5 Air quality

5.1 Introduction

This section provides an overview of the existing legislation and assessment criteria in relation to air quality. The Local Air Quality Management (LAQM) review and assessment process is outlined together with a summary of the assessment findings and monitoring data for the Westbury area.

The impact of the proposed development on air quality is assessed and mitigation measures recommended as appropriate. The full air quality modelling and assessment and health risk assessment reports, undertaken by ADM Ltd, are included within Appendix D and the results summarised in this section.

5.2 Assessment methodology and significance criteria

5.2.1 Air quality limit values and objectives

Government policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales & Northern Ireland (AQS), published in July 2007 in accordance with the requirements of Part IV of the Environment Act 1995. The AQS sets out a framework to reduce adverse health effects from air pollution and ensures that international commitments are met. The AQS sets standards and objectives for pollutants to protect human health, vegetation and ecosystems; standards are derived from EU directives on air quality.

The Environment Act 1995 places statutory duties on Local Authorities for Local Air Quality Management (LAQM) and requires Local Authorities to contribute to the achievement of AQS objectives and conduct periodic reviews and assessments of air quality.

Where the air quality objectives are unlikely to be or have not been achieved by the target date, a local planning authority is required to designate an AQMA and to draw up an air quality action plan (AQAP) towards achieving air quality objectives in the future.

5.2.2 Pollutants relevant to the proposed development

The principal pollutants that will be released to atmosphere from the proposed development are:

- Oxides of nitrogen (NO_x)
- Fine particulate matter (PM_{10} and $PM_{2.5}$)

- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)
- Hydrogen chloride (HCl)
- Hydrogen fluoride (HF)
- Ammonia (NH_3)
- Benzene (C_6H_6)
- Dioxins and furans
- Twelve metals
- Polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs)

Descriptions of these pollutants, including their effects on human health and relevant standard and guideline values are given in section 2.3 of Appendix D.

Modelling has also been undertaken of emissions of odour and bio-aerosols from the 40 m high air extraction system stack.

5.2.3 Significance criteria

The combination of the 'sensitivity' and / or 'value' of the affected environmental receptor and the predicted 'extent' and / or 'magnitude' of the impact or change generally determine the significance of an impact. The assessment of significance ultimately relies on professional judgement, although comparing the extent of the impact with criteria and standards specific to each environmental topic can guide this judgement.

Details of impact descriptors used in this assessment are taken from the Institute of Air Quality Management (IAQM) / Environmental Protection UK (EPUK) guidance and[9] are given in Table 4 below. It should be noted that the IAQM / EPUK impact descriptors refer to permanent changes in air quality brought about by a development and not short term or temporary changes. They also refer to locations where there is relevant exposure and not therefore necessarily the location of the maximum impact. The criteria therefore are only appropriate for changes to annual average concentrations at locations where there is relevant exposure i.e. not generally the point of maximum impact.

[9] Environmental Protection UK/IAQM (January 2017) Land-Use Planning& Development Control: Planning for Air Quality

Table 4: IAQM / EPUK air quality impact descriptors for individual receptors

Long term average concentration at receptor in assessment year	% change in concentration relative to air quality assessment level (AQAL)			
	1	2 - 5	6 - 10	> 10
≤ 75% AQAL	Negligible	Negligible	Slight	Moderate
76 – 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102% of AQAL	Slight	Moderate	Moderate	Substantial
102 – 109% of AQAL	Moderate	Moderate	Substantial	Substantial
> 110% AAQAL	Moderate	Substantial	Substantial	Substantial
Note: Changes less than 0.5% are negligible				

The IAQM guidance on significance shown in Table 4 is only applicable to long term / annual average impacts.

For peak short-term concentrations from an elevated source, IAQM provides the following guidance:

- Magnitude of impact (percentage of relevant Air Quality Assessment Level, AQAL):
  - 10-20% - Small
  - 20-50% - Medium
  - >50% - Large

The corresponding severity of these impacts can be described as slight, moderate and substantial without the need to make reference to background or baseline concentration.

The Environment Agency's (EA) risk assessment guidance[10] includes a test for insignificance of short-term impacts and states that the process contribution (PC) can be considered as insignificant if:

- the long term PC is <1% of the assessment criteria
- the short term PC is < 10% of the assessment criteria

It is important to note that if these thresholds are exceeded it is not automatically concluded that the process contribution (PC) is significant, just that it cannot be ruled out as being insignificant.

For the assessment of significance, this assessment uses the IAQM guidance.

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

The IAQM guidance[11] on the assessment of odour for planning suggests three categories for receptor sensitivity (high, medium and low) and defines odour effect descriptors based on the sensitivity of the receptor and the magnitude of the impact in terms of odour units ($OU_e\ m^{-3}$). The categories are described in full in Appendix D; the relevant assessment criteria for high sensitivity (e.g. residential) receptors as used in this assessment are shown in Table 5 below.

Table 5: IAQM odour effect descriptors

Odour exposure (C_{98}, $OU_e\ m^{-3}$) [a]	Receptor sensitivity - high
>10	Substantial
5 – 10	Substantial
3 – 5	Moderate
1.5 – 3	Moderate
0.5 – 1.5	Slight
<0.5	Negligible

a) 98th percentile of hourly averages

The IAQM guidance on odours states: "*Where the overall effect is greater than 'slight adverse', the effect is likely to be considered significant. This is a binary judgement: either it is 'significant' or 'not significant'. Therefore, if the overall effect is not worse than 'slight adverse' then the impact is 'not significant'*". Given that the IAQM approach for judging significance for odours is the same as air quality the test for significance is valid for both air quality and odours.

5.3 Existing conditions

5.3.1 Wiltshire Council monitoring network

As part of on-going requirements to continually review and assess air quality, Wiltshire Council operates a monitoring network that includes both passive and continuous sampling at a number of roadside locations in Westbury. The closest locations to the proposed development are on Primmers Place (0.7 km away), Fore Street (1.7 km) and Haynes Road (1.7 km). There are two locations (Warminster Road and Haynes Road) where the 2016 measured annual average concentration exceeds the Air Quality Strategy (AQS) objective for nitrogen dioxide (NO_2).

The A350 through Westbury from 23 Haynes Road up to the junction with Warminster Road and Warminster Road from the junction with Haynes Road to the junction with Leigh Road has been declared an air quality management area (AQMA) for nitrogen dioxide and particulate matter (PM_{10}).

11 Institute of Air Quality Management (IAQM, May 2014) Guidance on the assessment of odour for planning.

5.3.2 Estimated background concentrations

Defra estimates background concentrations for a number of pollutants across the UK. The estimated background concentrations of NO_2, NO_x, PM10, $PM_{2.5}$ and SO_2 in the area are all less than the relevant AQS objectives. Table 6 below summarises background concentrations and expresses them as a percentage of the assessment criteria (sources for the data are listed in Appendix D).

Table 6: Estimated annual average background concentrations for 2018

Pollutant	Defra estimated background concentration (µg /m³)[1]	Assessment criterion (µg /m³)
Nitrogen dioxide (NO_2)	9.9	40
Oxides of nitrogen (NO_x)	13.3	30
Particulate matter (PM_{10})	12.8	40
Particulate matter ($PM_{2.5}$)	8.3	20
Sulphur dioxide (SO_2)	2.6	10 – 20
1: average for North Somerset is used		

Table 6 shows that the background annual average concentrations of NO_2, PM_{10} and $PM_{2.5}$ are all less than the AQS objectives and are considered to provide a reasonable estimate of current background concentrations in the region of the proposed development.

5.4 Assessment of impacts

5.4.1 Construction

No demolition or site clearance is required for the proposed development.

HGV deliveries during the construction period will vary dependent on the activities on site with larger numbers of deliveries, estimated to be up to 20 / day, associated with earthworks and foundations. At other times, HGV deliveries will be approximately 2 – 5 / day. There will also be approximately 20 oversized loads associated with key items of the process equipment.

The EPUK guidance for development control[12] includes criteria for when an air quality assessment is required and states that an assessment is required when there is a change in AADT of more than 10% (or 5% in an AQMA). An assessment is also required if there is an increase in HGV movements of more than 200 per day.

12 IAQM / EPUK (2017) Land-Use Planning & Development Control: Planning for Air Quality.

Construction vehicle movements are clearly well below the EPUK threshold at which assessment is required and so the impacts on air quality along the routes that will be used by construction traffic will be negligible. The effect of emissions to atmosphere from vehicles during construction has therefore not been considered further.

The closest residential properties to the proposed development are Brookfield and Crosslands off Brook Lane approximately 75 m to the east of the site. Arla Foods Westbury Dairies adjacent to the site is also considered to be a potentially sensitive receptor in terms of construction impacts.

The IAQM has published guidance[13] on how to assess impacts of emissions of dust from demolition and construction sites. This guidance has been followed in Table 7, which shows the steps undertaken to determine the risk of dust from construction giving rise to annoyance.

Table 7: IAQM dust risk assessment methodology

Step	Outcome
Step 1: Need for detailed assessment	Assessment required due to proximity of sensitive receptors within 350 m
Step 2: Assess the risk of dust effect	Low risk site due to small number of receptors
Step 3: Identify the need for site-specific mitigation	IAQM guidance stipulates that for low risk sites the low risk mitigation measures are appropriate. The guidance however states that professional judgement should be employed. Given the close proximity of the air intakes to the dairy it is considered that medium risk mitigation measures should be followed. These are detailed in the IAQM guidance
Step 4: Define effects and their significance	Low impact (following mitigation)

Following the implementation of appropriate mitigation measures the significance of the impacts is considered to be negligible.

5.4.2 Operation

The principal types of emissions to air that may result from operation of the proposed development are:

- Emissions associated with vehicle movements.
- Process emissions vented through the proposed facility's stacks.

13 IAQM (February 2014) Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance.

The potential impacts of these types of emissions are considered in turn below.

Vehicle movements

Currently, Solid Recovered Fuel (SRF) from Northacre RRC destined for Germany passes through the Westbury AQMA resulting in 718 trips / year; these movements will cease on the opening of the proposed development. Waste material imports to the consented development will result in 2,343 trips per year through the Westbury AQMA, therefore the net change in HGV traffic is an additional 1,625 trips per year. On the basis of 7,500 hours operation per year this equates to no more than an additional 6 HGV movements per days through the Westbury AQMA.

Emissions to atmosphere from 6 HGV movements per day will have a negligible impact on air quality as the numbers of HGVs are significantly below the EPUK/IAQM threshold for requiring an assessment (an increase in HGV movements of more than 100 per day). The additional movements can also be put into context by comparison to the current annual average daily traffic (AADT) of 17,310[14], which passes through the AQMA. The extra HGVs represent a negligible increase in the AADT of 0.03% (the EPUK threshold for assessment is a change of more than 5% of AADT in an AQMA).

The effect of emissions to atmosphere from vehicles during operation has therefore not been considered further.

Process emissions

In order to quantify the potential impact of emissions from the process, and to determine the optimum stack height for dispersion, detailed atmospheric dispersion modelling using the industry standard atmospheric dispersion model ADMS version 5.2 has been undertaken. The full dispersion modelling report is included in Appendix D and results are summarised in this section. A detailed analysis was undertaken to assess the sensitivity of the predicted concentrations to *inter alia* variations in meteorological data, grid spacing, terrain, building downwash, stack height and dispersion model used as well as consideration of short term impacts and those arising from abnormal operations. The sensitivity analysis is included in Appendix D. The assessment is undertaken for continuous full load emissions. It should be noted that the installation is expected to operate for 7,500 hours per year so all predicted annual average concentrations are conservative.

[14] AMEC (September 2014) Land North of Bitham Park, Westbury, Air Quality Assessment.

Receptor locations

To determine the maximum ground level concentrations occurring due to emissions to atmosphere from the proposed facility and the distribution of impacts, predictions are made of ground level concentrations for a grid of receptors; making predictions for a grid of receptors also allows the predicted ground level concentrations to be presented as contour plots. The specific receptors used in the assessment can be divided into three groups as follows:

- Monitoring locations – allows for the predicted impacts to be directly compared and added to the measured concentrations.
- Locations where there is relevant exposure – such as residential properties.
- Statutory and non-statutory sites of ecological importance – in accordance with Agency guidance[15] this includes European sites within 10 km and national / local sites within 2 km.

For the purpose of Local Air Quality Management (LAQM) the Air Quality Strategy Objectives (AQS) only apply where there is relevant exposure. This is defined as being where members of the public are regularly present and are likely to be exposed for a period of time, appropriate to the averaging period of the objective. For the annual average objective, locations of relevant exposure include residential properties, schools and hospitals. Receptor locations used in the assessment are given in Table 8 below. The air intake for the dairy has been included as a receptor to allow the potential for tainting and effects on the filter to be assessed.

Table 8: Receptors used in the assessment

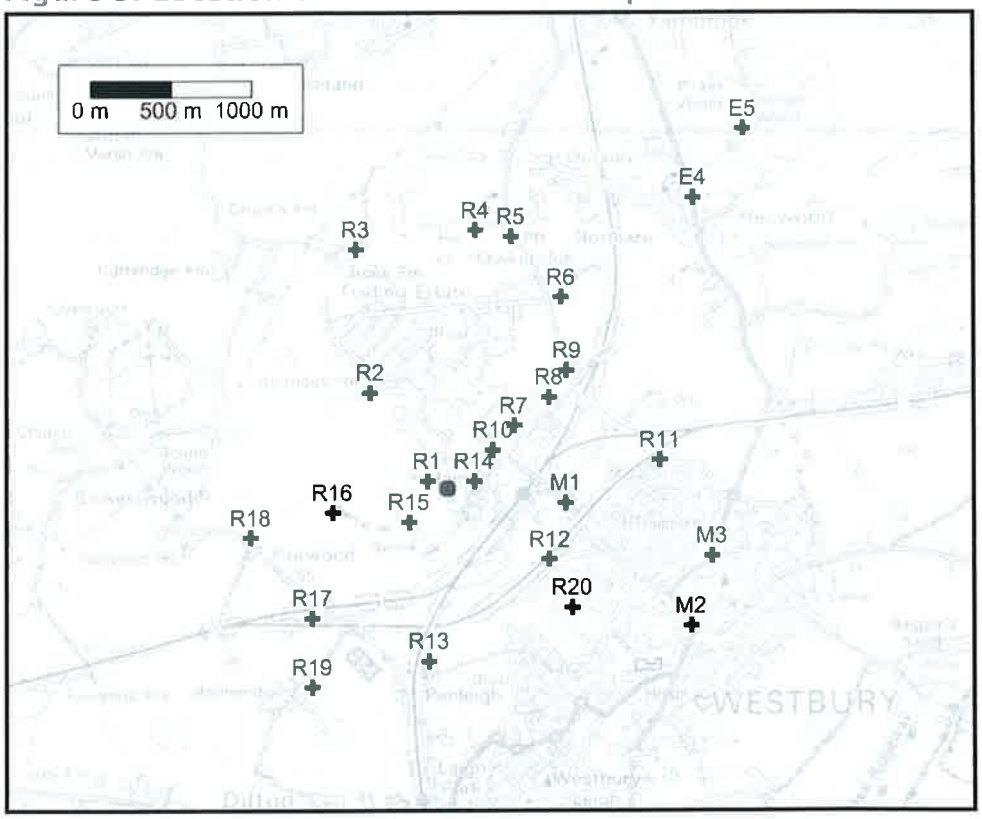
No	Description	Distance (km)
R1	Dairy, air intake	0.1
R2	Storridge Farm	0.8
R3	Brook Farm	1.6
R4	Court Farm	1.6
R5	Property on Hawkeridge Road	1.6
R6	Hawkeridge Farm	1.4
R7	Hawkeridge Park	0.6
R8	Hawkeridge Park	0.8
R9	Grenmore Farm	1.0
R10	Storridge Road	0.4
R11	Bramble Drive	1.3
R12	Oldfield Road	0.8
R13	Penleigh Farm	1.1
R14	Brook Lane	0.2
R15	Orchard House	0.3
R16	Brook Cottage	0.7

[15] Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar Sites within 10 km together with Sites of Special Scientific Interest (SSSs), National Nature Reserves (NNRs), Local Nature Reserves (LNRs), Local Wildlife sites and ancient woodland within 2 km.

No	Description	Distance (km)
R17	Lambert's farm	1.2
R18	Dairy Farm	1.3
R19	Bremeridge Farm	1.5
R20	School	1.1
M1	P13/58 Primmers Place	0.7
M2	P13/51 41 Haynes Road	1.7
M3	P13/56 12 Fore Street	1.7
E1	Salisbury Plain SAC (Max)	4.2
E2	Salisbury Plain SAC (Representative)	7.3
E3	River Avon SAC	8.6
E4	Picket and Clanger Wood SSSI (Max)	2.4
E5	Picket and Clanger Wood SSSI (Representative)	2.9

Figure 3 shows the locations of the human health receptors, as well as the location of the stack (blue spot).

Figure 3: Location of human health receptors and the stack



There are no statutory or non-statutory sites within 2 km. Given that 2 km is the screening distance specified in the Environment Agency guidance it would be reasonable to disregard sites outside this distance (unless they are SAC, Ramsar or SPAs). However, given the location of Picket and Clanger SSSI to the north-east which is in the direction that the prevailing wind will transport emissions from the facility, assessment of the impacts on this SSSI have been included.

The Westbury Ironstone Quarry SSSI has been designated a SSSI for geological reasons and therefore is not relevant to this assessment.

Modelling and assessment results

The incremental increase in ground level concentrations predicted to occur as a consequence of emissions to atmosphere from the operation of the proposed facility have been calculated, assuming that the facility is operating continuously at full load. Emissions data used are set out in full in section 4.2 of Appendix D.

The focus of the assessment is on the impacts of nitrogen dioxide (NO_2) as this is the pollutant of most concern both in terms of the existing prevailing concentration and the incremental impacts from the proposed facility.

This section also presents an assessment of the impacts of all the pollutants released to atmosphere from the proposed facility as well as predictions of the potential for emissions of odour to cause annoyance and bioaerosols to affect the dairy.

Nitrogen dioxide

Oxides of nitrogen (NO_x), which all progressively becomes nitrogen dioxide (NO_2) in the atmosphere, is the principal pollutant released to atmosphere from the proposed development.

Table 9 shows the maximum predicted ground level concentration of nitrogen dioxide (NO_2) occurring as a consequence of emissions to atmosphere from the development for each of the five years of meteorological data used in the assessment. Predictions include the effects of terrain and building downwash.

Table 9: Maximum predicted (process contribution) annual average and 99.8th percentile of hourly average concentrations of nitrogen dioxide (µg m^{-3})

Year	Annual average[a]	99.8th percentile of hourly averages[a]
2012	1.03	8.0
2013	0.74	7.7
2014	0.83	10.1
2015	0.94	8.4
2016	0.64	8.5
Background Concentration	9.9[b]	-
Background + Maximum Impact (PEC) [c]	10.9	29.9[d]
Assessment Criteria	**40**	**200**

(a) Assumes 70% oxidation for annual average and 35% for 99.8th percentile.
(b) Defra estimate background concentration, appropriate for point of maximum impact.

(c) Predicted Environmental Concentration
(d) Environment Agency (H1) guidance; 99.8th + 2 x annual average background.

Table 9 shows that 2012 meteorological data give rise to the highest predicted increment to annual average ground level concentrations and 2014 data the highest 99.8th percentile of hourly averages.

For 2012 meteorological data, at the point of maximum predicted impact the incremental increase in annual average ground level concentration is 1.03 µg m^{-3} which can be compared to the air quality strategy objective of 40 µg m^{-3}. When added to the prevailing background concentration of 9.9 µg m^{-3}, the resulting total concentration of 10.9 µg m^{-3} is less than the Air Quality Strategy objective.

The maximum predicted 99.8th percentile of hourly averages of 10.1 µg m^{-3} is small compared to the Air Quality Strategy objective of 200 µg m^{-3}. To determine the incremental increase to background occurring due to the proposed facility, the Agency's H1 guidance is used; the resulting total 99.8th percentile is 29.9 µg m^{-3}.

Table 10 shows the predicted annual average concentration at the specific receptors for human exposure and at the monitoring locations using 2012 meteorological data, assuming 70% oxidation.

Table 10: Predicted annual average concentrations of NO_2 at specific receptors (µg m^{-3})

Location / description		Predicted increment (PC)[a]	Prevailing concentration	PC + prevailing (PEC)	Increment (PC) as % of objective
R1	Dairy, air intake	0.0	9.9	9.9	0.0
R2	Storridge Farm	0.1	9.9	10.0	0.3
R3	Brook Farm	0.1	9.9	10.0	0.3
R4	Court Farm	0.2	9.9	10.1	0.6
R5	Property on Hawkeridge Road	0.3	9.9	10.2	0.6
R6	Hawkeridge Farm	0.5	9.9	10.4	1.2
R7	Hawkeridge Park	0.8	9.9	10.7	2.0
R8	Hawkeridge Park	0.9	9.9	10.8	2.2
R9	Grenmore Farm	0.8	9.9	10.7	1.9
R10	Storridge Road	0.3	9.9	10.2	0.7
R11	Bramble Drive	0.3	9.9	10.2	0.7
R12	Oldfield Road	0.2	9.9	10.1	0.5
R13	Penleigh Farm	0.2	9.9	10.1	0.4
R14	Brook Lane	0.0	9.9	9.9	0.0
R15	Orchard House	0.1	9.9	10.0	0.3
R16	Brook Cottage	0.2	9.9	10.1	0.4
R17	Lambert's farm	0.3	9.9	10.2	0.7
R18	Dairy Farm	0.1	9.9	10.0	0.3
R19	Bremeridge Farm	0.2	9.9	10.1	0.5

Location / description		Predicted increment (PC)[a]	Prevailing concentration	PC + prevailing (PEC)	Increment (PC) as % of objective
R20	School	0.2	9.9	10.1	0.4
M1	P13/58 Primmers Place	0.2	28 [b]	28.2	0.6
M2	P13/51 41 Haynes Road	0.1	38 [b]	38.1	0.3
M3	P13/56 12 Fore Street	0.1	39 [b]	39.1	0.3
	Assessment criteria	**40**			

(a) Assumes 70% oxidation.
(b) Measured values.

The EPUK significance criteria are applicable to locations where there is relevant exposure and are only applicable to annual average concentration. Defra TG(16) guidance gives the following examples of where there is relevant exposure to annual average objectives:

- Building facades of residential properties
- School
- Hospital
- Care homes

Examples given of where there is not relevant exposure to annual average objectives include gardens of residential properties, hotels and kerbside sites.

Table 11: EPUK Significance Criteria – Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$)

Location / description		Predicted increment (PC)[a]	Increase % of objective	PEC	PEC % of objective	Impact descriptor
R1	Dairy, air intake	0.0	0%	9.9	24.8	Negligible
R2	Storridge Farm	0.1	0%	10.0	25.0	Negligible
R3	Brook Farm	0.1	0%	10.0	25.1	Negligible
R4	Court Farm	0.2	1%	10.1	25.3	Negligible
R5	Property on Hawkeridge Road	0.3	1%	10.2	25.4	Negligible
R6	Hawkeridge Farm	0.5	1%	10.4	26.0	Negligible
R7	Hawkeridge Park	0.8	2%	10.7	26.7	Negligible
R8	Hawkeridge Park	0.9	2%	10.8	27.0	Negligible
R9	Grenmore Farm	0.8	2%	10.7	26.7	Negligible
R10	Storridge Road	0.3	1%	10.2	25.4	Negligible
R11	Bramble Drive	0.3	1%	10.2	25.5	Negligible
R12	Oldfield Road	0.2	0%	10.1	25.2	Negligible
R13	Penleigh Farm	0.2	0%	10.1	25.1	Negligible
R14	Brook Lane	0.0	0%	9.9	24.8	Negligible
R15	Orchard House	0.1	0%	10.0	25.0	Negligible
R16	Brook Cottage	0.2	0%	10.1	25.2	Negligible
R17	Lambert's farm	0.3	1%	10.2	25.5	Negligible
R18	Dairy Farm	0.1	0%	10.0	25.1	Negligible
R19	Bremeridge Farm	0.2	1%	10.1	25.3	Negligible
R20	School	0.2	0%	10.1	25.2	Negligible
M1	P13/58 Primmers Place	0.2	1%	28.2	70.6	Negligible

Location / description		Predicted increment (PC)[a]	Increase % of objective	PEC	PEC % of objective	Impact descriptor
M2	P13/51 41 Haynes Road	0.1	0%	38.1	95.3	Negligible
M3	P13/56 12 Fore Street	0.1	0%	39.1	97.8	Negligible
	Assessment criteria		40			

Table 11 shows that the impact description is 'negligible' at all the receptor locations including receptors M1 M2 and M3, which are in the Air Quality Management Area (AQMA).

Table 12 shows the predicted 99.8th percentile concentration at the specific receptors using 2014 meteorological data.

Table 12: Predicted 99.8th percentile of hourly average concentrations (µg/m^3) of NO_2 at specific receptors

Location / description		Predicted increment (PC)[a]	Predicted increment + prevailing (PEC)	Increment (PC) as % of objective
R1	Dairy, air intake	0.1	19.9	0.0%
R2	Storridge Farm	4.0	24.0	2.0%
R3	Brook Farm	3.0	23.1	1.5%
R4	Court Farm	3.0	23.2	1.5%
R5	Property on Hawkeridge Road	3.0	23.3	1.5%
R6	Hawkeridge Farm	3.7	24.6	1.8%
R7	Hawkeridge Park	7.6	29.2	3.8%
R8	Hawkeridge Park	6.5	28.2	3.2%
R9	Grenmore Farm	5.4	26.9	2.7%
R10	Storridge Road	5.0	2.5%	2.5%
R11	Bramble Drive	3.5	1.8%	1.8%
R12	Oldfield Road	5.6	2.8%	2.8%
R13	Penleigh Farm	3.7	1.8%	1.8%
R14	Brook Lane	0.2	0.1%	0.1%
R15	Orchard House	3.9	1.9%	1.9%
R16	Brook Cottage	5.1	2.6%	2.6%
R17	Lambert's farm	4.1	2.1%	2.1%
R18	Dairy Farm	3.5	1.8%	1.8%
R19	Bremeridge Farm	3.0	1.5%	1.5%
R20	School	4.1	2.0%	2.0%
M1	P13/58 Primmers Place	6.0	3.0%	3.0%
M2	P13/51 41 Haynes Road	2.5	1.3%	1.3%
M3	P13/56 12 Fore Street	2.8	1.4%	1.4%
	Assessment criteria		200	

(a) Assumes 35% oxidation.
(b) Defra guidance (TG4(00)); NO_2 99.8th + 2 x annual average NO_2 background.

Table 12 shows that the maximum predicted 99.8th percentile of hourly average nitrogen dioxide (NO_2) concentrations is 7.6 µg m^{-3} at any of the specific receptors which is only 3.8% of the objective.

It is not appropriate to use the EPUK significance criteria for short term concentrations of nitrogen dioxide (NO_2); short term impacts can be screened out as being insignificant using the Environment Agency's H1 guidance.

The results reported above (Table 9 - Table 12) show that at the specific receptors, the predicted incremental increase in concentrations of nitrogen dioxide (NO_2) occurring due to emissions from the proposed facility are small compared to the assessment criteria and are not of concern to human health.

Figure 4 and Figure 5 below illustrate the distribution of nitrogen dioxide (NO_2) emissions (process contributions) from the proposed facility, using 2012 meteorological data for annual average and 2014 data for 99.8th percentile of hourly averages.

The figures show that peak predicted increments to ground level concentrations occur within about 750 m of the facility.

Figure 4: Annual average NO_2 concentrations

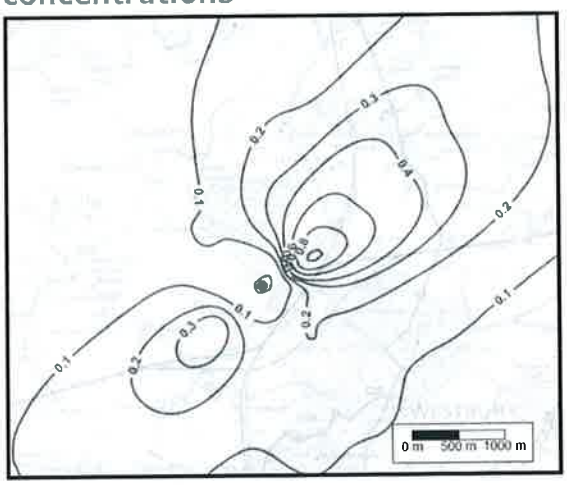
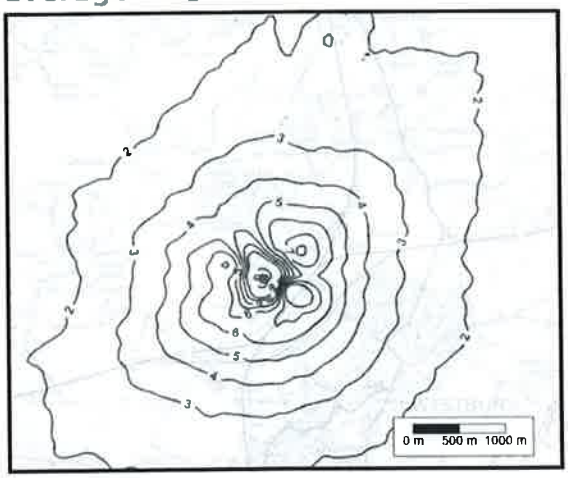


Figure 5: 99.8th percentile of hourly average NO_2 concentrations



Remaining pollutants

Table 13 below shows the results for all pollutants considered in this assessment, assuming full load continuous operation and 2012 meteorological data because this gives rise to the largest increment to annual average concentrations.

Table 13: Maximum predicted incremental concentrations due to emissions to atmosphere from the proposed facility (µg m^{-3})

Pollutant	Averaging period	Predicted concentration (µg m^{-3})	Assessment criteria (µg m^{-3})	Percentage of assessment criteria (%)
Nitrogen dioxide (NO_2)	1 hour	8.0	200	4.0%
	Annual	1.03	40	2.6%
Particulate matter (PM_{10})	24 hour	0.25	50	0.5%
	Annual	0.07	40	0.2%
($PM_{2.5}$)	Annual	0.07	20	0.4%
Sulphur dioxide (SO_2)	15 minutes	6.5	266	2.4%
	1 hour	5.5	350	1.6%
	24 hour	2.7	125	2.2%
Carbon monoxide	8 Hour	5.3	10,000	0.1%
Hydrogen chloride	1 Hour	3.0	750	0.4%
Hydrogen fluoride (HF)	Annual	0.007	16	0.0%
	1 Hour	0.30	160	0.2%
Benzene (C_6H_6)	Annual	0.007	5.0	0.1%
	1 Hour	0.30	195	0.2%
Ammonia (NH_3)	Annual	0.073	180	0.0%
	1 Hour	2.95	2,500	0.1%
Antimony (Sb) (a)	Annual	0.0004	5	0.0%
	1 Hour	0.017	150	0.0%
Arsenic (As)	Annual	0.000005	0.003	0.2%
Cadmium (Cd)	Annual	0.00018	0.005	3.7%
Chromium (Cr) (b)	Annual	0.0004	5	0.0%
	1 Hour	0.017	150	0.0%
Chromium (Cr,	Annual	0.0000003	0.0002	0.1%
Cobalt (Co)	Annual	0.0004	0.2	0.2%
Copper (Cu)	Annual	0.0004	10	0.0%
	1 Hour	0.017	200	0.0%
Lead (Pb)	Annual	0.0004	0.25	0.2%
Manganese (Mn)	Annual	0.0004	150	0.0%
	1 Hour	0.017	1,500	0.0%
Mercury (Hg)	Annual	0.0004	0.25	0.1%
	1 Hour	0.015	7.5	0.2%
Nickel (Ni)	Annual	0.0004	0.02	2.1%
Vanadium (Vn)	Annual	0.0004	5	0.0%
	1 Hour	0.017	1	1.7%
Dioxins	Annual	0.73 (a)	-	-
PAHs	Annual	0.73 (a)	0.00025	0.0%
PCB	Annual	0.02 (a)	0.2	0.0%
	1 Hour	0.77 (a)	6	0.0%

(a) – units are fg m^{-3} ($x10^{-15}$)

Table 13 shows that, as a percentage of the short term assessment criteria, it is the 99.8th percentile of hourly average concentration of nitrogen dioxide (NO_2) which is 4.0% of the assessment criteria that has the largest impact. When combined with the background concentration, the PEC (Predicted Environmental Concentration) of 27.8 $\mu g\ m^{-3}$ is 13.9% of the assessment criteria and not considered to be of concern to human health.

For annual average impacts the increment to annual average concentration of cadmium (Cd) is predicted to give rise to the largest percentage of the assessment criteria of 3.7%. It should be noted that the assessment criteria of 0.005 $\mu g\ m^{-3}$ is from the World Health Organisation Air Quality guidelines (2000) which state that the guideline is set to *'prevent any further increase of cadmium in agricultural soils'*. Given that the maximum predicted concentration is substantially less than the assessment criteria and that the location of maximum impact is predominantly urban, it is considered that there is no concern to human health.

Dioxins and furans are a group of organic compounds that are formed as a result of incomplete combustion in the presence of chlorine. Sources include vehicles, domestic and industrial coal burning, power generation and incinerators. There are no regulatory air quality standards set for dioxins and furans; this group of substances, however, are important in terms of risk to human health and the effects of dioxins are assessed through a human health risk assessment (HRA). The maximum predicted ground level concentration of dioxin of 0.73 fg I-TEQ m^{-3} is small compared with the prevailing dioxin concentration and not of concern to human health as demonstrated by the health risk assessment[16] that has been undertaken for the proposed development and which is contained in Appendix D.

Plume visibility

Once released to atmosphere, emissions will dilute, cool, and depending on the prevailing ambient temperature and relative humidity, may condense to form a visible vapour plume. The frequency and extent of any visible plume depends on the ambient temperature and relative humidity and the rate of plume dilution.

Table 14 summarises the predictions of visible vapour plume length and frequency for each year of metrological data.

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Table 14: Predicted occurrence of a visible vapour plume

Year of Meteorological Data	2012	2013	2014	2015	2016	Average
%age occurrence of visible plume (%)	4.4	6.3	2.1	2.4	3.2	3.7
%age visible plume length > 250 m (%)	0.0	0.2	0.0	0.0	0.0	0.0
%age visible plume length > 100 m (%)	0.5	1.1	0.5	0.3	0.3	0.5
%age visible plume length > 50 m (%)	1.2	2.7	0.9	0.8	0.9	1.3
Maximum length of visible plume (m)	231	345	179	217	236	-
Average length of vapour plume (m)	44	59	57	45	42	-

Table 14 shows that for the year that gives rise to the highest frequency occurrence of visible vapour plumes (2013) the predicted occurrence is 6.3% of the time. It should be noted that these percentages are for all hours including night time hours where a higher frequency will occur due to lower ambient temperatures.

Plume grounding

Plume grounding is usually the description given when a plume can be observed to impact on the ground or elevated terrain. Plumes are usually only visible if they contain smoke, which is not the case here, or if water vapour in the plume has condensed to form a visible vapour plume.

Whether visible or not, all plumes will ground; the dispersion model used for this assessment calculates the frequency and intensity of plume grounding events to predict the resulting ground level concentrations.

The assessment of the frequency of visibility vapour plumes presented above shows that visible vapour plumes longer than 100 m will only occur for 0.5% of the year and therefore the frequency of visible plume grounding events will be significantly less than 0.5% for locations more than 100 m from the proposed facility. It should be noted that for the majority of the time when a plume is visible (e.g. 0.5% for plumes more than 100 m) the visible part of the plume will not be coming to ground and therefore there will not be a visible plume grounding event.

Odour

Table 15 below shows the results of the assessment of potential odour impact from the ventilation stack.

Table 15: Predicted 98th percentile hourly average odour concentrations ($OU_e\ m^{-3}$) for five years of meteorological data

Location / description		Predicted odour concentration for each year					Receptor sensitivity[a]	Magnitude of impact
		2012	2013	2014	2015	2016		
R1	Dairy, air intake	0.07	0.10	0.09	0.02	0.02	-	-
R2	Storridge Farm	0.2	0.2	0.2	0.2	0.2	High	Negligible
R3	Brook Farm	0.1	0.1	0.1	0.1	0.1	High	Negligible
R4	Court Farm	0.1	0.1	0.2	0.1	0.1	High	Negligible
R5	Property on Hawkeridge Road	0.2	0.1	0.2	0.2	0.1	High	Negligible
R6	Hawkeridge Farm	0.2	0.2	0.2	0.2	0.2	High	Negligible
R7	Hawkeridge Park	0.5	0.4	0.5	0.5	0.5	High	Slight
R8	Hawkeridge Park	0.3	0.3	0.3	0.4	0.4	High	Negligible
R9	Grenmore Farm	0.2	0.2	0.3	0.3	0.3	High	Negligible
R10	Storridge Road	0.7	0.7	0.7	0.8	0.8	High	Slight
R11	Bramble Drive	0.1	0.1	0.1	0.1	0.1	High	Negligible
R12	Oldfield Road	0.2	0.2	0.2	0.2	0.2	High	Negligible
R13	Penleigh Farm	0.1	0.1	0.1	0.1	0.1	High	Negligible
R14	Brook Lane	1.2	1.2	1.2	1.3	1.3	High	Slight
R15	Orchard House	1.0	1.0	1.1	1.1	1.2	High	Slight
R16	Brook Cottage	0.2	0.2	0.2	0.3	0.3	High	Negligible
R17	Lambert's farm	0.1	0.1	0.2	0.2	0.2	High	Negligible
R18	Dairy Farm	0.1	0.1	0.1	0.1	0.1	High	Negligible
R19	Bremeridge Farm	0.1	0.1	0.1	0.1	0.1	High	Negligible
R20	School	0.1	0.1	0.1	0.1	0.2	High	Negligible
M1	P13/58 Primmers Place	0.2	0.2	0.2	0.2	0.3	High	Negligible
M2	P13/51 41 Haynes Road	0.1	0.1	0.1	0.1	0.1	High	Negligible
M3	P13/56 12 Fore Street	0.1	0.1	0.1	0.1	0.1	High	Negligible
Assessment criteria		**3.0**						

(a) The IAQM odour significance guidance is intended to determine the likelihood of annoyance and is not appropriate for use for the air intake of the dairy where tainting is the concern.

Table 15 clearly shows that the predicted odour impacts are significantly below the level that would give rise to annoyance of 3.0 $OU_e\ m^{-3}$ and therefore can be screened out as having an impact of negligible significance.

There are four locations where the IAQM magnitude of change descriptor is slight. The IAQM guidance on odours states: *Where the overall effect is greater than 'slight adverse', the effect is likely to be considered significant. This is a binary judgement: either it is 'significant' or 'not significant'*. Therefore, in this case, the overall impact is *'not significant'*.

Predictions of odour impact have also been made at the location of the air intake to the dairy because of the potential for odour to taint dairy products. The maximum predicted 98th percentile odour concentration at the dairy air intake is 0.10 OUe m^{-3}. Even though this is only 3% of the threshold for annoyance

there is still the possibility of detectable odours from time to time, but not at an intensity or duration likely to cause annoyance.
Widely accepted odour thresholds[17] are as follows:

- 1 OUe m^{-3} - point of detection in a laboratory
- 3 OUe m^{-3} - recognition threshold
- 5 OUe m^{-3} - a faint odour
- 10 OUe m^{-3} - a distinct odour

For 2013 meteorological data, which is the year of maximum impact at the location of the dairy, the maximum one hour average odour concentrations at the location of the dairy air intake is 2.3 OUe m^{-3} which is less than the recognition odour threshold and so odours at the location of the air intake will be undetectable over an averaging period of one hour. It should also be noted that the prevailing background odour is likely to be in the range of 5 to 40 OUe m^{-3} i.e. considerably higher than the incremental increase predicted to occur due to emissions from the proposed facility.

Bio-aerosols

There is a wide range in natural background concentrations of bio-aerosols and there are no legal standards or guidelines for acceptable concentrations. The assessment criteria normally used is 1,000 colony forming units (cfu) m^{-3}, which is cited in a number of documents including the Environment Agency's guidance on monitoring around waste facilities and its policy statement on composting and potential health effects.

It was reported in the 2008 air quality assessment for the Northacre RRC that the key concern for Arla Foods Westbury Dairies in relation to bio-aerosols relates to the potential to affect its existing air filtration system leading to increased operational and maintenance costs. Bio-aerosols are not normally included in an assessment for an advanced thermal treatment facility such as the proposed development, however, given the proximity of Arla Foods Westbury Dairies and its previous concern over bio-aerosols, they have been included in this assessment for completeness.

The 2008 assessment for Northacre RRC stated that Westbury Dairies had indicated that an increase in levels of bio-aerosols within 1 order of magnitude (i.e. a factor of 10) of existing backgrounds is broadly acceptable. Therefore, as existing background levels in the area have been measured at an average of

[17] Environment Agency (March 2007) Review of odour character and thresholds.

50 cfu m^{-3}, the assessment criteria at the location of the air intakes for the dairy is 500 cfu m^{-3}, as an annual average concentration.

Table 16 shows the predicted annual average concentrations of bioaerosols for each of five years of meteorological data at the location of the dairy air intake (receptor R1).

Table 16: Predicted annual average bio-aerosol concentration at dairy air intake (receptor R1)

Meteorological data year	Annual average (cfu m^{-3})
2012	0.0041
2013	0.0047
2014	0.0059
2015	0.0037
2016	0.0059
Maximum	0.0059
Assessment criterion	500
Maximum expressed as % of criterion	0.0%

Table 16 clearly shows that the maximum predicted annual average concentration of bio-aerosols at the location of the dairy air intake is negligible.

Vegetation and ecosystems

The assessment has also considered the effects of emissions on vegetation and ecosystems and conservatively assumes that emissions to atmosphere of oxides of nitrogen (NO_x), sulphur dioxide (SO_2) and ammonia (NH_3) are all at their respective emissions limits. The full results are contained in section 6.2 of Appendix C.

For the annual average process contribution, results at the Salisbury and River Avon Special Areas of Conservation (SAC) were below the Environment Agency's 1% level of insignificance. The maximum and representative impacts at Picket and Clanger Woods SSSI were 1.7% and 1.4% respectively. Although the predicted impact at Picket and Clanger Wood is close to 1%, because it is not less than 1% it requires further assessment.

Predicted environmental concentrations of NO_x were therefore calculated and were below the critical level at all receptors.

Predicted 24 hour average concentrations of NO_x were all less than the Environment Agency's 10% level of insignificance for short term impacts.

For sulphur dioxide annual average process contributions were all less than the Environment Agency's 1% level of insignificance and therefore no further assessment is required although for completeness the deposition rates and contribution to acidification were assessed and found that critical levels for

sulphur dioxide were not predicted to be exceeded.

For ammonia, there are two critical levels dependent on the ecological receptors under consideration – a lower level for lichens and a higher level for all higher plants. Process contributions ranged from 0.9% - 2.6% of the critical levels and are not of concern. Background levels of ammonia are 190% of the lower critical level and 63% of the higher critical level meaning that the predicted environmental concentration exceeds the critical level for sensitive lichen communities at all receptors as a direct consequence of the prevailing background concentrations.

Acid deposition has also been considered for ammonia (NH_3), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and hydrogen chloride (HCl). Using Environment Agency guidance, the impacts can be combined and expressed as total nitrogen (N) and total sulphur (S) deposition rates. The predicted process contribution to acid deposition is at most 2.9% of the critical load, which is not of concern to habitats and ecosystems.

5.5 Mitigation measures

The assessments presented in this section assume adequate levels of mitigation built into the design of the facility itself e.g. through the identification and selection of an appropriate stack height for dispersion. The predicted effects are those that remain following the implementation of the mitigation measures i.e. the residual effects.

5.5.1 Construction

Emissions of dust generated during construction can be almost entirely abated by mitigation measures should these be necessary. The mitigation measures that would be employed during construction would be those set out in the IAQM dust guidance for medium risk sites and would be incorporated into a site Construction and Environmental Management Plan (section 3.12).

5.5.2 Operation

The assessment has shown that the dispersion provided by the 75 m main stack and 40 m ventilation stack is sufficient to render the emissions harmless at ground level to both human health and ecological receptors and therefore no further mitigation measures are required.

The potential for annoyance due to emissions of odours from the ventilation stack is predicted to be negligible.

The potential for emissions of bioaerosols from the ventilation stack to affect the operation of Westbury Dairies is predicted to be negligible.

The potential for emissions of volatile organic compounds (VOCs) from the ventilation stack to taint food products at Westbury Dairies is considered to be negligible.

The potential for emissions from vehicles to affect air quality in the AQMA is predicted to be negligible.

Therefore no further mitigation measures are required.

5.6 Residual effects and conclusions

The results of the atmospheric dispersion modelling and assessment clearly demonstrate that the maximum predicted concentrations of all substances comply with relevant air quality objectives at nearby sensitive locations.

The overall effect on air quality of emissions to atmosphere from the proposed facility can be described as of minor significance. This conclusion is based on all the impacts presented in the assessment and takes account of the localised nature of the area of maximum impact.