Air Quality Consultants

Odour and Air Quality Assessment:
SRF Plant, Nine Mile Point, Caerphilly

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Experts in air quality management & assessment

Document Control

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Preamble

This air quality assessment was originally prepared to support the planning application for the proposed SRF plant at Nine Mile Point in Caerphilly. The approach and methodology applied throughout this assessment is consistent with the requirements of both planning and permitting applications, however, the structure of the report does not closely adhere the suggested air quality assessment report structure set out in Annex F of the Environment Agency's H1 guidance (Environment Agency, 2010). In order to assist Natural Resources Wales (NRW) in their appraisal of this air quality assessment, a checklist has been provided in Section 2 (page 4) of this report to guide the reader to the relevant information set out in Annex F of H1. In addition, the dispersion model files are appended for the use of NRW.

1 Introduction

1.1 This report describes the potential for air quality and odour impacts associated with the operation of a proposed Solid Recovered Fuel (SRF) facility at Nine Mile Point Industrial Estate in Caerphilly, South Wales. The assessment has been carried out by Air Quality Consultants Ltd (AQC) on behalf of Enzygo.

1.2 The odour assessment has utilised a source-pathway-receptor odour risk assessment approach to identify the risk of potential odour impacts on the surrounding area arising from the proposed facility.

1.3 In addition to odours, emissions to air from the gas burners associated with the drying process, and a regenerative thermal oxidiser (RTO) installed to provide odour abatement for the facility, may impact on local air quality where there is relevant exposure. The main air pollutant of concern related to gas-burner emissions is nitrogen dioxide.

1.4 It is predicted that the facility will receive up to four HGV deliveries per hour during the hours of operation (Monday to Friday 07:30 – 18:00; and Saturday 07:30 – 13:00). This equates to a worst-case total of up to 88 HGV movements per day. The development is not located within or adjacent to an AQMA, and thus the published criterion of '*a change of HDV flows of more than 100 AADT*' (EPUK & IAQM, 2015), required to proceed to a detailed Air Quality Assessment, is unlikely to be exceeded. Thus, the air quality impacts associated with traffic generated by the development have been screened out of this assessment and are not considered further.

1.5 This report has been prepared taking into account all relevant local and national guidance and regulations, and follows a methodology agreed with Caerphilly Council.

2 Environment Agency H1 Checklist

Table 1: H1 Annex F Air Emissions Checklist

Item	Included	Comment
Locations map	Yes – page 14	
Site plan	No	Details of site layout were unavailable at time of this assessment
List of emissions modelled and relevant air quality guidelines	Yes – pages 7 and 24	
Details of modelled scenarios	Yes – page 38	
Details of relevant ambient concentrations used	Yes – page 16	
Model description and justification	Yes – page 15	
Special model treatments used	N/A	N/A
Table of emission parameters used	Yes – page 37	
Details of modelled domain and receptors	Yes – page 14	
Details of meteorological data used (including origin) and justification	Yes – pages 21 and 38	
Details of terrain treatment	No	Terrain not required due to close proximity of receptors to emission source
Details of building treatment	Yes – page 38	
Sensitivity analysis	N/A	N/A
Assessment of impacts – Odour	Yes – page 22	
Assessment of impacts – Air Quality	Yes – page 25	
Model input files	Yes	Appended with report

3 Policy Context and Assessment Criteria

Air Quality Strategy

3.1 The Air Quality Strategy published by the Department for Environment, Food, and Rural Affairs (Defra) and the Welsh Assembly Government provides the policy framework (Defra, 2007) for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

Clean Air Act 1993

3.2 Small combustion plant of less than 20 MW net rated thermal input are controlled under the Clean Air Act 1993. This requires the local authority to approve the chimney height. Plant which are smaller than 366kW have no such requirement.

Planning Policy

3.3 Land-use planning policy in Wales is established within the policy document Planning Policy Wales (PPW) (Welsh Government, 2014) and its updates (the most recent being edition 7), which provide the strategic policy framework for the effective preparation of local planning authority development plans. PPW is supported by 21 Technical Advice Notes (TANs) and National Assembly for Wales Circulars. Local planning authorities have to take PPW, TANs and Circulars into account when preparing Development Plans.

3.4 With respect to planning policy guidance, TAN 18 on transport (Welsh Government, 2007) makes reference to local air quality and the need for Air Quality Action Plans to be prepared for any Air Quality Management Areas declared.

3.5 PPW places a general presumption in favour of sustainable development, stressing the importance of local development plans, and states that the planning system should perform an environmental role to minimise pollution. To prevent unacceptable risks from air pollution, planning decisions should ensure that new development is appropriate for its location.

3.6 The need for compliance with any statutory air quality limit values and objectives is stressed, and the presence of AQMAs must be accounted for in terms of the cumulative impacts on air quality from individual sites in local areas. New developments in AQMAs should be consistent with local air quality action plans.

Air Quality Action Plan

3.7 In 2008 Caerphilly Council has declared an AQMA for nitrogen dioxide that covers properties along Clifton Street, Whilte Street and Bartlett Street. The proposed development site is located over 5 km to the northeast of this AQMA.

Assessment Criteria

Health Criteria

3.8 The Government has established a set of air quality standards and objectives to protect human health. The ‘standards’ are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The ‘objectives’ set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).

3.9 The objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2009). Measurements have also shown that the 24-hour PM_{10} objective could be exceeded where the annual mean concentration is above 32 $\mu g/m^3$ (Defra, 2009). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedence of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 $\mu g/m^3$ it is unlikely that the 24-hour mean objective will be exceeded.

3.10 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2009). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

3.11 The European Union has also set limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$. The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded.

3.12 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and $PM_{2.5}$

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 $\mu g/m^3$ not to be exceeded more than 18 times a year
	Annual Mean	40 $\mu g/m^3$
Fine Particles (PM_{10})	24-hour Mean	50 $\mu g/m^3$ not to be exceeded more than 35 times a year
	Annual Mean	40 $\mu g/m^3$ [b]
Fine Particles ($PM_{2.5}$) [a]	Annual Mean	25 $\mu g/m^3$

[a] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

[b] A proxy value of 32 µg/m3 as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean PM10 objective being exceeded. Measurements have shown that, above this concentration, exceedences of the 24-hour mean PM10 objective are possible (Defra, 2009).

Odour Guidance and Criteria

3.13 There are currently no statutory standards in the UK covering the release and subsequent impacts of odours. This is due to complexities involved with measuring and assessing odours against compliance criteria, and the inherently subjective nature of odours.

3.14 It is recognised that odours have the potential to pose a nuisance for residents living near to an offensive source of odour. Determination of whether or not an odour constitutes a statutory nuisance in these cases is usually the responsibility of the local planning authority or Natural Resources Wales (NRW). The Environmental Protection Act 1990 (1990) outlines that a local authority can require measures to be taken where any:

"dust, steam, smell or other effluvia arising on an industrial, trade and business premises and being prejudicial to health or a nuisance…" or

"fumes or gases are emitted from premises so as to be prejudicial to health or cause a nuisance.."

3.15 Odour can also be controlled under the Statutory Nuisance provisions of Part III of the Environmental Protection Act.

Defra Guidance

3.16 Defra published Odour Guidance for Local Authorities in March 2010 (Defra, 2010). This is a reference document aimed at environmental health practitioners and other professionals engaged in preventing, investigating and managing odours. The purpose of the guide is:

"…to support local authorities in their regulatory roles in preventing, regulating and controlling odours..."

3.17 The guidance outlines tools and methods which may be employed by environmental health practitioners in determining whether there is a statutory nuisance from odours; it covers the fundamentals of odours, the legal framework, assessment methods, mitigation measures and intervention strategies which may be adopted.

Environment Agency Guidance

3.18 The Environment Agency has produced a horizontal guidance note (H4) on odour assessment and management (Environment Agency, 2011), which is designed for operators of Environment Agency-regulated processes (i.e., those which classify as Part A(1) processes under the Pollution Prevention and Control (PPC) regime). The guidance was adopted by NRW in October 2014. The H4 guidance document is primarily aimed at methods to control and manage the release of odours, but also contains a series of recommended assessment methods which can be used to assess potential odour impacts.

Institute of Air Quality Management Guidance

3.19 The latest UK guidance on odour was published by the Institute of Air Quality Management (IAQM) in 2014 (IAQM, 2014). The IAQM guidance sets out assessment methods which may be utilised in the assessment of odours for planning applications. It is the only UK odour guidance document which contains a method for estimating the significance of potential odour impacts.

3.20 The IAQM guidance endorses the use of multiple assessment tools for odours, stating that, "*best practice is to use a multi-tool approach where practicable".* This is in order to improve the robustness of the assessment conclusions. Some of the methods outlined in the IAQM guidance have been adopted in this odour assessment.

Environment Agency Assessment Criteria

3.21 The Environment Agency has considered potential impacts from industrial and boiler emission in its H1 guidance (Environment Agency, 2010). This explains that regardless of what the baseline environmental conditions are, a process can be considered as insignificant if:

- the long-term (annual mean) process contribution is <1% of the long-term environmental standard; and
- the short-term (24-hour mean or shorter) process contribution is <10% of the short-term environmental standard.

3.22 It should be recognised that these criteria determine when an impact can be screened out as insignificant. They do not imply that impacts will necessarily be significant above these levels merely that above these levels there is a potential for significant impacts that should be assessed using a detailed assessment methodology such as detailed dispersion modelling (as has been carried out for this project in any event).

3.23 The approach taken in this assessment is to use detailed dispersion modelling in the first instance, and to apply the Environment Agency screening criteria to the model outputs. Where impacts are shown to be below these screening criteria, they are judged to be insignificant. Where this initial screening shows the potential for significant impacts, then an assessment of the predicted total concentrations needs to be carried out following the joint Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) guidance described below.

3.24 Guidance from the IAQM (EPUK & IAQM, 2015) expands upon the consideration of the short-term process contribution, stating that:

“Where peak short term concentrations (those averaged over periods of an hour or less) from an elevated source are in the range 10-20% of the relevant Air Quality Assessment Level (AQAL), then their magnitude can be described as small, those in the range 20-50% medium and those above 50% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as slight, moderate and substantial respectively, without the need to reference background or baseline concentrations. In most cases, the assessment of impact severity for a proposed development will be governed by the long-term exposure experienced by receptors and it will not be a necessity to define the significance of effects by reference to short-term impacts. The severity of the impact will be substantial when there is a risk that the relevant AQAL for short-term concentrations is approached through the presence of the new source, taking into account the contribution of other local sources”.

Descriptors for Air Quality Impacts and Assessment of Significance

Health

3.25 There is no official guidance in the UK on how to describe air quality impacts, nor how to assess their significance. The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[1] (EPUK & IAQM, 2015) has therefore been used. This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors. Full details of the EPUK/IAQM approach are provided in Appendix A1. The approach includes elements of professional judgement, and the experience of the consultants preparing the report is set out in Appendix A1.

[1] The IAQM is the professional body for air quality practitioners in the UK.

4 Assessment Approach

Consultation

4.1 The assessment follows a methodology agreed with Caerphilly Council via a telephone discussion between Maria Godfrey (Environmental Health Officer at Caerphilly Council) and Paul Outen (Air Quality Consultants) held on 15th May 2015.

Odour Assessment

4.2 Odour impact assessment is a challenging and subjective science. There are a number of odour assessment methods and tools that have been developed which are widely used in the UK, including desk-based methods, such as complaints analysis and qualitative risk assessment, through to field odour testing (sniff testing) and dispersion modelling. Each has its advantages and disadvantages and not all assessment methods are appropriate in every case; for example, where a potentially odourous process is proposed rather than existing, then assessment methods such as sniff testing and odour sampling are less relevant than predictive methods such as odour risk assessment. The scale and location of odourous processes is also important in selecting appropriate assessment methodologies, with more simple methodologies often sufficient for small or remotely located processes.

4.3 The approach to assessing the odour impacts from the SRF facility on the surrounding area has been to apply a qualitative risk-assessment as described in the IAQM guidance on assessment of odours for planning (IAQM, 2014). Details of this approach are outlined below.

Assessment Approach

4.4 The odour risk assessment set out in the IAQM guidance follows a Source-Pathway-Receptor approach. This approach describes the concept that, in order for an odour impact (such as annoyance or loss of amenity) to occur, there must be a source of odour, a pathway to transport the odour to an off-site location, and a receptor (e.g. people) to be affected by the odour.

4.5 The risk of odour effects at a given receptor location may be estimated using the following fundamental relationship:

$$\text{Effect} \approx \text{Dose} \times \text{Response}$$

4.6 In this relationship, the **dose** is a measure of the likely exposure to odours, in other words the ***impact***. The **response** is determined by the sensitivity of the receiving environment and thus the overall ***effect*** is the result of changes in odour exposure at specific receptors, taking into account their sensitivity to odours.

4.7 In order to determine the risk of potential odour effects from the SRF facility, the 'FIDOR' factors for odour exposure have been used. These factors are commonly used in the assessment of odours and are outlined in the IAQM guidance, but are also described in the Environment Agency's H4 guidance document on odour management (Environment Agency, 2011), as well as Defra's odour guidance for local authorities (Defra, 2010). The FIDOR factors are:

- **F**requency – the frequency with which odours are detected;
- **I**ntensity – the intensity of odours detected;
- **D**uration – the duration of exposure to detectable odours;
- **O**ffensiveness – the level of pleasantness or unpleasantness of odours; and
- **R**eceptor – the sensitivity of the location where odours are detected, and/or the proximity of odour releases to an odour-sensitive location.

4.8 Odour emissions from the facility have been assigned a risk-ranking based on the "effect ≈ dose x response" relationship, whereby the dose (impact) is determined by the "FIDO" part of FIDOR, and the response is determined by the "R" (receptor sensitivity). The risk of odour effects can therefore be described as:

Effect ≈ Impact (FIDO) x Receptor Sensitivity (R)

4.9 The key factors that will influence the effects of odours are the magnitude of the odour source(s), the effectiveness of the pathway for transporting odours, and the sensitivity of the receptor. The methodology set out in the IAQM guidance document describes in detail a Source-Pathway-Receptor approach to odour risk assessment, and includes tables and matrices to assist in determining the likely risk of odour effects. The IAQM methodology is outlined below. It includes an element of professional judgement.

4.10 The assessment examines the source odour potential (source magnitude) of the facility, and then identifies the effectiveness of the pathway and receptor sensitivity at nearby sensitive locations.

4.11 Table 2 describes the risk-rating criteria (high, medium and low) for source odour potential, pathway effectiveness and receptor sensitivity applied in this assessment. This table has been adapted from Table 8 in the IAQM odour guidance.

Table 2: Source-Pathway-Receptor Risk Ratings

Source Odour Potential	Pathway Effectiveness	Receptor Sensitivity
Large Source Odour Potential: Large-scale odour source and/or a source with highly unpleasant odours (hedonic tone -2 to -4); no odour control.	**Highly Effective Pathway:** Very short distance between source and receptor; receptor downwind of source relative to prevailing wind; ground level releases; no obstacle between source and receptor.	**High Sensitivity:** Highly sensitive receptors e.g. residential properties and schools.
Medium Source Odour Potential: Medium-scale odour source and/or a source with moderately unpleasant odours (hedonic tone 0 to -2); basic odour controls.	**Moderately Effective Pathway:** Receptor is local to the source; releases are elevated, but compromised by building effects.	**Medium Sensitivity:** Moderately sensitive receptors e.g. commercial and retail premises, and recreation areas.
Small Source Odour Potential: Small-scale odour source and/or a source with pleasant odours (hedonic tone +4 – 0); best practise odour controls.	**Ineffective Pathway:** Long distance between source and receptor (>500 m); receptors upwind of source relative to prevailing wind; odour release from stack/high level.	**Low Sensitivity:** Receptors not sensitive e.g. industrial activities or farms.

4.12 The risk ratings for source magnitude and pathway effectiveness (for each receptor) identified using the criteria in Table 2 are then combined using the matrix shown in Table 3 to estimate an overall risk of odour impact at each specific receptor location.

Table 3: Assessment of Risk of Odour Impact at a Specific Receptor Location

Pathway Effectiveness	Source Odour Potential (Source Magnitude)		
	Large	Medium	Small
Highly Effective	High Risk	Medium Risk	Low Risk
Moderately Effective	Medium Risk	Low Risk	Negligible Risk
Ineffective	Low Risk	Negligible Risk	Negligible Risk

4.13 The next stage of the risk assessment is to identify the potential odour effect at each receptor location. This is done using the matrix presented in Table 4, which combines the overall odour impact risk descriptor for each receptor with the receptor sensitivity determined using the criteria in Table 2.

Table 4: Assessment of Potential Odour Effect at a Specific Receptor Location

Risk of Odour Impact	Receptor Sensitivity		
	High	Medium	Low
High Risk	Substantial Adverse Effect	Moderate Adverse Effect	Slight Adverse Effect
Medium Risk	Moderate Adverse Effect	Slight Adverse Effect	Negligible Effect
Low Risk	Slight Adverse Effect	Negligible Effect	Negligible Effect
Negligible Risk	Negligible Effect	Negligible Effect	Negligible Effect

4.14 As a final stage of assessment, an overall significance of odour effects is determined, based on professional judgment and taking into account the significance of effect at each specific receptor location.

Sensitive Locations

4.15 Locations sensitive to odour emitted during site operations will be places where members of the public are regularly present. Residential properties closest to, and downwind of, the SRF facility will be most sensitive. The surrounding industrial properties are likely to be of low to medium sensitivity, with those closest to, and downwind of, the SRF most likely to be affected by odours. The receptor locations chosen for this assessment are shown in Figure 1.

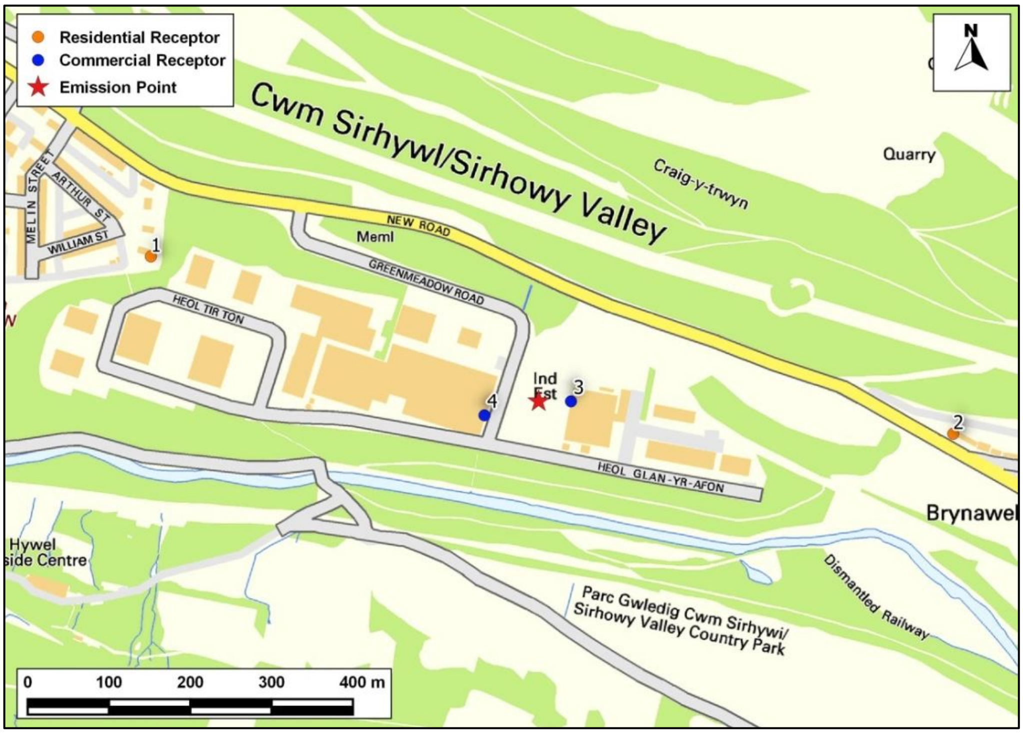


Figure 1: Receptors Locations

Impacts of the Proposed Gas Burner

Sensitive Locations

4.16 In terms of the potential air quality impacts from the proposed gas burner, concentrations have been modelled at the two residential receptors shown in Figure 1.

Assessment Scenarios

4.17 Predictions of nitrogen dioxide concentrations have been carried out assuming that the plant is installed in 2015.

Modelling Methodology

4.18 The impacts of emissions from the proposed gas burner have been modelled using the ADMS-5.1 dispersion model. ADMS-5.1 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. Entrainment of the plume into the wake of the building has been simulated within the model. The model input parameters are set out in Appendix A2.

5 Background Concentrations

5.1 Estimated background concentrations in the study area have been determined for 2015 (Table 5). The derivation of background concentrations is described in Appendix A2. The background concentrations are all well below the objectives.

Table 5: Estimated Annual Mean Background Pollutant Concentrations (µg/m^3)

Year [a]	NOx	NO_2
2015 – Receptor 1	15.5	11.8
2015 – Receptor 2	19.0	14.1
Objectives	**-**	**40**

n/a = not applicable

[a] This assumes that road vehicle emission factors in 2015 remain the same as in 2011 (See Appendix A2).

6 Odour Risk Assessment

Process Description

6.1 The SRF facility is expected to receive bulked commercial and industrial dry, recyclable waste, with the possibility of some bulked municipal waste. It is expected that the facility will receive up to 100,000 tonnes of waste per annum. The waste will be delivered by HGV, and tipped into the main building’s south entrance. The material will then be processed through drying plant, which is to be located outside of the facility building. The odourous emissions from the dryer(s) will be treated by a regenerative thermal oxidiser (RTO) prior to release to atmosphere.

6.2 The dried material will be used to produce baled SRF, which will be undertaken 24/7. All processing of the waste to produce SRF will be undertaken within the main facility building. It is expected that the facility will produce approximately 62,725 tonnes of SRF per annum, with an additional 3,500 tonnes of other recyclables, and 14,475 tonnes of residuals. It is understood that the main facility building will be maintained under negative pressure, with all emissions being treated by the RTO prior to release to atmosphere. The facility building will also utilise fast-acting roller shutter doors to minimise the fugitive release of any odourous air.

Source Odour Potential

6.3 Table 6 outlines the key potential odourous processes and procedures at the proposed SRF facility and identifies the potential for odour releases from each source. For each source, the odour potential in terms of the FIDO part of FIDOR is discussed (i.e. the frequency, intensity, duration and offensiveness).

Table 6: Nine Mile Point SRF Facility Odour Source Potential

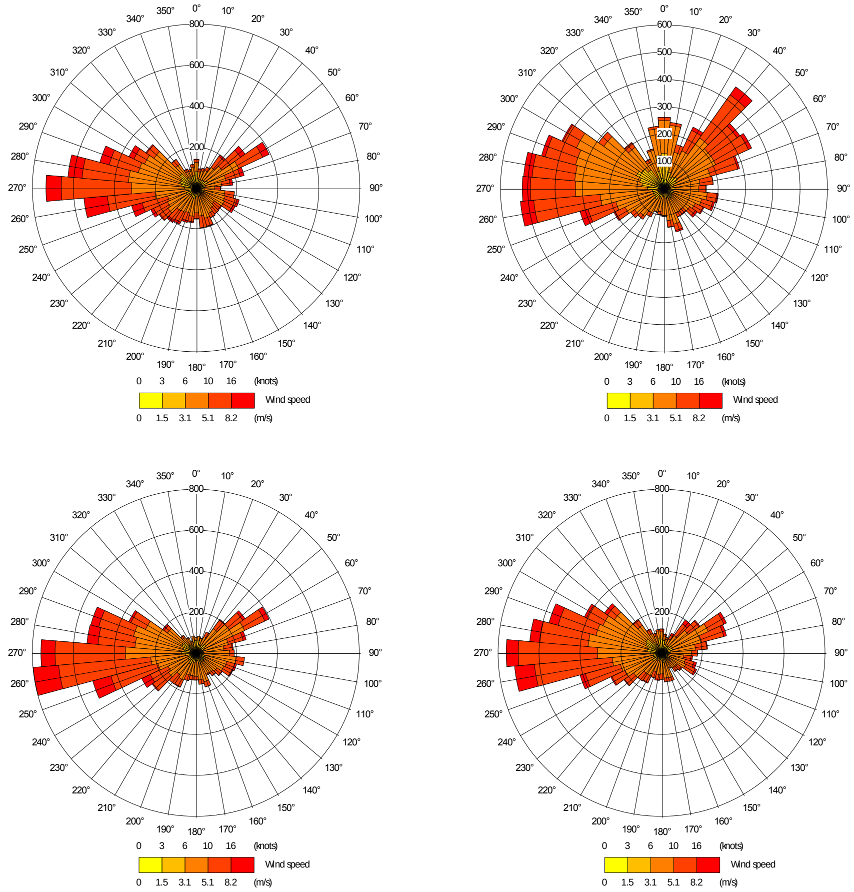
Potential Source of Odours	Frequency and Duration	Intensity and Offensiveness	Management and Mitigation	Overall Risk of Odour Release
Reception of Waste	Frequent deliveries of feedstock to the facility (4 deliveries per hour). Individual deliveries short in duration.	Potential intensity and offensiveness of odours will vary depending on nature and condition of feedstock. However, waste is expected to be mostly dry, solid recyclables, and thus the offensiveness is anticipated to be low.	Deliveries will be made by covered/sealed vehicles. Feedstock will be received within the reception building, which will utilise fast-acting roller shutter doors, and be maintained under negative pressure with all emissions being treated by the RTO.	Small
Storage and Handling of Waste	Short-term storage of feedstock. Feedstock disturbed to load hoppers.	Potential intensity and offensiveness of odours will vary depending on nature and condition of feedstock.	All waste stored in reception building, which will utilise fast-acting roller shutter doors, and be maintained under negative pressure with all emissions being treated by the RTO.	Small
Drying of Waste	Continuous drying of waste to prepare it for the SRF processing.	All emissions treated by thermal oxidiser.	All emissions treated by thermal oxidiser.	Small
Regenerative Thermal Oxidiser (RTO)	RTO will treat emissions from the dryers and main facility building, and will operate continuously	RTOs are known to provide very high odour abatement (often as high as 95-99%), and thus the intensity and offensiveness of the RTO emissions will be low.	The treated airstream will be emitted to atmosphere via a dedicated stack with a suitable efflux velocity to aid dispersion. Furthermore, the emissions, although cooled during heat recovery, will be significantly warmer (~105°C) than the ambient air and thus buoyant enough to aid dispersion.	Small
Processing of Waste into SRF	Continuous use SRF plant, including shredders, screens, classifiers, magnets and baling plant.	The processing of the waste will increase the intensity and offensive of the waste by agitation and increased surface area.	Waste processing will be undertaken within the main building, which will utilise fast-acting roller shutter doors, and be maintained under negative pressure with all emissions being treated by the RTO.	Small

Potential Source of Odours	Frequency and Duration	Intensity and Offensiveness	Management and Mitigation	Overall Risk of Odour Release
Storage of Baled SRF	Continuous storage.	Residual odours are likely to be low following processing. Waste will be relatively clean and have a very low moisture content once baled.	Baled SRF will be stored outside, with no odour mitigation.	Small
Overall Source Odour Potential	The facility is judged to be a large-scale odour source in terms of its potential to generate odours; however, the facility will include a high level of odour control to minimise the risk of odour releases. The Environment Agency's H4 Guidance (National Planning Policy Framework (NPPF), 2012) does not specifically place SRF processing in any "offensiveness category", however given that the process uses waste products, and based upon the professional judgement of AQC's odour experts, it is judged that untreated odours from the facility would be classed as "*Most Offensive".* However, the treatment of odourous air in a RTO will significantly reduce the offensiveness of any residual odours released to the atmosphere. With proposed odour abatement in place, the overall source odour potential of Caerphilly SRF facility is judged to be **Small**.			

Pathway Effectiveness

6.4 In order to consider the effectiveness of the pathway, it is important to consider receptor locations in terms of their proximity to odour source(s) and in relation to the prevailing wind direction. Four receptor locations have been selected for this assessment, which represent worst-case locations within the proposed development. These receptor locations are shown in Figure 1.

6.5 The wind roses for 2009 to 2013 from the Rhoose meteorological station presented in Figure 2 demonstrate that the prevailing wind in the region is from the west, with other significant components from the northeast. In general, odours will be transported by the wind and will not detectable at locations upwind of a source. The exception to this is during very light wind conditions when odours may disperse against the wind direction, although typically only for relatively short distances.



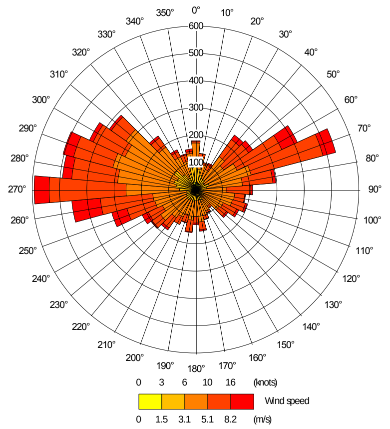


Figure 2: Wind Rose for Rhoose 2008 – 2013 (left to right, top to bottom)

6.6 The effectiveness of the odour pathways between the SRF facility and the nearby, worst-case sensitive receptors is summarised in Table 7, which draws upon the guidance set out in Table 2.

Table 7: Effectiveness of Odour Pathway

Receptor ID	Receptor Location	Distance from Source[a]	Direction from Source (°)	% Winds from Source[b]	Pathway Effectiveness[c]
1	Residential Receptor	509 m	NW	1.6	Ineffective
2	Residential Receptor	512 m	SE	1.5	Ineffective
3	Commercial Receptor	40 m	SE	1.5	Highly Effective
4	Commercial Receptor	69 m	SW	5.2	Highly Effective

a Measured as distance to the centre of the facility.

b Average wind frequency in each 10° sector is 2.8% across all wind directions.

c Overall pathway effectiveness is based on professional judgement, taking account of distance between source and receptor, and frequency of winds with respect to the average.

6.7 The residential receptors are both located more than 500 m from the facility, and the effectiveness of the pathway between the facility and both receptors is inhibited by a number of large industrial buildings as well as dense woodland. Thus, the pathway effectiveness for these highly-sensitive receptors is judged to be *ineffective*. Both commercial receptors are located in close proximity to the proposed facility, with little or no obstruction for the transport of odours between the source and receptor. Furthermore, Receptor 4 is likely to experience an above average wind frequency, and is considered to be directly downwind in terms of the prevailing wind direction. Thus, the pathway effectiveness for both receptor 3 and 4 is judged to be *highly effective*.

Receptor Sensitivity

6.8 Receptors 1 and 2 represent residential properties and are therefore considered to be high sensitivity receptors with respect to odour impacts. Receptors 3 and 4 are commercial properties, and are considered to be medium sensitivity receptors.

Potential Odour Effects

6.1 The assessments of the potential odour effects at sensitive receptor locations are presented in Table 8. This brings together the source odour potential, effectiveness of pathway and receptor sensitivity identified using the criteria described in Table 2, to identify an overall potential for odour effects, using the matrices set out in Table 3 and Table 4.

Table 8: Assessment of Potential Odour Effects from the Proposed AD Plant

Receptor	Risk of Odour Impact (Dose)			Receptor Sensitivity	Likely Odour Effect
	Source Odour Potential	Effectiveness of Pathway	Risk of Odour Impact		
1	Small	Ineffective	Negligible Risk	High	Negligible
2	Small	Ineffective	Negligible Risk	High	Negligible
3	Small	Highly Effective	Low Risk	Medium	Negligible
4	Small	Highly Effective	Low Risk	Medium	Negligible

6.2 The potential odour effects have been identified using the effect ≈ dose x response relationship identified in paragraph 4.5. The process is described as follows:

1) Identify the impact:

6.3 Based on a small source odour potential; where the pathway is deemed to be ineffective, then the risk of odour impacts (dose) is judged to be negligible risk (see Table 3); and where the pathway is deemed to be highly effective, then the risk of odour impacts (dose) is judged to be low risk.

2) Consider the response:

6.4 Based on the matrix presented in Table 4, a low risk of odour impacts will lead to a negligible odour effect for medium-sensitivity, commercial receptors. A negligible risk of odour impacts will also lead to a negligible effect at high-sensitivity receptor locations.

6.5 The potential odour effects at each receptor location are summarised in the final column of Table 8. The final stage of the risk assessment is to make an overall judgement as to the likely significance of effects.

6.6 In this case it is judged that that overall significance of odour effects is *negligible.* This conclusion is based on the findings of the risk assessment that have identified a low risk of odour effects at the worst-case receptor locations and the resultant predicted odour impacts being negligible.

6.7 It should be noted that this assessment is based upon the assumption that the RTO odour abatement system will be suitably specified and maintained. RTOs are known to provide very high levels of odour abatement; however, the effectiveness of the system's performance is reliant on a suitable operation and maintenance regime. In addition, this assessment has assumed that the entire main facility building will be continuously maintained under negative pressure; again the adequate design and maintenance of the ventilation system is paramount in terms of minimising offsite odour impacts.

6.8 In addition to the above, fugitive emissions should also be minimised by means of a stringent Odour Management Plan (OMP) which should be adhered to by all site staff, at all times. It is recommended that fast-closing doors are used for all personnel and vehicle entry points, all vehicles importing and exporting waste to site are covered, and measures are in place to reduce odour releases from spillages and plant breakdown.

7 Air Quality Assessment

7.1 Concentrations have been predicted at two locations at the façades of the nearest residential properties, and at a range of heights.

7.2 The model input parameters are detailed in Appendix A2. It should be noted that these parameters have been based upon a number of assumptions. These assumptions use both professional judgement and technical specification data for similar systems previously modelled by AQC at sites undertaking processes comparable to those of the proposed development.

7.3 The worst-case assumption has been made that the gas burner will run continuously and at full (100%) load. This will have led to an over-prediction in modelled concentrations.

Initial Screening Assessment

7.4 The predicted nitrogen dioxide concentrations associated with emission from the gas burner are shown in Table 9. The maximum predicted concentrations at either receptor are provided.

Table 9: Predicted Maximum Pollutant Concentrations associated with Gas Burner Emissions (μg/m^3)

Pollutant/Averaging Period	Maximum Grid Area Process Contribution		Objective
	μg/m^3	% of Objective	
Annual Mean NO_2	1.3	3.3	40
99.79th %ile of 1-hour NO_2	6.6	3.3	200

7.5 These predicted maximum concentration can be compared with the screening criteria recommended by the Environment Agency, as previously described in Section 2, and the following conclusions can be drawn:

- the predicted maximum annual mean nitrogen dioxide concentration (3.3% of the objective) is above the screening criterion (1%);
- the predicted maximum 99.79th percentile of 1-hour mean nitrogen dioxide concentrations (3.3% of the objective) is well below the screening criterion (10%).

7.6 The predicted impacts exceed the screening criteria for the annual mean nitrogen dioxide objective and therefore require further detailed assessment. No further assessment is required for nitrogen dioxide against the 1-hour mean objectives.

Detailed Assessment

7.7 The predicted annual mean nitrogen dioxide concentrations at each receptor, including emissions from the gas burner, are shown in Table 10. The concentrations shown for "With Plant" include the background concentrations. Concentrations have been calculated following the guidance in LAQM.TG(09) (Defra, 2009), which is explained in Appendix A2.

Table 10: Predicted Annual Mean Concentrations of Nitrogen Dioxide (NO_2) (µg/m^3)

Receptor	2015			
	Baseline [a]	"With Plant"	% Change	Impact Descriptor
1 (1.5 m)	11.8	12.3	1	Negligible
2 (4.5 m)	14.1	15.4	3	Negligible
1 (1.5 m)	11.8	12.3	1	Negligible
2 (4.5 m)	14.1	15.4	3	Negligible
Objective	40		-	-

[a] Local road emissions are not included in the baseline concentrations.

7.8 The annual mean nitrogen dioxide concentrations are well below the objective at all receptors.

7.9 The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 1% at receptor 1 and 3% at receptor 2. Using the matrix in Table A1.1 (Appendix A1) these impacts are described as *negligible.*

8 Summary and Conclusions

8.1 The odour and air quality impacts of a proposed SRF facility at Nine Mile Point, Caerphilly, on the surrounding area have been assessed.

8.2 It is judged that the overall risk of odour impacts from facility on the worst-case receptors in the surrounding area is *negligible.* It should be noted that this judgement is based upon the assumption that the main facility building will be continually maintained under negative pressure, with building emissions being treated by an RTO.

8.3 The proposed gas burner will lead to an increase of up to 3% in annual mean dioxide concentrations at the nearest sensitive receptor. Total concentrations are only up to 38.5% of the relevant objective, and as such the proposed plant will have a *negligible* impact on local air quality.

9 References

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10 Glossary

DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
IAQM	Institute of Air Quality Management
NPPF	National Planning Policy Framework
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

11 Appendices

A1 EPUK & IAQM Planning for Air Quality Guidance

A1.1 The guidance issued by EPUK and IAQM[2] (EPUK & IAQM, 2015) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air quality as a material consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- *the severity of the impacts on air quality;*
- *the air quality in the area surrounding the proposed development;*
- *the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and*
- *the positive benefits provided through other material considerations".*

Recommended Best Practice

A1.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

A1.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m^2 of commercial floorspace;
- are carried out on land of 1 ha or more.

A1.4 The good practice principles are that:

[2] The IAQM is the professional body for air quality practitioners in the UK.

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;
- Wherever possible, new developments should not create a new "street canyon", as this inhibits pollution dispersion;
- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;
- The provision of at least 1 Electric Vehicle (EV) "rapid charge" point per 10 residential dwellings and/or 1000 m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
    - Spark ignition engine: 250 mgNOx/Nm^3;
    - Compression ignition engine: 400 mgNOx/Nm^3;
    - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

A1.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

"It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the "damage cost approach" used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential".

A1.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

Impacts of the Development on the Local Area

A1.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the follow apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use;
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1 ha.

A1.8 Coupled with any of the following:

- the development has more than 10 parking spaces;
- the development will have a centralised energy facility or other centralised combustion process.

A1.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, the criteria for which are set out below. The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria is likely to be more appropriate.

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights, or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor;
- the development will have one or more substantial combustion processes where the combustion unit is:
    - any centralised plant using bio fuel;
    - any combustion plant with single or combined thermal input >300 kW; or
    - a standby emergency generator associated with a centralised energy centre (if likely to be tested/used >18 hours a year).
- the development will have a combustion unit of any size where emissions are at a height that may give rise to impacts through insufficient dispersion, e.g. through nearby buildings.

A1.10 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area.

A1.11 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Impact Descriptors and Assessment of Significance

A1.12 There is no official guidance in the UK on how to describe the nature of air quality impacts, nor how to assess their significance. The approach developed by EPUK and IAQM[3] (EPUK & IAQM, 2015) has therefore been used. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

Impact Descriptors

A1.13 Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table A1.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table A1.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme' concentration where there is an increase.

[c] AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.

[3] The IAQM is the professional body for air quality practitioners in the UK.

A2 Modelling Methodology

Background Concentrations

A2.1 The background concentrations across the study area have been defined using the national pollution maps published by Defra (2015). These cover the whole country on a 1x1 km grid and are published for each year from 2011 until 2030. The maps include the influence of emissions from a range of different sources; one of which is road traffic. The maps currently in use were verified against measurements made during 2011 at a large number of automatic monitoring stations and so there can be reasonable confidence that the maps are representative of conditions during 2011. Similarly, there is reasonable confidence that the reductions which Defra predicts from other sectors (e.g. rail) will be achieved.

A2.2 In order to calculate background nitrogen dioxide and nitrogen oxides concentrations in 2015, it is assumed that there was no reduction in the road traffic component of backgrounds between 2011[4] and 2015. This has been done using the source-specific background nitrogen oxides maps provided by Defra (2015). For each grid square, the road traffic component has been held constant at 2011 levels, while 2015 values have been taken for the other components. Nitrogen dioxide concentrations have then been calculated using the background nitrogen dioxide calculator which Defra (2015) publishes to accompany the maps. The result is a set of 'adjusted 2015 background' concentrations.

[4] This approach assumes that there has been no reduction in emissions per vehicle, but that traffic volumes have remained constant. This is not the same as the assumption made for dispersion modelling, in which emissions per vehicle are held constant while traffic volumes are assumed to change year on year. This discrepancy is unlikely to influence the overall conclusions of the assessment.

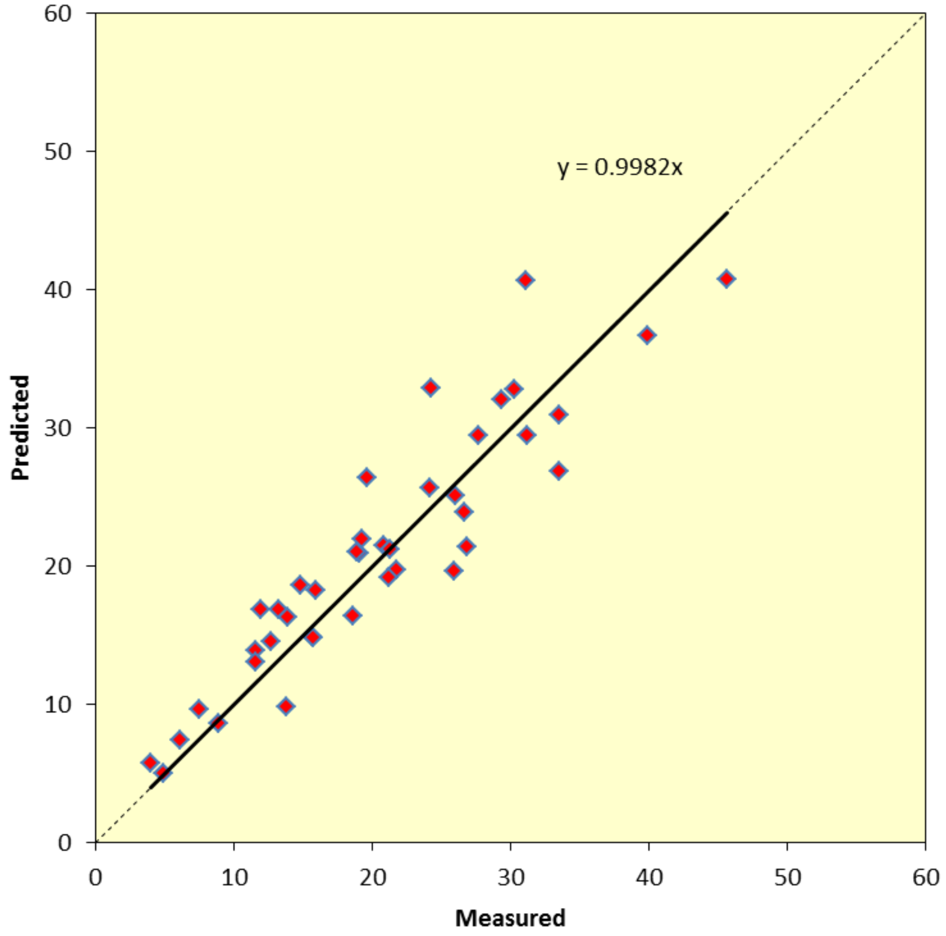

Figure A2.1: Predicted Mapped versus Measured NO_2 Concentrations at AURN Background Sites in 2014

Model Inputs

A2.3 The impacts of emissions from the proposed gas burner have been predicted using the ADMS-5.1 dispersion model. ADMS-5.1 is a new generation model that incorporates a state-of-the art understanding of the dispersion processes within the atmospheric boundary layer. The model has been run to predict the contribution of the proposed gas burner emissions to annual mean concentrations of nitrogen oxides and the 99.79th percentile of 1-hour mean nitrogen oxides concentrations.

A2.4 The model input parameters for the gas burner have been based on assumptions derived from a similar process at another SRF facility in the UK. The emissions parameters employed in the modelling are displayed in Table A2.1.

Table A2.1: Modelled Plant Specifications, Emissions and Release Conditions

Parameter	Value
Gas Burner	
Exhaust Temperature (°C)	150
NOx Emissions (g/s)	1.61379
Normalised Exhaust flow (Nm^3/s)	5.38
Actual Exhaust flow (m^3/s)	8.33
Flue Diameter (m)	1
Exit velocity (m/s)	10.61

A2.5 The building dimensions have been obtained from drawings provided by Enzygo. The location of the flue has been estimated and is shown in Figure A2.2. The flue has been modelled at a height of 18 m (8 m above the assumed roof level).

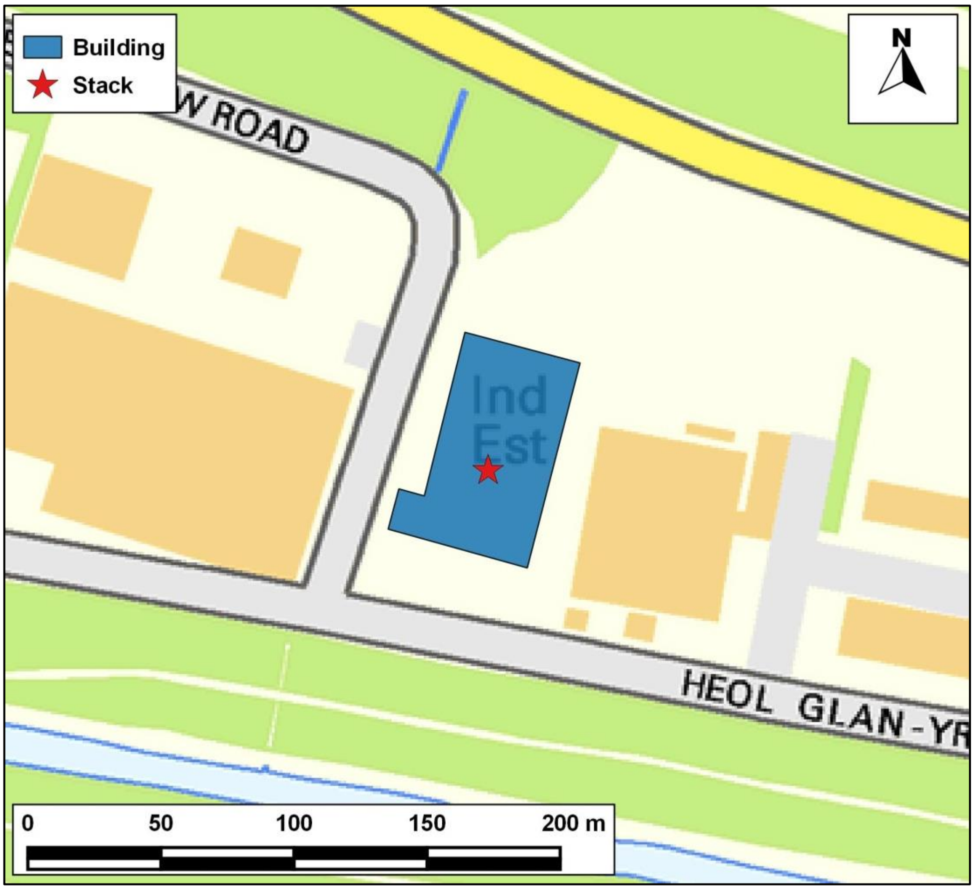

Figure A2.2: Flue Location

A2.6 Entrainment of the plume into the wake of the main facility building (the so-called building downwash effect) has been taken into account in the model. The building included in the model is shown in Figure A2.2.

A2.7 Hourly sequential meteorological data from Rhoose for 2013 have been used in the model.

Modelling Assumptions

A2.8 The following assumptions have been made:

- The gas burner will operate for 100% of the year.

A2.9 The following assumptions have been used within the ADMS-5.1 modelling:

- The gas burner is at full load while operating.

Model Post-processing

A2.10 Emissions from the gas burner will be predominantly in the form of nitrogen oxides (NOx).

A2.11 ADMS-5.1 has been run to predict the contribution of the proposed plant emissions to annual mean concentrations of nitrogen oxides and the 99.79th percentiles of 1-hour mean nitrogen oxides. For the initial screening of the process contributions, the approach recommended by the Environment Agency (Environment Agency, 2005) has been used to predict annual mean nitrogen dioxide concentrations and 99.79th percentiles of 1-hour mean nitrogen dioxide concentrations. This assumes that:

- Annual mean nitrogen dioxide concentrations = Annual mean nitrogen oxides x 0.7; and
- 99.79th percentiles of 1-hour mean nitrogen dioxide concentrations = 99.79th percentiles of 1-hour mean nitrogen oxides x 0.35.

Long-term

A2.12 Where long-term (annual mean) objectives need to be assessed the following post-processing has been carried out:

- Nitrogen dioxide has been calculated using the approach recommended by the Environment Agency (Environment Agency, 2005) to predict annual mean nitrogen dioxide concentrations = *annual mean nitrogen oxides x 0.7;*
- In order to predict total annual mean concentrations, the concentration predicted from the local background has been added to this process contribution.

A3 Professional Experience

Prof. Duncan Laxen, BSc (Hons) MSc PhD MIEnvSc FIAQM

Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM_{10}, $PM_{2.5}$ and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

Mr Caird is a Principal Consultant with AQC, with nine years' experience in the field of air quality including the detailed assessment of emissions from road traffic, airports, heating and energy plant, and a wide range of industrial sources including the thermal treatment of waste. He has experience in ambient air quality monitoring for numerous pollutants using a wide range of techniques and is also competent in the monitoring and assessment of nuisance odours and dust. Mr Caird has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Paul Outen, BSc (Hons)

Mr Outen is a Consultant with AQC, having joined in 2014. He holds a degree in Environmental Geoscience, having specialised in the study of landfill-related particulate matter for his final year thesis. Prior to joining AQC he worked as an Air Quality Consultant at Odournet UK Ltd for 6 years, undertaking a range of air quality and odour assessments across a number of different industries, as well as managing the sampling/technical department for the company. He now undertakes air quality assessments at AQC, utilising the ADMS dispersion models to assess the impacts of a variety of sources on concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$.

Full CVs are available at www.aqconsultants.co.uk.