmarthenshire County Council
  - Air Quality in Wales website[1]
- Desk study of the building arrangements and locations of human and ecological receptors sensitive to a change in local air quality resulting from the boiler emissions;
- ADMS dispersion models with operational energy centre emissions to predict process contributions (PCs) at identified sensitive receptors for comparison against relevant ambient National Air Quality Objectives (NAQOs).

2.2 Air Quality Strategy Objectives

The long term and short-term NAQOs that are applicable to this assessment are detailed below in Table 2-1.

Table 2-1: National Air Quality Objective

Pollutant	Concentration (µg/m³)	Averaging Period	NAQO Exceedances Allowed	Percentiles
Human Health Impacts				
Nitrogen dioxide (NO_2)	200	One hour mean	18	99.79
Nitrogen dioxide (NO_2)	40	Annual mean	-	-
Ecological receptors				
Oxides of nitrogen (NOx)	30	Annual mean	-	-

Recent guidance produced by the Institute of Air Quality Management (IAQM)[2] provides an explanation of the reasoning behind setting of the annual mean NO_x objective for the protection of ecosystems (paragraphs D.4.8 to D.4.10):

'The critical level does not differentiate between the role of nitrogen deposition and NO_x in the air. It is a precautionary general threshold, not specific to a particular habitat, plant species or impact pathway, below which there is currently a high degree of confidence that no adverse effects on vegetation will arise. Long term NO_x concentrations below the critical level are therefore desirable. Some species or habitats may not show adverse effects until higher concentrations are present.

The long term (annual mean) concentration of NO_x is most relevant for its impacts on vegetation, as the effects, particularly through the nitrogen deposition pathway, are

[1] https://airquality.gov.wales/ sourced August 2019.

[2] A guide to the assessment of air quality impacts on designated nature conservation sites, D.4.9, v1.0 June 2019

additive over months and years. This is reflected in the adoption of the long term guideline in the EU Air Quality Directive as a limit value for vegetation. However, atmospheric exposure to very high concentrations of NO_x for short periods (hours/days) may also have an adverse effect under certain conditions even if the long term concentrations are below the limit value. The WHO guidelines include a short term (24-hour average) NO_x critical level of 75µg/m^3. Originally set at 200µg/m^3 as a four-hour mean, the more detailed CD-ROM version of the 2000 WHO guidelines comments: "Experimental evidence exists that the CLE decreases from around 200µg/m^3 to 75µg/m^3 when in-combination with O_3 or SO_2 at or above their critical levels. In the knowledge that short-term episodes of elevated NO_x concentrations are generally combined with elevated concentrations of O_3 or SO_2, 75µg/m^3 is proposed for the 24 h mean." Ozone and SO_2 concentrations are typically low in the UK compared to many other countries. If a regulator does require the use of the short term NO_x critical level, given the low UK SO_2 concentrations IAQM consider it is most appropriate to use 200µg/m^3 as the short term critical load.

The relative importance of the long term mean compared to the short term mean is reflected in several studies which state that the 'UNECE Working Group on Effects strongly recommended the use of the annual mean value, as the long term effects of NOx are thought to be more significant than the short term effects'. This IAQM guidance, therefore, recommends that only the annual mean NO_x concentration is used in assessments unless specifically required by a regulator; for instance, as part of an industrial permit application where high, short term peaks in emissions, and consequent ambient concentrations, may occur.'

In terms of the assessment of the impacts of NO_x emissions for an Environmental Permit, the assessment is required to consider both the annual mean and daily mean concentrations. As the extract from the IAQM guidance makes clear however, compliance with the annual mean critical level is the more significant of the two parameters and is likely to highly protective of vegetation in general.

In terms of the daily mean critical level, the published Environmental Assessment Level in EA guidance[3] is 75µg/m^3 and this is likely to be highly conservative in the context of UK O_3 and SO_2 concentrations and a critical level of 200µg/m^3 is likely to be more appropriate. The results of the dispersion modelling are therefore compared against both of these short-term criteria.

2.3 Critical Loads

For the deposition of air pollutants critical loads have been set for different habitats. The Air Pollution Information System (APIS)[4] provides critical loads for nitrogen deposition (leading to eutrophication) and nitrogen acid deposition (leading to acidification) for different habitat types and specific site relevant critical loads for designated sites. The APIS website does not provide site relevant critical loads for the Afon Tywi SAC site interest features (sea lamprey, brook lamprey, river lamprey, allis shad, twaite shad, bullhead and otter). It is stated that there is '*No comparable habitat with established critical load estimate available'*, with the additional comment:

No Critical Load has been assigned to the EUNIS classes for meso/eutrophic systems. These systems are often P limited (or N/P co-limiting), therefore decisions should be

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

[4] http://www.apis.ac.uk accessed August 2019

taken at a site specific level. Furthermore, consideration should also be given to other sources of N, i.e. discharges to water, diffuse agricultural pollution etc.

In relation to the potential impacts of nitrogen deposition on freshwater habitats, the APIS website also states in relation to nitrogen deposition to rivers and streams:

Deposition of ammonia, nitrate and other forms of nitrogen from the atmosphere could be an important source of nitrogen in some upland catchments where intensive agricultural activity is absent. Detailed nitrogen budgets, however, do not exist, so the relative inputs from atmospheric deposition are unknown. In such cases, increasing nitrogen inputs from atmospheric sources are likely to have ecological impacts. In most lowland rivers and burns, nitrogen inputs from catchment land-use, not deposition from the atmosphere, are likely to be much more significant (Strong et al. 1997, Smith & Stewart 1989, Foy et al. 1982).

Given the lowland location of the installation and the large amount of agricultural activity in the vicinity of the site, it is considered that nitrogen inputs from the land-use are likely to be much more significant than atmospheric nitrogen deposition.

Section 5.5.4.4 of the IAQM guidance also notes that where the change in NO_x concentrations is less than 0.4µg/m^3 it is unlikely that it would exceed 1% of the most stringent critical loads for nitrogen and acid deposition. This is on the basis that the most stringent critical load for a grassland type habitat is 5kgN/ha/year; with the calculation based on a conversion factor for NO_x to NO_2 of 0.7 and a deposition velocity of 1.5mm/s, a NO_x concentration of 0.4µg/m^3 is equivalent to 0.04kgN/ha/year (0.8% of the critical load). The guidance also notes that the lowest critical load is for water plantain at 3kgN/ha/year albeit APIS recommends[5] that this critical load should only be applied to oligotrophic waters with low alkalinity with no significant agricultural or other human inputs. However, in the absence of a site relevant critical load for the habitat, a value of 3kgN/ha/year has been used as the assessment criteria and this is likely to be very conservative.

2.4 Significance Criteria

2.4.1 Environmental Permitting

For Environmental Permitting, Natural Resources Wales currently follow guidance issued by the Environment Agency for assessing the risks of air pollution. For Environmental Permitting, the process contribution (PC) is compared against the relevant environmental standard. PCs that meet both the following criteria can be screened out from further assessment:

- the short-term PC is less than 10% of the short-term environmental standard
- the long-term PC is less than 1% of the long-term environmental standard

It is not explicitly stated within the guidance what is meant by 'short-term' beyond applying to concentrations measured over a 1-hour period. However, conversion factors are provided to convert 1-hour concentrations to 8-hour and 24-hour means, and therefore for the purposes of environmental permitting, these are also considered to be short-term. Note, however, that this differs from guidance provided by the IAQM which does not consider 24-hour mean concentrations as corresponding to short-term (see below).

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[5] APIS indicative critical load values: Recommended values within nutrient nitrogen critical load ranges for use in air pollution impact assessments http://www.apis.ac.uk/indicative-critical-load-values

Whilst intended to apply to screening assessments and the need to undertake dispersion modelling of emissions, the above criteria are commonly applied to the consideration of the impacts from dispersion modelling. Where the PCs do not screen out, the Predicted Environmental Concentration (PEC) must also be calculated. The PEC includes the background concentration and assesses whether the cumulative impact in relation to the environmental standard.

The following screening criteria are then applied to the PECs:

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

Again, whilst these are screening criteria they are commonly applied to the consideration of the results of modelling assessments.

For ecological assessments, similar criteria apply:

- 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

Where the above assessment criteria are not met, the long term PEC is assessed:

- If the long-term PEC is less than 70% of the long-term environmental standard, the emissions are insignificant and dispersion modelling is not required.

If the PEC is greater than 70% of the long-term environmental standard, detailed modelling is required, but thereafter, the assessment of significance is whether or not the PEC exceeds the environmental standard.

2.4.2 Planning Applications

The assessment of the significance of human health impacts for planning applications differs to that for permit applications and is normally undertaken in accordance with the land use planning guidance provided by the IAQM. Table 2-2 provides the assessment criteria for annual average impacts.

Table 2-2: Annual Average Impacts Descriptors

Concentration at receptor compared to AQAL	**% Change in concentration relative to Air Quality Assessment Level (AQAL)**			
	1	**2-5**	**6-10**	**>10**
75%	Negligible	Negligible	Slight	Moderate
76-94%	Negligible	Slight	Moderate	Moderate
95-102%	Slight	Moderate	Moderate	Substantial
103-109%	Moderate	Moderate	Substantial	Substantial
110% or more	Moderate	Substantial	Substantial	Substantial

The table is applied by rounding the percentage change to whole numbers, with changes of less than 0.5% described as negligible.

For short-term concentrations, the impact is considered in relation to the PC alone; for PCs 11-20% of the relevant AQAL the magnitude is described as small, 21-50% medium and above 51% large. The severity of the impact is described as slight, moderate or substantial respectively. In this context the IAQM guidance states that:

short-term impacts are those averaged over periods of an hour or less. These are exposures that would be regarded as acute and will occur when a plume from an elevated source affects airborne concentrations experienced by a receptor over an hour or less. Impacts expressed using an averaging time of a day are not amenable to this form of assessment of short term impacts, since the plume spread will be much too wide over the course of a day, leading to a different kind of exposure to the peak short term concentrations.

For planning applications, IAQM guidance follows the criteria set by the Environment Agency for the consideration of impacts on ecologically designated sites.

3. DISPERSION MODELLING

3.1 Introduction

Air quality impacts were modelled using the ADMS5[6] air quality dispersion model. This uses representative meteorological data for the local area and plant emissions data to predict ambient concentrations of pollutants in the vicinity of the stack. Details of the ADMS 5 model set up are provided in Appendix 1 with an overview in the following sections.

3.2 Model Set Up

3.2.1 Emission Rates and Operating Hours

There are two boilers that provide heat to the installation; the main boiler and a back-up Wellman Robey boiler. The back-up boiler is only operational when the main boiler is unavailable. For modelling purposes, the main boiler is assumed to be operating continuously all year round for the assessment of annual average impacts.

For hourly and daily mean impacts it is assumed that both boilers will be operational all year round although this is likely to over-estimate short-term concentrations as simultaneous operation of both boilers is only likely to occur for short periods of time.

Emission rates and volumetric flowrates for the main boiler were taken from the Exova monitoring report dated 23rd November 2018. A copy of the measured data from the Exova report is shown in Figure 3-1.

Figure 3.1: Exova Monitoring Report Summary Data

9th November 2018

where MU = Measurement Uncertainty associated with the Result

	Concentration				Mass Emission			
Parameter	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter [1]	mg/m³	1.29	2.22	-	g/hr	3.2	6.0	-
PM_{10} [1]	mg/m³	0.17	0.34	-	g/hr	0.4	0.9	-
$PM_{2.5}$ [1]	mg/m³	0.17	0.33	-	g/hr	0.4	0.9	-
Sulphur Dioxide [1]	mg/m³	0.55	0.05	-	g/hr	1.3	1.1	-
Nitrogen Monoxide [1]	mg/m³	59.2	2.9	-	g/hr	148.6	118.5	-
Oxides of Nitrogen (as NO_2) [1]	mg/m³	88.9	4.4	-	g/hr	223.2	178.0	-
Carbon Monoxide [1]	mg/m³	3	0.68	-	g/hr	8.5	6.9	-
Carbon Dioxide	% v/v	Dry 8.5	0.2					
Oxygen	% v/v	Dry 6.0	0.2					
Water Vapour	% v/v	5.5	0.28					
Stack Gas Temperature	°C	149						
Stack Gas Velocity	m/s	3.7	2.9					
Volumetric Flow Rate (ACTUAL)	m³/hr	4423	3520					
Volumetric Flow Rate (REF) [1]	m³/hr	2511	1999					

NOTE: VOLUMETRIC FLOW RATE & VELOCITY DATA TAKEN FROM AN AVERAGE OF ALL OF THE ISOKINETIC RUNS.

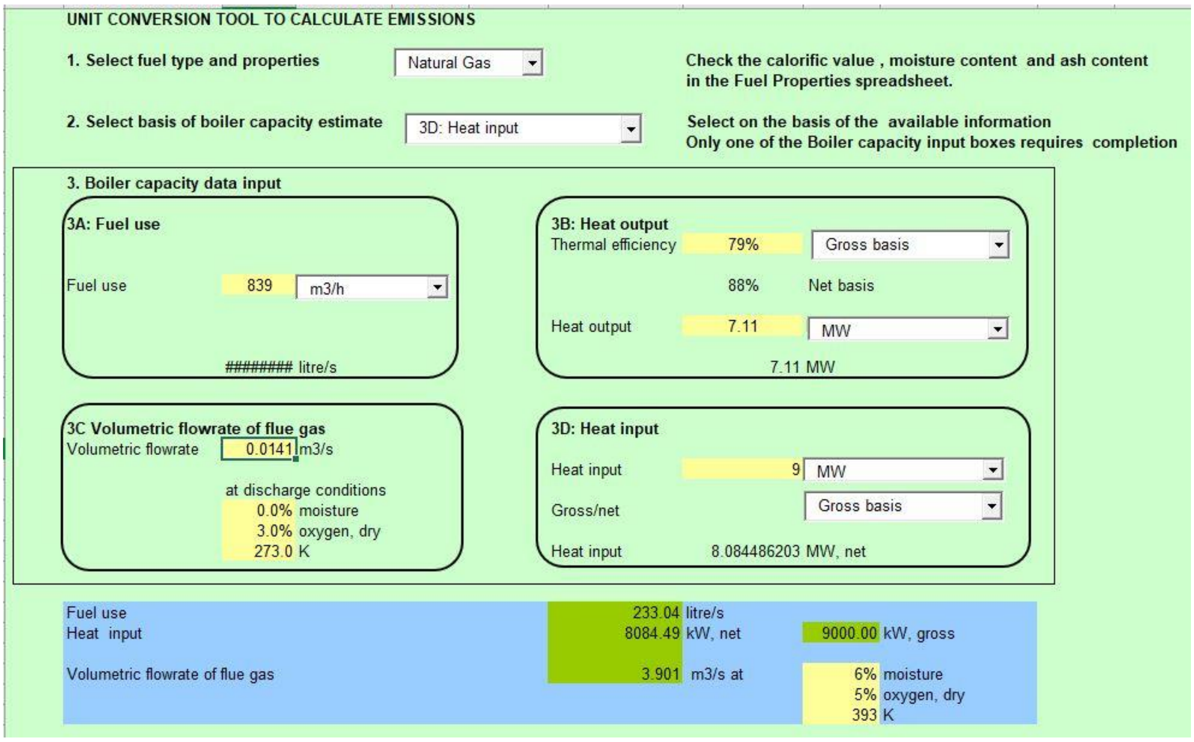
[1] Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 5% oxygen.

The only available data on the Wellman Robey boiler is the Saake burner data sheet which shows that the thermal input into the boiler is 9MW gross and 8.1MW net. The AEA Technology Unit Conversion and Screening Tool[7] was used to estimate the volumetric flowrate from the Wellman Robey boiler and the emissions calculated assuming that it meets the Medium Combustion Plant

[7] Unit Conversion Workbook V1.0 John Abbott AEA, 22 Dec 08

Directive emission limit of 100mg/Nm³. The results of the emission calculation are shown in Figure 3.2.

Figure 3.2: Wellman Robey Emissions Calculation



The stack diameter for the Wellman Robey boiler was assumed to be the same as for the main boiler for the existing site modelling.

For the future site modelling, the minimum exit velocities for both boilers were calculated from the heat release and discharge momentum in accordance with Section 6.1.1 of HMIP Technical Guidance Note D1, and the flue diameter set in the model to achieve it. The minimum discharge velocities were calculated to be 10.2 and 11.5m/s for the main boiler and Wellman Robey boiler respectively.

3.2.2 Meteorological Data

The modelling has used 5 years' worth of meteorological data for 2014-2018 from the Sennybridge meteorological station which is located approximately 23km to the east of the site. The results from the year that gave the highest predicted concentrations have been reported in the assessment.

3.2.3 Receptor Locations

Annual mean and the 99.8th percentile of one hour mean NO_2 concentrations have been predicted at the three residential properties immediately to the east of the site boundary.

For the assessment of the impacts within the Afon Tywi SAC/SSSI annual mean and daily mean NO_x concentrations have been predicted at seven receptor locations representing the eastern and western boundaries of the designated site at its closest point to the installation.

In addition to predicting concentrations at individual receptor locations, a grid of receptors was used to provide a visual interpretation of the dispersion of emissions. The receptor grid was

1500 metres west to east and 1000 metres north to south approximately centred on the site, with a grid spacing of 15 and 10 metres respectively.

Table 3-1: Modelled Receptor Locations

Receptor name	Description	X(m)	Y(m)	Height (m)
Res_1	Residential property	269926	228576	0
Res_2	Residential property	269943	228624	0
Res_3	Residential property	269970	228620	0
SAC_1	Afon Tywi east	269544	228566	0
SAC_2	Afon Tywi	269551	228508	0
SAC_3	Afon Tywi	269582	228465	0
SAC_4	Afon Tywi	269600	228426	0
SAC_5	Afon Tywi	269610	228383	0
SAC_6	Afon Tywi	269607	228334	0
SAC_7	Afon Tywi	269517	228420	0

Nitrogen deposition has been calculated from the predicted annual mean NO_x concentrations by using a conversion factor of 0.7 to convert NO_x to NO_2. A deposition velocity of 1.5mm/s was used to convert NO_2 concentrations into a deposition flux and the results converted into kgN/ha/year in accordance with the AQTAG06 guidance[8].

3.2.4 Existing Site

Modelling was undertaken for the existing boiler and stack locations and with the existing buildings on the site.

3.2.5 Future Site

For the future site operations, available information for the modelling included the proposed building layout and therefore the existing site model was adjusted to include the proposed building layout. The emission point for the new boiler plant was placed to the east of the proposed new boiler house as this is the most conservative location for the consideration of the impacts on the nearby residential receptors.

In order to ascertain an appropriate stack height, the model was iterated with stack heights from 10m to 27.5m at 2.5m intervals, and the annual mean NO_2 concentrations were predicted at the residential receptor locations.

[8] AQTAG06 Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. 20/4/10, v10

4. BASELINE

4.1 Local Monitoring Data

A review of the Carmarthenshire County Council monitoring data confirms that there are no nitrogen dioxide monitoring locations in the vicinity of the site. This is to be expected given the lack of pollution sources in the local area.

4.2 Defra Background Map Data

The 2019 Defra predicted background concentrations for the grid square covering the site (including the receptor locations) are shown in Table 4-1 below. As anticipated, these show very low NO_x and NO_2 concentrations reflecting the rural nature of the area surrounding the site.

Table 4-1: Background Concentrations (μg/m³)

Year	X (m)	Y (m)	NO_x	NO_2
2019	269500	228500	4.3	3.4

Apart from the site boiler plant, the only local pollution sources are the roads in the vicinity of the site and the railway line adjacent to the site. The A4069 past the site has very low traffic flows; the DFT count data[9] shows a flow of only 2,842 vehicles per day in 2018. The A40 to the west of the site has higher flows[10], with an estimated flow of 7,330 vehicles per day in 2018. These volumes of traffic are insufficient to significantly increase background pollutant concentrations. Train services on the Llangadog Heart of Wales line are infrequent (10 per day) and also would not significantly increase background pollutant concentrations.

In terms of the assessment, the Defra background concentrations will therefore be used as the baseline concentrations which are likely to be only slightly under-predicted. To assess the short-term PEC against the short-term air quality objectives, a baseline concentration of double the annual mean has been used, i.e. 8.6μg/m³ for NO_x and 6.8μg/m³ for NO_2.

4.3 APIS Background Data

The APIS website provides estimates of background pollutant concentrations and deposition for ecological sites averaged over 5km grid squares. The background deposition data are currently 3-year averages for 2013-2015. The nitrogen deposition data for the grid square covering the site is provided in Table 4-2 below.

Table 4-2: Background Nitrogen Deposition (kgN/ha/year)

Year	X (m)	Y (m)	N deposition
2013-2015	265500	225500	14.0

The background nitrogen deposition rate is above the critical load that has been assumed for the assessment (3kgN/ha/year).

[9] https://roadtraffic.dft.gov.uk/manualcountpoints/627
[10] https://roadtraffic.dft.gov.uk/manualcountpoints/50513

5. EXISTING SITE

5.1 Introduction

For the existing site operations, the impacts have been considered in terms of the Environmental Permitting criteria.

5.2 Human Health Impacts

The maximum predicted PCs and PECs for the five years' worth of meteorological data modelled at the three residential receptor locations in the vicinity of the site are shown in Table 5-1.

Table 5-1: Predicted Mean NO_2 Concentrations

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
Annual Mean Concentrations						
Res_1	40	3.4	0.62	1.6	4.0	10.1
Res_2	40	3.4	0.45	1.1	3.8	9.6
Res_3	40	3.4	0.41	1.0	3.8	9.5
99.8th %ile of Hourly Mean Concentrations						
Res_1	200	6.8	13.5	6.7	20.3	10.1
Res_2	200	6.8	9.9	4.9	16.7	8.3
Res_3	200	6.8	9.0	4.5	15.8	7.9

The maximum annual mean PC occurs at Receptor 1 and this contribution is 1.6% of the assessment level and therefore is not insignificant in accordance with Environmental Permitting criteria. The maxim annual mean PEC is only 10.1% of the assessment level, and is therefore not significant.

The maximum hourly mean PC also occurs at Receptor 1 and is 6.7% of the assessment level and therefore can be considered insignificant.

5.3 Ecological Impacts

5.3.1 NO_x Concentrations

The maximum predicted PCs and PECs for the five years' worth of meteorological data modelled at the seven receptor locations in the Afon Tywi SAC/SSSI are shown in Table 5-2.

Table 5-2: Predicted NO_x Concentrations

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
Annual Mean Concentrations						
SAC_1	30	4.3	0.07	0.22	4.4	14.6
SAC_2	30	4.3	0.09	0.28	4.4	14.6

Receptor	AQAL $\mu g/m^3$	Background Concentration $\mu g/m^3$	PC $\mu g/m^3$	PC as % of the AQAL	PEC $\mu g/m^3$	PEC as a % of the AQAL
SAC_3	30	4.3	0.12	0.39	4.4	14.7
SAC_4	30	4.3	0.15	0.50	4.4	14.8
SAC_5	30	4.3	0.17	0.57	4.5	14.9
SAC_6	30	4.3	0.16	0.52	4.5	14.9
SAC_7	30	4.3	0.09	0.31	4.4	14.6
Daily Mean Concentrations						
SAC_1	75	8.6	9.6	12.8	18.2	24.3
SAC_2	75	8.6	11.7	15.6	20.3	27.1
SAC_3	75	8.6	13.9	18.5	22.5	30.0
SAC_4	75	8.6	10.6	14.1	19.2	25.6
SAC_5	75	8.6	7.4	9.9	16.0	21.4
SAC_6	75	8.6	7.3	9.8	15.9	21.3
SAC_7	75	8.6	7.1	9.5	15.7	21.0
SAC_1	200	8.6	9.6	4.8	18.2	9.1
SAC_2	200	8.6	11.7	5.8	20.3	10.1
SAC_3	200	8.6	13.9	6.9	22.5	11.2
SAC_4	200	8.6	10.6	5.3	19.2	9.6
SAC_5	200	8.6	7.4	3.7	16.0	8.0
SAC_6	200	8.6	7.3	3.7	15.9	8.0
SAC_7	200	8.6	7.1	3.6	15.7	7.9

The maximum annual mean PC occurs at Receptor 5 and this contribution is only 0.6% of the assessment level and therefore can be considered insignificant. The maximum PEC is only 14.9% of the critical level and is dominated by the existing baseline concentration.

The maximum daily mean PC occurs at Receptor 3 and this contribution is 18.5% of the 75$\mu g/m^3$ critical level and 6.9% of the 200$\mu g/m^3$ critical level. When assessed against the lower critical level the PC is potentially significant, but not so against the higher critical level. The maximum PEC is 22.5$\mu g/m^3$ which is well below both critical levels. Overall, the NO_x emissions are unlikely to have an adverse impact on the SAC/SSSI at the point of maximum concentration. In addition, the impacts above 10% of the critical level impact only a short section of the river, the remaining sections have lower concentrations. This is illustrated by the contour plot of daily mean NO_x concentrations shown in Appendix 2.

5.3.2 Nitrogen Deposition

The maximum predicted PCs and PECs for the five years' worth of meteorological data modelled at the seven receptor locations in the Afon Tywi SAC/SSSI are shown in Table 5-3.

Table 5-3: Predicted Nitrogen Deposition

Receptor	AQAL kgN/ha/yr	Background Deposition kgN/ha/yr	PC kgN/ha/yr	PC as % of the AQAL
SAC_1	3	14.0	0.007	0.22
SAC_2	3	14.0	0.009	0.29
SAC_3	3	14.0	0.012	0.40
SAC_4	3	14.0	0.015	0.50
SAC_5	3	14.0	0.017	0.58
SAC_6	3	14.0	0.016	0.52
SAC_7	3	14.0	0.007	0.22

The maximum predicted nitrogen deposition occurs at Receptor 5 and is 0.6% of the assessment level (which is the lowest critical load for any habitat on APIS). The PC can therefore be considered to be insignificant.

6. FUTURE SITE

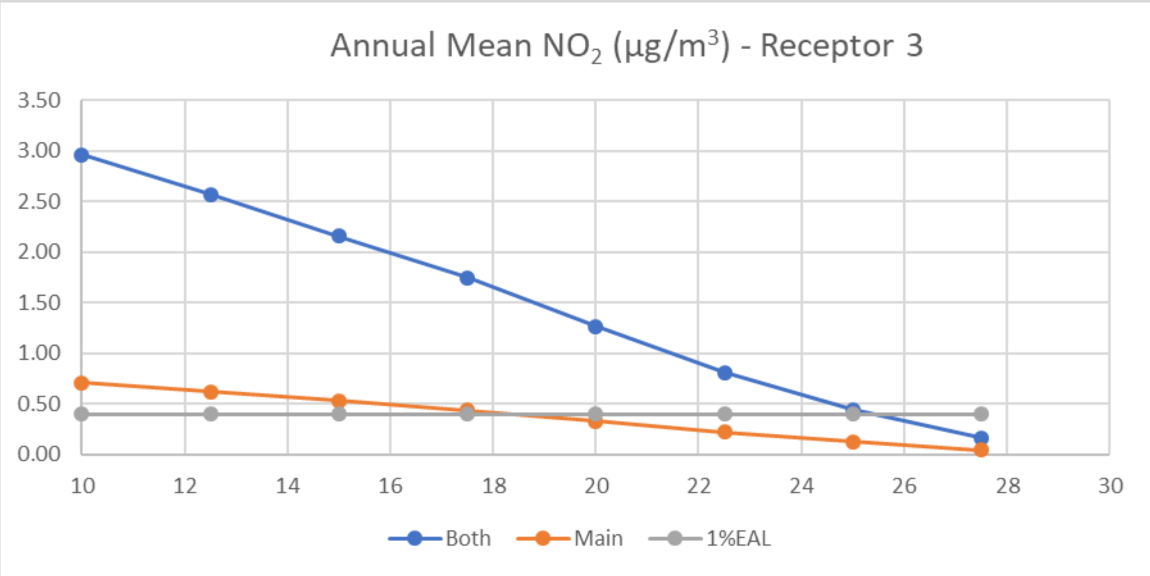
6.1 Introduction

For the future site operations, the impacts have been considered in terms of the Environmental Permitting and planning criteria (as planning permission will be required for the alteration of the site).

6.2 Stack Height Determination

The modelling undertaken for different stack heights shows that Receptor 3 is the receptor that requires the highest minimum stack height. Figure 6-1 shows the predicted annual mean NO_2 concentration for the main boiler and both boilers operating together for iterations of the stack height.

Figure 6.1: Stack Height Graph



A stack height of approximately 18m is the point at which the impacts from the main boiler become insignificant in terms of Environmental Permitting, where-as for both boilers operating the height would need to increase to 25m.

In terms of planning criteria, given the very low baseline concentrations in the area, in accordance with Table 2-2 a contribution of greater than 5% (2µg/m^3) is required before slight adverse impacts occur, and 10% (4 µg/m^3) before moderate adverse impacts. In terms of significance, slight adverse is not regarded as a significant impact where-as moderate is. When judged against the planning criteria, a stack height of 18m would give negligible impacts for the main boiler operating alone and for both boilers operating together. Overall therefore, it is recommended that a stack height of 18m is used for the new site layout.

6.3 Human Health Impacts

The maximum predicted PCs and PECs for the five years' worth of meteorological data modelled at the three residential receptor locations in the vicinity of the site for a stack height of 18m are shown in Table 6-1.

Table 6-1: Predicted Mean NO_2 Concentrations

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
Annual Mean Concentrations						
Res_1	40	3.4	0.43	1.1	3.8	9.6
Res_2	40	3.4	0.35	0.9	3.8	9.4
Res_3	40	3.4	0.43	1.1	3.8	9.6
99.8th %ile of Hourly Mean Concentrations						
Res_1	200	6.8	7.9	3.9	14.7	7.3
Res_2	200	6.8	6.8	3.4	13.6	6.8
Res_3	200	6.8	6.2	3.1	13.0	6.5

The maximum annual mean PC is 1.1% of the assessment level and therefore is marginally above the level that is considered insignificant in Environmental Permitting terms. The maximum annual mean PEC is only 9.6% of the assessment level and can be considered insignificant in Environmental Permitting terms. The maximum PC is negligible in planning terms and therefore insignificant.

The hourly mean PCs and PECs are insignificant as they are well below 10% of the assessment level.

6.4 Ecological Impacts

6.4.1 NO_x Concentrations

The maximum predicted PCs and PECs for the five years' worth of meteorological data modelled at the seven receptor locations in the Afon Tywi SAC/SSSI for a stack height of 18m are shown in Table 6-2.

Table 6-2: Predicted NO_x Concentrations

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
Annual Mean Concentrations						
SAC_1	30	4.3	0.06	0.18	4.4	14.5
SAC_2	30	4.3	0.07	0.23	4.4	14.6
SAC_3	30	4.3	0.08	0.27	4.4	14.6
SAC_4	30	4.3	0.09	0.29	4.4	14.6
SAC_5	30	4.3	0.09	0.31	4.4	14.6
SAC_6	30	4.3	0.08	0.28	4.4	14.6
SAC_7	30	4.3	0.06	0.21	4.4	14.5
Daily Mean Concentrations						

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
SAC_1	75	8.6	7.8	10.4	16.4	21.9
SAC_2	75	8.6	9.2	12.3	17.8	23.8
SAC_3	75	8.6	6.5	8.7	15.1	20.1
SAC_4	75	8.6	4.8	6.4	13.4	17.9
SAC_5	75	8.6	4.6	6.1	13.2	17.6
SAC_6	75	8.6	4.0	5.4	12.6	16.9
SAC_7	75	8.6	4.2	5.6	12.8	17.1
SAC_1	200	8.6	7.8	3.9	16.4	8.2
SAC_2	200	8.6	9.2	4.6	17.8	8.9
SAC_3	200	8.6	6.5	3.3	15.1	7.6
SAC_4	200	8.6	4.8	2.4	13.4	6.7
SAC_5	200	8.6	4.6	2.3	13.2	6.6
SAC_6	200	8.6	4.0	2.0	12.6	6.3
SAC_7	200	8.6	4.2	2.1	12.8	6.4

The maximum annual mean PC occurs at Receptor 5 and this contribution is only 0.3% of the assessment level and therefore can be considered insignificant. The maximum PEC is only 14.6% of the critical level and is dominated by the existing baseline concentration.

The maximum daily mean PC occurs at Receptor 2 and this contribution is 12.3% of the 75µg/m³ critical level and 4.6% of the 200µg/m³ critical level. When assessed against the lower critical level the PC is not insignificant, but would be insignificant when assessed against the higher critical level. The maximum PEC is 17.8µg/m³ which is well below both critical levels.

Overall, the impacts on the SAC/SSSI are lower than for the existing site layout as the boiler plant is located further from the habitat. The NO_x emissions are unlikely to have an adverse impact on the SAC/SSSI at the point of maximum concentration. In addition, the impacts above 10% of the critical level affect only a short section of the river, the remaining sections have lower concentrations. This is illustrated by the contour plot of daily mean NO_x concentrations shown in Appendix 2.

6.4.2 Nitrogen Deposition

The maximum predicted PCs and PECs for the five years' worth of meteorological data modelled at the seven receptor locations in the Afon Tywi SAC/SSSI are shown in Table 6-3.

Table 6-3: Predicted Nitrogen Deposition

Receptor	AQAL kgN/ha/yr	Background Deposition kgN/ha/yr	PC kgN/ha/yr	PC as % of the AQAL
SAC_1	3	14.0	0.01	0.19

Receptor	AQAL kgN/ha/yr	Background Deposition kgN/ha/yr	PC kgN/ha/yr	PC as % of the AQAL
SAC_2	3	14.0	0.01	0.24
SAC_3	3	14.0	0.01	0.27
SAC_4	3	14.0	0.01	0.29
SAC_5	3	14.0	0.01	0.31
SAC_6	3	14.0	0.01	0.28
SAC_7	3	14.0	0.01	0.21

The maximum predicted nitrogen deposition occurs at Receptor 5 and is 0.3% of the assessment level (which is the lowest critical load for any habitat on APIS). The PC can therefore be considered to be insignificant.

7. CONCLUSIONS

An assessment of the impacts of emissions from the boilers at the Cambrian Pet Foods site at Llangadog has been carried out. The assessment has assumed that the main (existing) boiler operates continuously all year round for the assessment of annual average impacts. For the assessment of short-term (hourly and daily) impacts, the assessment has assumed that both site boilers operate concurrently.

There are three residential properties located close to the eastern boundary of the site; and the Afon Tywi SAC/SSSI is located to the west of the site. Background NO_2 and NO_x concentrations in the area are very low due to the predominantly rural nature of the site and the lack of heavily trafficked roads in the area.

Two operating scenarios have been considered; the existing site layout and the future site layout. For the existing site layout the emissions from the boiler do not have any significant effects on the human health or ecological receptors; with pollutant concentrations well below NAQOs and critical levels respectively. Impacts on the Afon Tywi are not significant and are restricted to a short length of the river; it is likely that inputs of nitrogen to the river are dominated by agricultural sources with atmospheric emissions providing very low contributions. Nitrogen deposition is insignificant when considered against the lowest critical load available.

For the future site layout a stack height of 18m is recommended to ensure adequate dispersion of emissions; minimum exit velocities for the main boiler and Wellman Robey boiler have been calculated as 10.2m/s and 11.5m/s respectively. Assuming these input values, the modelling predicts no significant effects on the residential and ecological receptors in accordance with criteria used for Environmental Permitting or planning applications. Due to the relocation of the boilers further from the Afon Tywi, impacts from the future site layout are lower than for the existing site layout.

APPENDIX 1
MODELLING SET UP

Stack Emissions Modelling Input Parameters – Existing Site

Parameter	Main Boiler	Wellman Robey
Modelled Stack Location	269823.6 228466.5	269823.6 228466.5
Flue diameter (m)	0.65	0.65
Exit velocity (m/s)	3.7	11.8
Flue exit Temperature (°C)	149	120
Actual flue volumetric flow (m^3/s)	1.229	3.901
Normalised flue volumetric flow (Nm^3/s)	0.698	2.33
NO_x emission	88.9mg/Nm^3	100mg/Nm^3
NO_x emission, each (g/s)	0.062	0.233

Stack Emissions Modelling Input Parameters – Future Site

Parameter	Main Boiler	Wellman Robey
Modelled Stack Location	269901 228512	269901 228512
Flue diameter (m)	0.391	0.656
Exit velocity (m/s)	10.2	11.5
Flue exit Temperature (°C)	149	120
Actual flue volumetric flow (m^3/s)	1.229	3.901
Normalised flue volumetric flow (Nm^3/s)	0.698	2.33
NO_x emission	88.9mg/Nm^3	100mg/Nm^3
NO_x emission, each (g/s)	0.062	0.233

Operational Hours

For modelling purposes, the equipment is assumed to be operating continuously, 24 hours every day. The annual average results are presented for the main boiler operating alone and the 1-hour and 24-hour mean results are presented for both boilers operating. As this is an infrequent occurrence, the short-term concentrations are likely to be over-predicted.

Special Treatments

Conversion ratios of 70% and 35% have been applied for the conversion of NO_X to NO_2 for annual and hourly mean concentrations in accordance with the *EA Conversion Ratios for NO_x and NO_2*[11].

Buildings Effects

Tall buildings can have a substantial impact on the dispersion of pollutants from stacks, as a result of building downwash i.e. pollutants being drawn down in the wake of a building, giving rise to high concentrations close to the base of the buildings. ADMS5 is able to take account of this

[11] Air Quality Modelling and Assessment Unit, available at file:///Z:/Modelling%20Data/Guidance/noxno2conv2005_1233043.pdf

potential impact by the inclusion of rectangular buildings in the model. The buildings included within the modelling are provided in the tables below and the model layouts are shown pictorially.

Receptor Locations

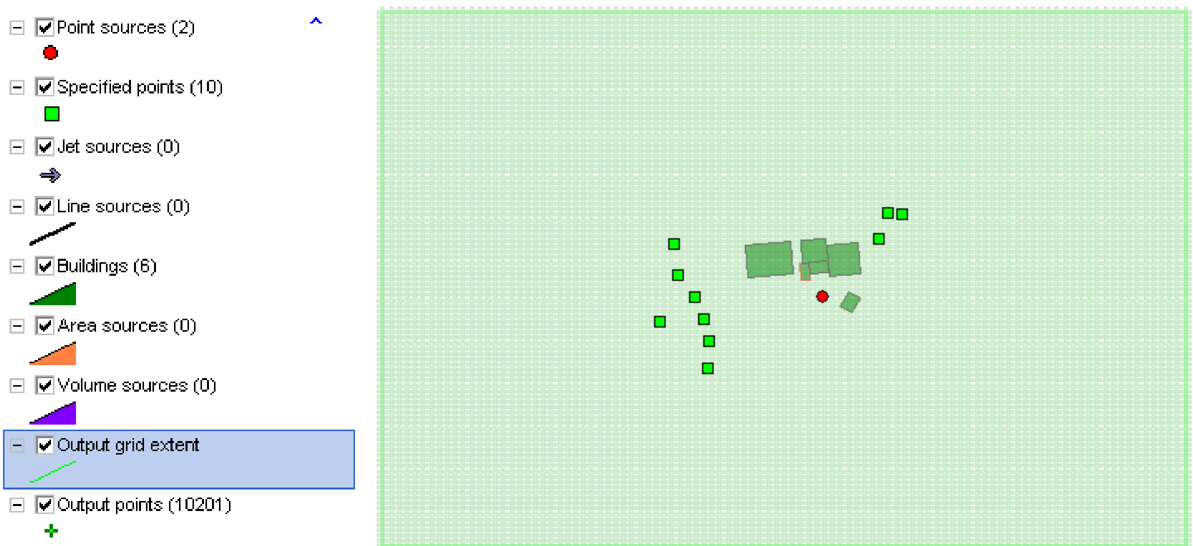
Receptor locations are shown as green squares; the receptors to the west of the site are arranged along the boundary of the Afon Tywi SAC/SSSI, the receptors to the east of the site are located on the three residential properties close to the site boundary.

Buildings – Existing Site

Buildings

New Delete

Main	Name	Shape	X (m)	Y (m)	Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
✔	Dryer	Rectangular	269789	228514	21	18	33	85.39
	Warehouse	Rectangular	269722	228536	9	87	62	85.39
	Canning	Rectangular	269806.5	228553	9	47	42	85.39
	Niro building	Rectangular	269815	228522.2	11.5	35	21	85.39
	Cold store	Rectangular	269874	228457	9	31	25	30.9
	Preparation	Rectangular	269860.6	228536.6	7	58	58	85.39

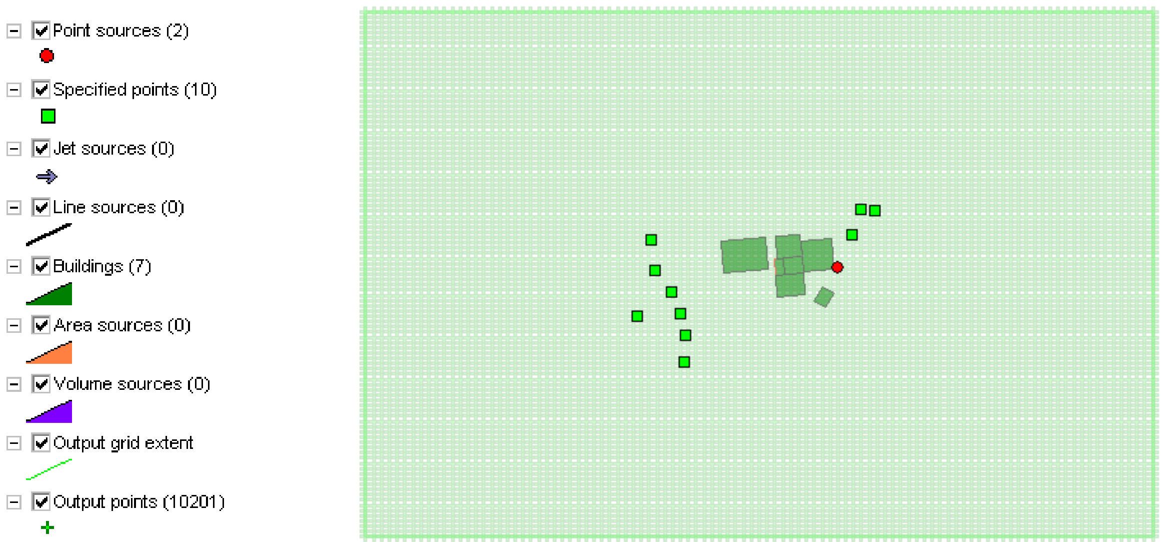


Buildings – Future Site

Buildings

New Delete

Main	Name	Shape	X (m)	Y (m)	Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
✓	Dryer	Rectangular	269789	228514	21	18	33	85.39
	Warehouse	Rectangular	269722	228536	9	87	62	85.39
	Canning	Rectangular	269806.5	228553	9	47	42	85.39
	New production	Rectangular	269815.5	228516.5	9	35	33	85.39
	Cold store	Rectangular	269874	228457	9	31	25	30.9
	Preparation	Rectangular	269860.6	228536.6	7	58	58	85.39
	New production 2	Rectangular	269809.6	228478.9	9	53	41	85.39



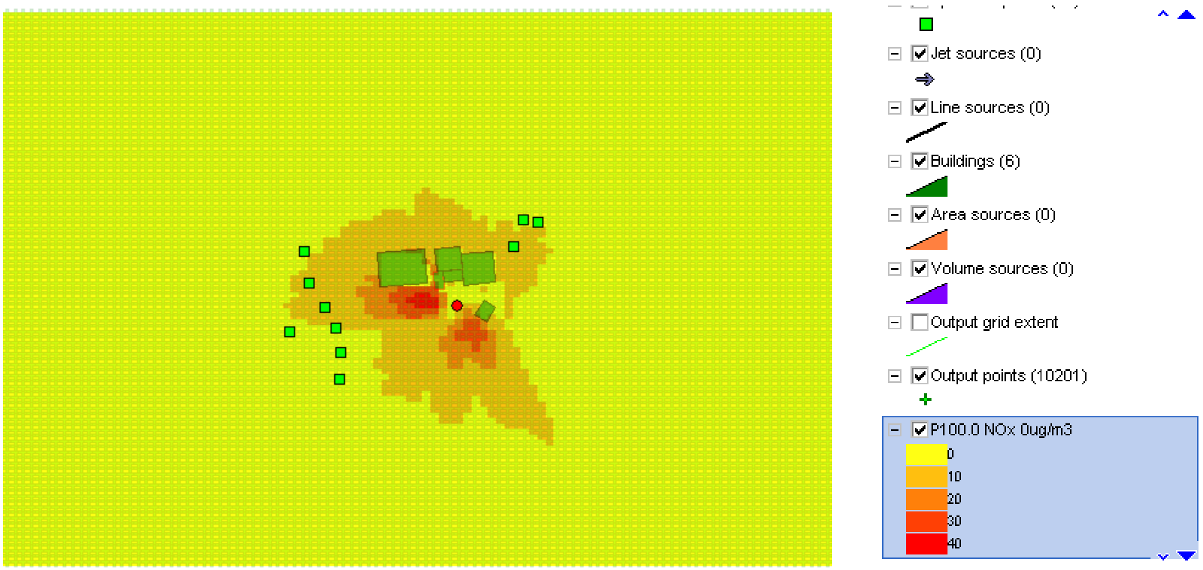
Terrain and Surface Roughness

The terrain in the vicinity of the development is relatively flat, and therefore terrain effects have not been included within the modelling.

The modelling adopts the maximum surface roughness value of 0.2m for the Site, to take account of the rural location of the site. The meteorological measurement site's surface roughness was set to the same value of the site.

APPENDIX 2
DAILY MEAN NO_X CONTOUR PLOTS

Existing Site



Future Site