Kyleakin Fish Feed Plant

Marine Harvest

Air Quality Technical Appendix

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1. Introduction

This report provides the technical appendix to the **Air Quality and Odour Assessment** of the Kyleakin Fish Feed Plant Environmental Statement (ES). The Air Quality and Odour assessment considers the likely significant air quality effects for the Proposed Development at Allt Anavig quarry. Jacobs was commissioned to undertake a construction dust assessment and operational air quality and odour assessment as part of the ES to support a planning application for the proposed development.

This report provides technical data, including model input data, and a detailed assessment of the predicted results and should be read in parallel with the **Air Quality and Odour Assessment**. This appendix also contains a detailed methodology for the construction dust assessment (**Appendix A**), a stack height assessment (**Appendix B**) and the methodology for carrying out the deposition assessment (**Appendix C**).

2. Methodology

2.1 Assessment Methodology

The assessment was carried out using an atmospheric dispersion modelling package. An industry standard atmospheric dispersion model ADMS version 5.1 was used to model releases of the identified substances. The ADMS model predicts the dispersion of operational emissions from a specific source (e.g. a stack), and the subsequent concentrations over an identified area (e.g. at ground level across a grid of receptor points) or at specified points (e.g. a residential properties). The ADMS modelling package was selected because this model is fit for the purpose of modelling the emissions from the types of sources on the site (i.e. point source emissions from a combustion source) and is accepted as a suitable assessment tool by local authorities and SEPA.

The modelling assessment was undertaken with due consideration to relevant guidance including the SEPA H1 guidance (Ref. 1) and SEPA odour guidance (Ref. 2). A summary of the dispersion modelling procedure is set out below.

1) Information on plant location, plant emission characteristics and building layout was obtained from Marine Harvest.
2) The meteorological data used for this assessment was taken from Skye / Lusa Meteorological Station for 2011 to 2015 (Ref. 3). The site is approximately 3.5km SSW from the Proposed Development and is the closest and most representative site for the assessment.
3) Ground level concentrations were calculated on a grid of receptor points and also at specified receptor locations in the vicinity of the site. The grid data are also used for the generation of dispersion contour plots. A total of 13 sensitive ecological receptors were also specified to enable ground level concentrations to be calculated at these receptors.
4) The above information was entered into the dispersion model.
5) The dispersion model was run to provide the Process Contribution (PC) or indicative odour concentration. The PC is the estimated maximum environmental concentration of substances due to releases from the combustion process alone. The results were then combined with baseline concentrations to provide the Predicted Environmental Concentration (PEC) of the substances of interest. The indicative odour results were compared directly to odour benchmarks in the SEPA odour guidance.
6) The PECs were then assessed against the appropriate Environment Assessment Level (EAL) for each substance set out in the SEPA guidance (Ref. 1) and the IAQM / EPUK guidance (Ref. 4) to determine the nature and significance of any adverse effects.
7) The modelled NO_2 and odour concentrations were processed using a widely used plotting package (SURFER version 11) to produce contour plots of the model results. These are provided for illustrative purposes only; assessment of the model results was based on the numerical values output by the model on the model grid or at the relevant assessment locations and which were processed using Microsoft Excel.
8) The predicted levels of NO_x were also used to assess the potential impact from acid deposition and nutrient nitrogen deposition at sensitive ecological receptors. Details of the deposition assessment methodology are provided in **Appendix C**.

In addition a review of existing ambient air quality in the area was undertaken to understand the baseline conditions with respect to NO_2, NO_x and CO, including the location and nature of existing sources of emissions in the locality of the Proposed Development site. These existing conditions were determined by review of the monitoring data already available for the area and other relevant sources of information.

2.2 Emission Sources and Scenarios

2.2.1 Emission Sources

The Proposed Development will introduce new point source sources to air. This includes combustion emissions from a natural gas boiler and process emissions of odour.

The proposed air cleaning system consists primarily of three main streams. Stream 1 is exhausted directly via the main stack (E3) whilst streams 2 and 3 pass through a biofiltration system where odour is removed prior to release to atmosphere via the stack. It has been assumed that the abatement efficiency of the biofiltration system is 85%. A full project description is provided in **Chapter 2** of the ES.

The boiler proposed to be installed on site will be gas-fired with the power generation plant planned at the site with an estimated capacity of up to 7 megawatts (MW).

In addition, there are three other emission points to air. These are filters associated with the bulk tank lorry material intake (E2) and the ship material intakes (E4 and E5). These sources are only operational whilst materials are being delivered to the site, each operating for less than 400 hours per year (less than 5% of the year). Therefore, based on the short operating hours of these sources, and the location of two sources on the pier these sources have been screened out from this assessment.

The aim of this assessment is to identify whether the emissions would result in a significant effect on local air quality and odour. **Table 2.1** summarises the emission points to air associated with the Proposed Development.

Table 2.1: Emission Points to Air

Emission Point	Description	Emission Description
E1	Process odour emissions	Process odour emissions from Stream 1 and Stream 2 and 3 discharged at a height of 60m
E2	Bulk tank lorry intake filter	This source operates periodically during bulk tank lorry delivery. It is expected that this process takes place for just 250 hours per year (i.e. 2.8% of the year). Therefore, this is considered to be a fugitive release and has not been included in this assessment.
E3	Boiler Emissions	Combustion emissions of NO_x and CO from the gas fired boiler discharging at a height of 19m.
E4	Ship bulk raw material intake filter	This source operates periodically during ship material delivery. It is expected that this process takes place for just 400 hours per year (i.e. 4.6% of the year). Therefore, this is considered to be a fugitive release and has not been included in this assessment. It is also located on the pier and away from sensitive receptors.
E5	Ship bulk raw material intake filter	This source operates periodically during ship material delivery. It is expected that this process takes place for just 400 hours per year (i.e. 4.6% of the year). Therefore, this is considered to be a fugitive release and has not been included in this assessment. It is also located on the pier and away from sensitive receptors.

2.2.2 Assessment Scenarios

This assessment has considered one main scenario which includes the continuous operation of the gas-fired boiler and the odour stack associated with the Proposed Development.

In addition, the analysis of various sensitivity scenarios have also been carried out.

2.3 Description of Dispersion Model

The dispersion model used in the study was ADMS 5.1. ADMS 5.1 is widely used in the UK as a current industry standard model for dispersion from point sources, such as the gas boiler exhausts and process odour stacks at these sites.

The model takes, as a starting point, information on emissions from each source, including:

- release rate of the substances under consideration;
- release temperature;
- release velocity or volumetric flow;
- release point location;
- release point height;
- release point diameter; and
- the location and dimensions of nearby buildings.

Information characterising a set of meteorological conditions is also required. This includes the wind speed, wind direction and information relating to the atmospheric stability. This information is normally provided in the form of hourly sequential measurements, obtained from the nearest or most representative meteorological station. Given this information, the model provides an estimated concentration of the substance of interest at a specified location. This process is repeated for each hour in the year, and at each location under consideration, to build up an estimate of long-term mean and short-term peak concentrations over an area of interest.

In any modelling study, there will be a degree of uncertainty in the model results. In the case of atmospheric dispersion modelling, models are generally more reliable for long period means than short period means. Models are usually more reliable over intermediate distances (100 m to 1000 m) than very close to the source or more distant from the source. This reflects the range of data that have been used to develop the models. To allow for these uncertainties, a conservative approach has been adopted in this study (for example, assuming all combustion plant operates simultaneously at maximum load for the full year).

2.4 Treatment of Modelled Pollutant Concentrations

2.4.1 Treatment of Oxides of Nitrogen

NO_x emitted from combustion sources such as the gas boiler are mainly in the form of nitric oxide (NO), with a relatively small proportion in the form of NO_2 (typically 5%) (Ref. 5). NO is less potentially harmful to human health than NO_2. NO is oxidised in the atmosphere to form NO_2. The reverse process converting nitrogen dioxide to nitric oxide also takes place in the atmosphere. In the immediate vicinity of a source of combustion gases, such as the gas boiler, conversion from NO to NO_2 does not proceed to near completion. This is because of three factors.

- Firstly, the reaction between NO and ozone (the main atmospheric oxidant) is not instantaneous, and dispersion away from the closest receptors will take place while this reaction is occurring.
- Secondly, the amount of oxidants in the atmosphere available to convert NO to NO_2 is limited. Once the immediately available oxidants have been consumed, further reaction will be limited by the extent of atmospheric mixing.
- Thirdly, there is a competing atmospheric process by which nitrogen dioxide is converted back to NO in the presence of sunlight.

The chemistry of this conversion (from NO to NO_2) is well understood but is subject to many influences, including the concentration of ozone in the surrounding atmosphere and the amount of sunlight.

In remote rural areas, where the atmosphere is relatively unpolluted, the oxidation process occurs rapidly and nitrogen dioxide is the predominant species. However, in more polluted areas where the oxidizing capacity of the atmosphere may be limited, nitric oxide predominates. Urban areas are typical of this limited oxidation pattern.

The conversion method utilised in this assessment was taken from the Environment Agency guidance (Ref. 6) for the assessment of NO_2 which specifies a “worst case” approach. The guidance states that it can be assumed that 70% of NO_x emitted from the power station will be present as NO_2 for the assessment of long-term mean concentrations. For short-term mean concentrations, it can be assumed that 35% of the NO_x emitted from the facility will be present as NO_2.

2.4.2 Calculation of Predicted Environmental Concentrations

In order to complete the assessment, it was necessary to combine modelled concentrations of substances emitted from the stack with baseline concentrations of the substances present in the environment due to emissions from other sources. In the case of long-term mean concentrations, this was relatively straightforward, as long-term mean concentrations due to emissions from the stack could be added directly to long-term mean baseline concentrations.

It is not possible to add short-period peak baseline and process concentrations in the same way. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different to the conditions which give rise to peak concentrations due to emissions from other sources.

This point is addressed in the SEPA H1 guidance (Ref. 1) which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum short term concentration due to emissions from the source to twice the annual mean baseline concentration.

2.5 Model Input Data

2.5.1 Emissions Data

Table 2.2 presents the input parameters specified within the ADMS dispersion model for the detailed dispersion modelling analysis of the gas boiler and the odour stack associated with the Proposed Development. The emissions data for the gas boiler were provided by Graintec (Ref. 7). The information on odour emissions from the site were obtained from the Stack Height Assessment report included in **Appendix B**

Table 2.2 Emission Parameters

Parameter	Unit	A1 – Process Odour Stack	A3 – Gas Fired Boiler
Location	m	173690, 826352	173747, 826423
Stack height	m	60	19
Stack diameter	m	2.5	0.6
Flue gas temperature	°C	38.1	140
Efflux velocity	m/s	15.6	11.1
Volumetric flow rate (actual)	m^3/s	76.48	3.15
Volumetric flow rate (normal)	Nm^3/s	67.11	2.08
Oxygen (O_2) content in exhaust gas	(Vol. %)	n/a	3%
NO_x emission concentration	mg/Nm^3	n/a	100
NO_x emission rate	g/s	n/a	0.21
CO emission concentration	mg/Nm^3	n/a	22.9
CO emission rate	g/s	n/a	0.05
Odour emission concentration	ou_E/m^3	6,135	n/a
Odour emission rate	ou_E/s	469,230	n/a

Note *: normalised flow rate at reference conditions of 273K, 101.3kPa, oxygen content of 3% and no correction for moisture.

A previous stack height assessment for odour emissions is presented in **Appendix B.**

2.5.2 Operation Hours

Emissions from the boiler and odour stack were modelled based on continuous operation throughout the entire year (i.e. operating for 8,760 hours per year) with emissions at the maximum emission limit. In practice, there will be downtime when the boiler plant is not operating at full load and also the site will have periods of shut-down for routine maintenance and inspection, and so the modelling assessment represents a substantial overestimate of actual predicted operating hours.

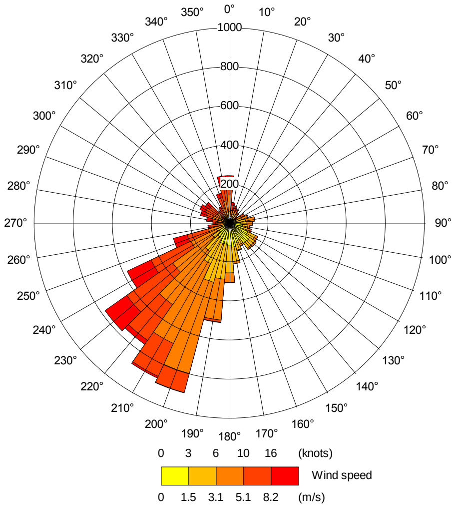
2.5.3 Meteorological Data

Meteorological data for the dispersion modelling study was obtained from ADM Ltd. The most appropriate meteorological station for the Proposed Development is the closest meteorological monitoring station at the Skye Lusa weather station which is located approximately 3.3km to the south-east. Hourly sequential data for 2011 to 2015 were used in this study. The highest forecast concentrations for any of the five years of meteorological data were used. Land use in the vicinity of the meteorological station is similar in many respects to that which will be present at the Proposed Development.

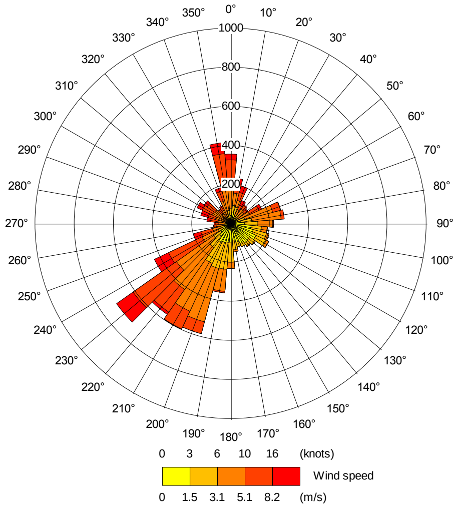
The windroses for each year are displayed in **Diagram A**.

Diagram A: Skye Lusa Weather Station Wind Roses – 2011 to 2015

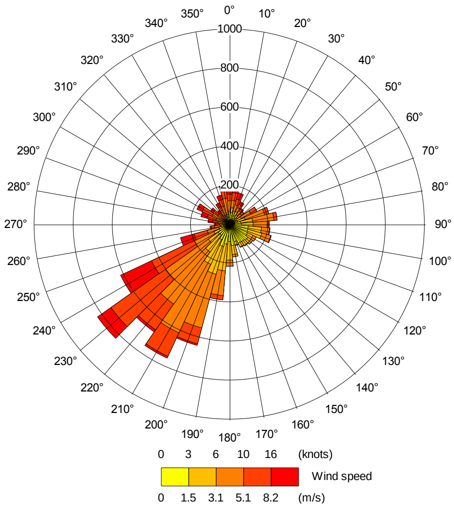
Skye Lusa 2011



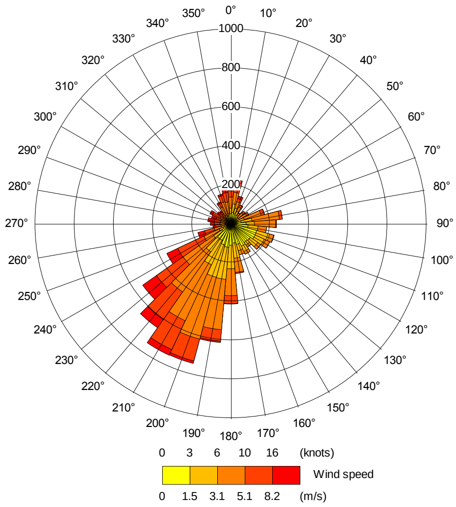
Skye Lusa 2012



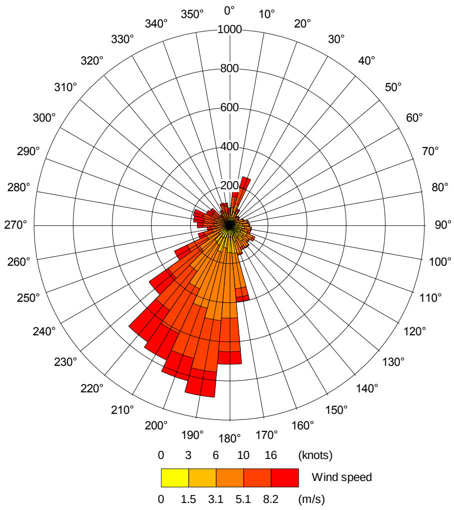
Skye Lusa 2013



Skye Lusa 2014



Skye Lusa 2015



2.5.4 Terrain

Guidance for the use of the ADMS model suggests that terrain is normally incorporated within a modelling study when the gradient exceeds 1:10 (Ref. 8). The gradients experienced in the vicinity of the Proposed Development are greater than this criterion. Therefore, in line with the ADMS guidelines, terrain influences have been included within the dispersion modelling. A sensitivity study has been carried out without the terrain option included in the model has been investigated. The terrain files were created using OS Terrain OpenData with a 50m resolution.

2.5.5 Surface Roughness

The surface roughness is a length scale used to represent the turbulent effect of obstructions in the surrounding area. A variable surface roughness file has been created to represent the area with locations representing the sea and estuary was given a surface roughness value of 0.0001m. The surface roughness used for area on land in this study was 0.5m which corresponds to open suburbia and is deemed to be most representative of the area. A value of 0.5m was used to represent the surface roughness at the Skye Lusa weather station was also 0.5m. A sensitivity study has been carried out with a fixed surface roughness value of 0.5m has been investigated.

2.5.6 Minimum Monin-Obukhov Length, Surface Albedo and Priestley-Taylor Parameter

The model default values were used for the Minimum Monin-Obukhov Length (1m), Surface Albedo (0.23) and Priestley-Taylor Parameter (1).

2.5.7 Buildings

Buildings or other structures can have a significant influence on local air flows that, under certain circumstances, may draw an emission plume down towards ground level. This is referred to as “building downwash”. The buildings included within the model are set out in **Table 2.3**.

Table 2.3 Modelled Buildings

Building	Location		Height	Length	Width	Angle to North
	E	N	m	m	m	degrees
115-120_Intake Silos	173706	826356	40.0	63.5	31.5	150
210-310-160_Production area (main building)	173758	826399	40.5	61.5	31.0	240
505_Finished Product Silos	173799	826432	30.0	40.0	13.1	240
565_Liquid storage	173684	826419	13.0	110.0	19.2	240
130-475_Storage	173809	826393	7.5	143.6	30.0	240
745_Pier Quay	173831	826619	8.0	140.0	14.8	183
740_Pier Quay	173814	826703	8.0	59.0	20.0	275
590_LNG Storage	173778	826495	8.0	66.0	19	272

2.5.8 Model Domain / Study Area

The ADMS model calculates the predicted ground level concentrations based on a user defined grid system of up to 151 x 151 points. Generally, the larger the study area, the greater the distance between the grid calculation points and the lower the resolution of the dispersion model predictions. This is to be offset against the need to encompass an appropriately wide area within the dispersion modelling study to capture the dispersion of the stack emissions.

The modelled grid was specified as a 4.5 km x 3.2km grid with 151 points at ground level along each grid axis. This size of grid was selected to provide a good grid resolution and also encompass a sufficient area so that the maximum predicted concentrations would be determined. The modelled grid parameters are provided in **Table 2.4**.

Table 2.4 Modelled Grid Parameters

Grid	Start	Finish	Number of Points	Grid Spacing
x	171747	176247	151	30m
y	824723	827923	151	21m
z	0	0	1	n/a

The air quality and odour assessment was carried out to identify the highest levels of air pollutants and odour that would arise at potentially sensitive off-site locations such as houses, schools etc. Modelled concentrations at other similar sensitive locations further away from the Proposed Development will be lower than those presented in this report. 20 potentially sensitive locations were identified in the vicinity of the site, as detailed in **Table 2.5** and shown in **Figure 1**. Pollutant concentrations were predicted at these specific locations. These are mainly residential receptors and places of business or leisure where people may be exposed to air pollutants for the short and long term averaging periods stipulated in legislation.

Table 2.5: Sensitive Human Receptor Locations

ID	Name	Receptor Sensitivity A	Grid Reference		Distance from Site Centre (km)	Direction
			x	y		
R1	Taste of India Restaurant	Medium	174112	826315	0.38	ESE
R2	Les Fleur (shops)	Medium	174252	826363	0.51	E
R3	Old Kyle Farm Road 1	High	174338	826296	0.60	ESE
R4	Residence on A87 by roundabout	High	174299	826376	0.55	E
R5	Mackinnon Country House Hotel	High	174393	826387	0.65	E
R6	Old Kyle Farm Road 2	High	174299	826181	0.60	ESE
R7	Old Kyle Farm Road 3	High	174330	826047	0.69	ESE
R8	Old Kyle Road Farm	High	174309	825930	0.75	SE
R9	Kyle House	High	174412	826507	0.67	E
R10	Community Centre	Medium	174671	826501	0.93	E
R11	Lochaish Road (mainland)	High	175740	827213	2.14	ENE
R12	Achmore Road	High	174787	826407	1.04	E
R13	Kyleside	High	174849	826489	1.10	E
R14	Kyleakin Primary School	High	174752	826424	1.01	E
R16	King Street	High	175054	826437	1.31	E
R17	Strath Street	High	174965	826347	1.22	E
R18	Meuse Lane	High	175150	826367	1.40	E
R15	Crannog Lodge	High	175513	826481	1.77	E
R19	Old Kyle Farm Road 4	High	174354	826401	0.61	E
R20	Station Road	High	176105	827254	2.50	ENE

Based on the IAQM Odour Guidance (Ref. 9).

Point source emissions of acidic compounds and nitrogen-containing species from the Proposed Development could potentially affect sensitive habitat sites such as Sites of Special Scientific Interest (SSSIs) which are designated at a national level, Special Protection Areas (SPA), Special Areas of Conservation (SAC), designated at a European level. In accordance with the SEPA guidance (Ref. 1) and the Environment Agency Guidance (Ref. 10) for local nature site, this assessment examines the potential for emissions of oxides of nitrogen to impact upon the protected sites within the following distances from the site.

- European sites (i.e. SACs and SPAs) within 10km.
- SSSIs within 10km.
- Local nature sites (National Nature Reserves (NNRs), Local Nature Reserves (LNRs), Ancient Woodlands and Local Wildlife Sites) within 2km.

The habitat sites within the distances specified above have been included in the model are described in **Table 2.6**.

Table 2.6: Sensitive Ecological Receptors

ID	Name	Receptor Sensitivity	Grid reference		Distance from Site Centre (km)	Direction
			x	y		
E1	Kinloch and Kyleakin Hills	SSSI, SAC	174805	825247	1.58	SE
			173955	825054	1.38	S
			170148	824133	4.27	SSW
E2	Loch Ashaig	SSSI	169217	823248	5.53	SW
E3	Ob Lusa to Ardnish	SSSI	170236	825346	3.67	SSW
E4	Mointeach nan Lochain Dubha	SSSI, SAC	167474	821742	7.83	SW
E5	Rubha an Eirennaich	SSSI	164675	824816	9.21	S
E6	Ard Hill	SSSI	181480	826776	7.74	E
E7	Coille Mhor	SSSI, SAC	180243	829029	7.00	ENE
E8	Lochs Duich, Long & Alsh Reefs	SAC	180357	827023	6.64	E
E9	Lochs Duich, Long & Alsh Reefs	SAC	174597	826707	0.90	ENE
			175517	825512	1.99	ESE
E10	Unnamed Ancient Woodland	AW	173887	826400	0.14	E
			173828	826325	0.13	SE
			173679	826247	0.19	WSW
E11	Unnamed Ancient Woodland	AW	174046	824858	1.59	S
			174456	825005	1.59	SSE
			174847	825157	1.68	SE
E12	Inner Hebrides & Minches	pSAC	173706	826573	0.16	NNW
			173896	826589	0.22	NE
			173980	826568	0.28	ENE
			174387	826689	0.69	ENE
			173286	826441	0.46	W
			174490	826971	0.92	NE

Receptors E2, E3, E5 and E6 are geological sites and Receptors E8, E9 and E10 are marine reef sites, these sites have therefore been screened out from further assessment.

2.6 Uncertainty and Conservative Assumptions

In general, there are always uncertainties in dispersion models as with any environmental modelling study, because a dispersion model is an approximation of the complex processes which take place in the atmosphere. In order to address this uncertainty a worst case approach has been adopted to increase the robustness of the assessment model and subsequent recommendations. These assumptions are detailed below.

2.6.1 Uncertainty

The principle uncertainties associated with the dispersion modelling undertaken within this study are as follows.

- The quality of the model output depends on the accuracy of the input data that goes into the model, particularly the emission sources. Where model input data are a less reliable representation of the true situation, the results are likely to be less accurate.
- The meteorological datasets used in the model are not likely to be completely representative of the meteorological conditions at the Proposed Development. However, suitable meteorological data were chosen for the assessment based on measurements at a nearby weather station.
- Atmospheric dispersion models are generally designed on the basis of data obtained for large scale point sources, and may be less well validated for modelling emissions from smaller scale sources.
- The dispersion of pollutants around buildings is a complex scenario to replicate. Dispersion models can take account of the effects of buildings on dispersion. However, there will be greater uncertainty in the model results when buildings are included in the model.
- Modelling does not specifically take into account individual small-scale features such as vegetation, local terrain variations and off-site buildings. The surface roughness length (z_o) selected is suitable to take account of the typical size of these local features.

To take account of these uncertainties and to ensure a cautious approach a number of conservative assumptions have been incorporated into the assessment. These are listed below.

2.6.2 Conservative assumptions

The conservative assumptions adopted in this study are summarised below.

- It was assumed that the boiler and odour stack would operate at the maximum capacity (continuously for the entire year). There are likely to be periods of downtime for maintenance and inspections.
- It was assumed that the emissions of NO_x, CO and Odour were continuously at the emission limit values specified for each emission source.
- The results are based on the maximum concentrations predicted at any of the receptor locations or within any of the nearby areas of interest.
- The results were based on the maximum predicted concentrations determined for the five years of meteorological data used in the assessment. During a typical year, the concentrations would be lower than those reported.
- It was assumed that 70% of oxides of nitrogen emitted from the plant will be converted to nitrogen dioxide at ground level in the vicinity of the plant for determination of the annual mean. It was assumed that 35% of oxides of nitrogen will be converted to nitrogen dioxide for determination of the short term concentrations. The actual conversion to nitrogen dioxide is likely to be considerably less than this at the points of maximum predicted concentrations within the vicinity of the power station.

3. Results

3.1 Air Quality – Human Health

The relevant results are set out below and each of the tables below present the following information.

- Environmental Assessment Level (EAL) (i.e. the relevant air quality standard).
- Estimated annual mean background concentration.
- For nitrogen dioxide, the estimated hourly mean background concentration is taken to be twice the estimated annual mean background concentration; for carbon monoxide, the estimated 1- hour and 8-hourly mean background concentration is taken to be twice the estimated annual mean background concentration.
- Process Contribution (PC), the maximum modelled concentration of NO_2 and CO due to the emissions from the Proposed Development alone.
- Predicted Environmental Concentration (PEC), the maximum modelled concentration due to process emissions combined with estimated baseline concentrations.
- PC and PEC as a percentage of the EAL.

The predicted maximum ground level concentrations of NO_2 and CO at any relevant human receptor grid are shown. The concentrations at all other locations will be less than those presented. Whilst five years of hourly sequential meteorological data have been used for the detailed dispersion modelling, the results shown in the tables below relate to the highest concentrations predicted during any of the five years modelled (2011 to 2015). It is therefore considered that this represents the maximum potential effect that could reasonably be expected. **Table 3.1** displays a summary of all of the results.

Table 3.1: Detailed Dispersion Modelling Results – Human Receptors

Pollutant	Averaging period	EAL (µg/m^3)	Background conc. (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EAL (%)	PEC / EAL (%)
Nitrogen dioxide	Annual mean	40	1.6	0.16	1.8	0.4%	4.5%
	1 hour mean (99.79th %ile) - offsite	200	3.3	18.6	21.8	9.3%	10.9%
	1 hour mean (99.79th %ile) - receptors			11.7	14.9	5.8%	7.5%
Carbon monoxide	Maximum 8 hour running mean	10,000	89	13.8	102.5	0.1%	1.0%
	Maximum hourly mean - offsite	30,000	89	94.0	182.8	0.3%	0.6%
	Maximum hourly mean - receptors			14.7	103.5	0.05%	0.35%

The results in **Table 3.1** show that for all pollutants, the modelled PECs are well within the relevant EALs both on the modelled receptor grid and at sensitive receptor locations. The maximum annual mean nitrogen dioxide concentration is less than 1% of the EAL. The maximum 1-hour nitrogen dioxide concentration and 1-hour and 8-hour carbon monoxide concentrations are all less than 10% of the relevant EALs. Therefore, based on the SEPA guidance, air quality impacts from emissions from the boiler are considered to be insignificant.

In addition, based on the EPUK / IAQM guidance, the predicted magnitude of impact on annual mean NO_2 concentrations is imperceptible (<1% change in the annual mean EAL). The unmitigated impact significance is predicted to be negligible at considered receptors in accordance with the stated assessment methodology.

Table 3.2 to **Table 3.5** display the results for each of the individual receptors for all pollutants.

Table 3.2: Detailed Dispersion Modelling Results - Nitrogen Dioxide – Individual Receptors

Ref	Averaging period	EAL (µg/m^3)	Background conc. (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EAL (%)	PEC / EAL (%)
R1	Annual mean	40	1.6	0.16	1.8	0.40%	4.5%
R2				0.09	1.7	0.23%	4.3%
R3				0.07	1.7	0.18%	4.3%
R4				0.08	1.7	0.20%	4.3%
R5				0.06	1.7	0.15%	4.2%
R6				0.07	1.7	0.17%	4.2%
R7				0.05	1.7	0.13%	4.2%
R8				0.04	1.7	0.09%	4.2%
R9				0.08	1.7	0.20%	4.3%
R10				0.04	1.7	0.10%	4.2%
R11				0.02	1.7	0.05%	4.1%
R12				0.03	1.7	0.07%	4.2%
R13				0.03	1.7	0.07%	4.1%
R14				0.03	1.7	0.08%	4.2%
R16				0.02	1.7	0.06%	4.1%
R17				0.02	1.7	0.06%	4.1%
R18				0.02	1.7	0.06%	4.1%
R15				0.02	1.6	0.04%	4.1%
R19				0.07	1.7	0.17%	4.2%
R20				0.01	1.6	0.04%	4.1%

Table 3.3: Detailed Dispersion Modelling Results - Nitrogen Dioxide – Individual Receptors

Ref	Averaging period	EAL (µg/m³)	Background conc. (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC / EAL (%)	PEC / EAL (%)
R1	1 hour mean (99.79th %ile)	200	3.3	11.69	14.9	5.8%	7.5%
R2				5.41	8.7	2.7%	4.3%
R3				3.64	6.9	1.8%	3.5%
R4				3.75	7.0	1.9%	3.5%
R5				2.74	6.0	1.4%	3.0%
R6				2.85	6.1	1.4%	3.1%
R7				0.91	4.2	0.5%	2.1%
R8				0.65	3.9	0.3%	2.0%
R9				2.78	6.0	1.4%	3.0%
R10				1.34	4.6	0.7%	2.3%
R11				0.62	3.9	0.3%	1.9%
R12				0.94	4.2	0.5%	2.1%
R13				1.02	4.3	0.5%	2.1%
R14				1.05	4.3	0.5%	2.2%
R16				0.81	4.1	0.4%	2.0%
R17				0.82	4.1	0.4%	2.0%
R18				0.82	4.1	0.4%	2.0%
R15				0.79	4.1	0.4%	2.0%
R19				3.14	6.4	1.6%	3.2%
R20				0.37	3.6	0.2%	1.8%

Table 3.4: Detailed Dispersion Modelling Results – Carbon Monoxide – Individual Receptors

Ref	Averaging period	EAL ($\mu g/m^3$)	Background conc. ($\mu g/m^3$)	PC ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PC / EAL (%)	PEC / EAL (%)
R1	Maximum 8 hour running mean	10000	88.8	13.8	102.5	0.14%	1.0%
R2				2.9	91.7	0.03%	0.9%
R3				2.0	90.8	0.02%	0.9%
R4				3.0	91.8	0.03%	0.9%
R5				2.8	91.6	0.03%	0.9%
R6				3.9	92.7	0.04%	0.9%
R7				1.4	90.2	0.01%	0.9%
R8				0.4	89.2	<0.00%	0.9%
R9				1.7	90.5	0.02%	0.9%
R10				0.8	89.6	0.01%	0.9%
R11				0.3	89.1	<0.00%	0.9%
R12				0.8	89.6	0.01%	0.9%
R13				0.7	89.5	0.01%	0.9%
R14				0.8	89.6	0.01%	0.9%
R16				0.6	89.4	0.01%	0.9%
R17				0.9	89.7	0.01%	0.9%
R18				0.9	89.7	0.01%	0.9%
R15				0.6	89.3	0.01%	0.9%
R19				3.1	91.9	0.03%	0.9%
R20				0.2	89.0	<0.00%	0.9%

Table 3.5: Detailed Dispersion Modelling Results – Carbon Monoxide – Individual Receptors

Ref	Averaging period	EAL ($\mu g/m^3$)	Background conc. ($\mu g/m^3$)	PC ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PC / EAL (%)	PEC / EAL (%)
R1	Maximum hourly mean	30000	88.8	14.7	103.5	0.049%	0.3%
R2				7.1	95.9	0.024%	0.3%
R3				4.2	93.0	0.014%	0.3%
R4				5.4	94.2	0.018%	0.3%
R5				3.5	92.3	0.012%	0.3%
R6				4.2	93.0	0.014%	0.3%
R7				2.3	91.1	0.008%	0.3%
R8				1.2	90.0	0.004%	0.3%
R9				2.8	91.6	0.009%	0.3%
R10				1.4	90.2	0.005%	0.3%
R11				0.6	89.4	0.002%	0.3%
R12				1.2	89.9	0.004%	0.3%
R13				1.1	89.9	0.004%	0.3%
R14				1.2	90.0	0.004%	0.3%
R16				0.9	89.7	0.003%	0.3%
R17				0.9	89.7	0.003%	0.3%
R18				0.9	89.7	0.003%	0.3%
R15				0.8	89.6	0.003%	0.3%
R19				4.4	93.2	0.015%	0.3%
R20				0.5	89.2	0.002%	0.3%

3.2 Air Quality – Ecological Receptors

3.2.1 Assessment Against Critical Levels

Although it is only NO_2 that may impact on human health, both NO_2 and nitric oxide are absorbed by vegetation. Their effects on plants are additive and the scientific consensus is that they should be treated together i.e. as total NOx. With regards to the protection of vegetation and ecosystems the UK Air Quality Strategy sets an annual mean objective for the protection of vegetation of $30\mu g/m^3$ for NO_x and a maximum daily mean EAL of $75\mu g/m^3$.

The predicted annual mean and maximum daily mean NO_x concentrations at the protected sites for the Proposed Development are shown in **Table 3.6** and **Table 3.7**, respectively. The highest concentrations modelled over the five years of meteorological data are presented below to ensure a suitably conservative approach.

Table 3.6 and **Table 3.7** give the following information.

- Environmental Assessment Level (EAL) (i.e. the relevant air quality standard).
- Estimated annual mean NO_x background concentration.
- Process Contribution (PC) and Predicted Environmental Concentration (PEC).
- Process Contribution (PC) and Predicted Environmental Concentration (PEC) as a percentage of the EAL.

Table 3.6: Detailed Dispersion Modelling Results – Oxides of Nitrogen – Habitat Sites

Ref	Habitat site	Averaging period	EAL (µg/m^3)	Background conc. (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EAL (%)	PEC / EAL (%)
E1	Kinloch and Kyleakin Hills (SSSI, SAC)	Annual mean	30	1.7	0.016	1.7	0.05%	5.8%
				1.9	0.043	2.0	0.14%	6.5%
				2.0	0.012	2.0	0.04%	6.8%
E4	Mointeach nan Lochain Dubha (SSSI, SAC)			1.8	0.004	1.8	0.01%	6.1%
E7	Coille Mhor (SSSI, SAC)			1.6	0.004	1.6	0.01%	5.5%
E10	Ancient Woodland			1.8	2.60	4.4	8.66%	14.8%
				1.8	0.346	2.2	1.15%	7.3%
				1.8	0.946	2.8	3.15%	9.3%
E11				1.6	0.039	1.7	0.13%	5.6%
				1.7	0.023	1.7	0.08%	5.8%
				1.7	0.018	1.7	0.06%	5.8%
E12	Inner Hebrides & Minches (pSAC)			1.8	0.597	2.4	1.99%	8.1%
				1.8	1.432	3.3	4.77%	10.9%
				1.8	0.873	2.7	2.91%	9.0%
				2.1	0.198	2.3	0.66%	7.7%
				1.8	0.304	2.1	1.01%	7.1%
				2.1	0.172	2.3	0.57%	7.6%

Table 3.7: Detailed dispersion modelling results – Oxides of nitrogen – Habitat sites

Ref	Habitat site	Averaging period	EAL (µg/m^3)	Background conc. (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EAL (%)	PEC / EAL (%)
E1	Kinloch and Kyleakin Hills (SSSI, SAC)	24-hour mean	75	3.4	1.0	4.4	1.3%	5.9%
				3.8	0.5	4.3	0.6%	5.7%
				4.0	0.7	4.7	0.9%	6.3%
E4	Mointeach nan Lochain Dubha (SSSI, SAC)			3.6	0.3	3.9	0.4%	5.2%
E7	Coille Mhor (SSSI, SAC)			3.3	0.1	3.4	0.1%	4.5%
E10	Ancient Woodland			3.7	30.0	33.6	40.0%	44.9%
				3.7	4.8	8.4	6.4%	11.3%
				3.7	12.3	16.0	16.4%	21.3%
E11				3.3	0.5	3.8	0.6%	5.0%
				3.4	0.5	4.0	0.7%	5.3%
				3.4	1.9	5.3	2.5%	7.1%
E12	Inner Hebrides & Minches (pSAC)			3.7	5.2	8.9	7.0%	11.9%
				3.7	6.5	10.1	8.6%	13.5%
				3.7	3.2	6.9	4.3%	9.2%
				4.2	2.5	6.8	3.4%	9.0%
				3.7	11.9	15.5	15.8%	20.7%
				4.2	0.8	5.1	1.1%	6.8%

The results in **Table 3.6** show that the maximum contribution from the boiler to the annual mean Oxides of Nitrogen EAL at the existing European designated habitat sites is less than 1%. These contributions are considered to be insignificant. In addition, the maximum contribution at the proposed SAC is 4.77% of the EAL. However, as the total PEC is only 10.9% of the EAL the risk of the EAL being exceeded is not considered to be significant.

The maximum contribution from the boiler to the annual mean Oxides of Nitrogen EAL at the identified local nature sites is 8.66%. As this is less than 100% of the EAL the contribution is not considered to be significant.

The results in **Table 3.7** show that the maximum contribution from the boiler plant to the daily mean Oxides of Nitrogen EAL at the existing European designated habitat sites is less than 10% of the EAL. These contributions are considered to be insignificant. In addition, the maximum contribution at the proposed SAC is 15.8% of the EAL. However, as the total PEC is only 20.7% of the EAL the risk of the EAL being exceeded is considered to be not significant.

The maximum contribution from the boiler plant to the daily mean Oxides of Nitrogen EAL at the identified local nature sites is 40.0%. As this is less than 100% of the EAL the contribution is considered to be not significant.

3.2.2 Assessment Against Critical Loads

The rate of deposition of acidic compounds and nitrogen-containing species have been estimated at the sensitive habitat sites. This allows the potential for adverse effects to be evaluated by comparison with critical loads for acid and nutrient nitrogen deposition.

Critical load functions for acid deposition are specified on the basis of both nitrogen-derived acid and sulphur-derived acid. This information, including existing deposition levels at habitat sites, is available on the Air Pollution Information System (APIS) (Ref. 11). The results of the acid deposition and nitrogen deposition assessment are shown in **Table 3.8** and **Table 3.9**, respectively.

Table 3.8: Acid Deposition Results at Habitat Sites

Ref	Habitat site	Habitat / Feature	Critical Load (CL) (kEqH+/ha-year)			Estimated acid deposition (kEqH+/ha-year)					
			CLMaxS	CLMinN	CLMaxN	Existing Deposition (N)	Existing Deposition (S)	PC (Nitrogen)	PEC	PC/CL (%)	PEC/CL (%)
E1	Kinloch and Kyleakin Hills (SSSI, SAC)	Blanket Bogs	0.81	0.32	1.13	0.41	0.19	0.0002	0.60	0.01%	53%
		Blanket Bogs	0.81	0.32	1.13	0.41	0.19	0.0004	0.60	0.04%	53%
		Blanket Bogs	0.81	0.32	1.13	0.41	0.19	0.0001	0.60	0.01%	53%
E1	Kinloch and Kyleakin Hills (SSSI, SAC)	Upland Oak woodland	2.13	0.36	2.46	0.58	0.22	0.0003	0.80	0.01%	33%
		Upland Oak woodland	2.13	0.36	2.46	0.58	0.22	0.0009	0.80	0.04%	33%
		Upland Oak woodland	2.13	0.36	2.46	0.58	0.22	0.0002	0.80	0.01%	33%
E4	Mointeach nan Lochain Dubha (SSSI, SAC)	Blanket Bogs	0.87	0.32	1.19	0.37	0.16	0.00004	0.53	0.004%	45%
E7	Coille Mhor (SSSI, SAC)	Upland Oak woodland	1.45	0.36	2.34	0.57	0.22	0.0001	0.79	0.003%	34%
E10	Un-named Ancient Woodland	Ancient Woodland	1.94	0.36	2.30	0.48	0.19	0.05	0.72	2.32%	31%
		Ancient Woodland	1.94	0.36	2.30	0.48	0.19	0.007	0.68	0.31%	29%
		Ancient Woodland	1.94	0.36	2.30	0.48	0.19	0.019	0.69	0.85%	30%
E11	Un-named Ancient Woodland	Ancient Woodland	2.11	0.28	2.39	0.52	0.19	0.0008	0.71	0.03%	30%
		Ancient Woodland	1.94	0.36	2.30	0.48	0.19	0.0005	0.67	0.02%	29%
		Ancient Woodland	1.94	0.36	2.30	0.48	0.19	0.0004	0.67	0.02%	29%
E12	Inner Hebrides & Minches (pSAC)	Harbour porpoise	n/a	n/a	n/a	0.37	0.18	0.006	0.56	n/a	n/a
		Harbour porpoise	n/a	n/a	n/a	0.37	0.18	0.01	0.56	n/a	n/a
		Harbour porpoise	n/a	n/a	n/a	0.37	0.18	0.009	0.56	n/a	n/a
		Harbour porpoise	n/a	n/a	n/a	0.37	0.18	0.002	0.55	n/a	n/a
		Harbour porpoise	n/a	n/a	n/a	0.37	0.18	0.003	0.55	n/a	n/a
		Harbour porpoise	n/a	n/a	n/a	0.37	0.18	0.002	0.55	n/a	n/a

Table 3.9: Nitrogen Deposition Results at Habitat Sites

Ref	Habitat site	Habitat / Feature	Minimum Critical Load (CL)	Estimated nutrient N deposition (kgN/ha-year)				
				Existing Deposition	PC	PEC	PC/CL (%)	PEC/CL (%)
E1	Kinloch and Kyleakin Hills (SSSI, SAC)	Blanket Bogs	5	5.74	0.002	5.74	0.04%	115%
		Blanket Bogs	5	5.74	0.006	5.75	0.1%	115%
		Blanket Bogs	5	5.74	0.002	5.74	0.03%	115%
E1	Kinloch and Kyleakin Hills (SSSI, SAC)	Upland Oak woodland	10	8.12	0.004	8.12	0.0%	81%
		Upland Oak woodland	10	8.12	0.012	8.13	0.1%	81%
		Upland Oak woodland	10	8.12	0.003	8.12	0.0%	81%
E4	Mointeach nan Lochain Dubha (SSSI, SAC)	Blanket Bogs	5	5.18	0.001	5.18	0.01%	104%
E7	Coille Mhor (SSSI, SAC)	Upland Oak woodland	10	7.98	0.001	7.98	0.01%	80%
E10	Un-named Ancient Woodland	Ancient Woodland	10	6.72	0.748	7.47	7.5%	75%
		Ancient Woodland	10	6.72	0.100	6.82	1.0%	68%
		Ancient Woodland	10	6.72	0.272	6.99	2.7%	70%
E11	Un-named Ancient Woodland	Ancient Woodland	10	7.28	0.011	7.29	0.1%	73%
		Ancient Woodland	10	6.72	0.007	6.73	0.07%	67%
		Ancient Woodland	10	6.72	0.005	6.73	0.05%	67%
E12	Inner Hebrides & Minches (pSAC)	Harbour porpoise	5	5.18	0.086	0.09	1.7%	105%
		Harbour porpoise	5	5.18	0.206	0.21	4.1%	108%
		Harbour porpoise	5	5.18	0.126	0.13	2.5%	106%
		Harbour porpoise	5	5.18	0.028	0.03	0.6%	104%
		Harbour porpoise	5	5.18	0.04	0.04	0.9%	104%
		Harbour porpoise	5	5.18	0.02	0.02	0.5%	104%

The results in **Table 3.8** show that the contribution to acid deposition at all of the existing European designated habitat sites is less than 1% of the relevant critical loads. In addition the contribution to acid deposition at the ancient woodlands is less than 100% of the relevant critical loads. Therefore, the contribution of the development to acid deposition is considered to be insignificant.

The maximum contribution from the Proposed Development to nitrogen deposition critical load at the proposed Inner Hebrides & Minches (pSAC) is 4.1%. However, the existing deposition rates alone exceed the critical load at this site. Therefore, the contribution from the Proposed Development is not considered to be significant.

3.3 Odour

Table 3.10 displays the output of the odour assessment is based on the modelled 98th percentile odour concentration at each individual receptor. The model output is evaluated against a benchmark odour concentration of 1.5ou_E/m^3. This table also displays a description of the effect based on the IAQM Odour Guidance (Ref. 9).

Table 3.10: Detailed Dispersion Modelling Results – Odour – Individual Receptors

Receptor	Receptor Sensitivity	Pollutant	EAL (ou_E/m^3)	Modelled 98%ile of 1-Hour Mean Odour Concentrations, ou_E/m^3	PC / EAL (%)	Effect Descriptor
R1	Medium	Odour	3	2.06	68.7%	Negligible
R2	Medium			1.45	48.5%	Negligible
R3	High			1.29	42.9%	Negligible
R4	High			1.27	42.5%	Negligible
R5	High			1.04	34.8%	Negligible
R6	High			1.41	47.1%	Negligible
R7	High			1.18	39.5%	Negligible
R8	High			1.12	37.5%	Negligible
R9	High			0.99	33.1%	Negligible
R10	Medium			0.61	20.5%	Negligible
R11	High			0.29	9.6%	Negligible
R12	High			0.57	19.0%	Negligible
R13	High			0.50	16.6%	Negligible
R14	High			0.59	19.7%	Negligible
R16	High			0.42	14.0%	Negligible
R17	High			0.49	16.3%	Negligible
R18	High			0.40	13.4%	Negligible
R15	High			0.29	9.6%	Negligible
R19	High			1.11	37.0%	Negligible
R20	High			0.21	7.0%	Negligible

The results of the odour modelling are presented in **Table 3.10.** The maximum concentration occurs at receptor 1, the Taste of India Restaurant, which is a Medium Sensitivity receptor. The concentration predicted at this receptor is 2.06ou_E/m^3. This value complies with the Odour Criterion of 3.0ou_E/m^3. The maximum concentration at any other receptor included in the assessment, including the High Sensitive receptors, is less than 1.5ou_E/m^3. In addition, based on the IAQM Odour Guidance (Ref. 9) and assuming the odour is highly offensive, there is predicted to be a negligible effect at all of the receptors included in this assessment. In accordance with the guidance, slight adverse and negligible impacts are considered to be not significant.

Therefore, taking into account the worst case approach and the maximum concentration from the five years of met data included in the assessment the impact of odour from the Proposed Development is considered to be not significant. However, as part of the PPC application, an Odour Management Plan might need to be developed to support the application.

3.4 Sensitivity Analysis

Three sensitivity studies were undertaken to see how changes to some of the modelling options impact on the predicted ground level concentrations. The model used for the sensitivity analysis was the 2015 model as this year resulted in the highest modelled odour concentrations at any modelled receptor location. The results of the sensitivity analysis are presented in **Table 3.11** to **Table 3.16**.

Table 3.11: Sensitivity Analysis Odour - No Terrain File

Pollutant	Averaging period	Original	S1 – No Terrain		
		PC (µg/m^3)	PC (µg/m^3)	PC/EAL	% Difference in PC Compared to EAL
Odour	1 hour mean (98th %ile) - receptors	2.1	1.2	80.3%	-57.1%

Table 3.12: Sensitivity Analysis Nitrogen Dioxide - No Terrain File

Pollutant	Averaging period	Original	S1 – No Terrain				
		PC (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC/EAL	PEC/EAL	% Difference in PC Compared to EAL
Nitrogen dioxide	Annual mean	0.15	0.10	1.73	0.24%	4.32%	-0.1%
	1 hour mean (99.79th %ile) - offsite	12.9	8.54	11.80	4.27%	5.90%	-2.2%
	1 hour mean (99.79th %ile) - receptors	8.19	2.28	2.28	1.14%	1.14%	-3.0%

The results in **Table 3.11** and **Table 3.12** indicate that the maximum predicted concentrations are higher with terrain included within the model. Therefore, including terrain is the preferred option for this study, to maintain a realistic and conservative approach.

Table 3.13: Sensitivity Analysis Odour - Fixed Surface Roughness of 0.5m

Pollutant	Averaging period	Original	S2 – Surface Roughness 0.5m		
		PC (µg/m^3)	PC (µg/m^3)	PC/EAL	% difference in PC compared to EAL
Odour	1 hour mean (98th %ile) - receptors	2.1	1.7	114.1%	-23.3%

Table 3.14: Sensitivity Analysis Nitrogen Dioxide - Fixed Surface Roughness of 0.5m

Pollutant	Averaging period	Original	S2 – Surface Roughness 0.5m				
		PC (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC/EAL	PEC/EAL	% difference in PC compared to EAL
Nitrogen dioxide	Annual mean	0.15	0.13	1.76	0.32%	4.40%	-0.1%
	1 hour mean (99.79th %ile) - offsite	12.9	6.91	10.17	3.45%	5.09%	-3.0%
	1 hour mean (99.79th %ile) - receptors	8.19	1.99	5.25	0.99%	2.63%	-3.1%

The results in **Table 3.13** and **Table 3.14** indicate that the maximum predicted concentrations were slightly lower for odour and for nitrogen dioxide with a variable surface roughness file included within the model. Therefore, to represent a more realistic approach variable surface roughness file is the preferred option for this study.

Table 3.15: Sensitivity analysis Odour - No Buildings

Pollutant	Averaging period	Original	S3 – No Buildings		
		PC (µg/m^3)	PC (µg/m^3)	PC/EAL	% Difference in PC Compared to EAL
Odour	1 hour mean (98th %ile) - receptors	2.1	0.6	38.9%	-98.5%

Table 3.16: Sensitivity analysis Nitrogen Dioxide - No Buildings

Pollutant	Averaging period	Original	S3 – No Buildings				
		PC (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC/EAL	PEC/EAL	% Difference in PC Compared to EAL
Nitrogen dioxide	Annual mean	0.15	0.16	1.79	0.40%	4.48%	0.01%
	1 hour mean (99.79th %ile) - offsite	12.9	13.88	17.15	6.94%	8.57%	0.5%
	1 hour mean (99.79th %ile) - receptors	8.19	7.19	10.45	3.59%	5.23%	-0.5%

The results in **Table 3.15** and **Table 3.16** indicate that the maximum predicted concentrations are higher with buildings included within the model for odour, for nitrogen dioxide the differences are negligible. Therefore, including buildings within the model is the preferred option for this study, to maintain a realistic and conservative approach.

The results presented in **Table 3.11** to **Table 3.16** show that a number of sensitivity analyses have been carried out to ensure that the dispersion modelling methodology and predictions were robust.

4. Reference

Ref. 1: Scottish Environment Protection Agency, Environmental Assessment and Appraisal of BAT, Horizontal Guidance Note IPPC H1, July 2003.

Ref. 2: Scottish Environment Protection Agency, Odour Guidance 2010, January 2010.

Ref. 3: ADM Ltd, five years of hourly sequential meteorological data for the Skye Lusa weather station, July 2016.

Ref. 4: Environmental Protection UK / Institute of Air Quality Management, land-use Planning and Development Control: Planning for Air Quality, May 2015 (v1.1).

Ref. 5: Department for Environment, Food and Rural Affairs, Local Air Quality Management Technical Guidance LAQM. TG(16), April 2016.

Ref. 6: Environment Agency: Air Quality Modelling and Assessment Unit, Conversion rates for NOx and NO2, location no longer available

Ref. 7: Graintec, Combustion and Emissions Data for 10 Tons Boilers, 09/06/2016.

Ref. 8: ADMS 5, Atmospheric Dispersion Modelling System, User Guide Version 5.1, Cambridge Environmental Research Consultants Ltd, May 2015.

Ref. 9: Institute of Air Quality Management, Guidance on the assessment of odour for planning, May 2014.

Ref. 10: Environment Agency and Department for Environment, Food and Rural Affairs, Air emissions risk assessment for your environmental permit, https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit/, accessed July 2016.

Ref. 11: UK Air Pollution Information System, http://www.apis.ac.uk/index.html, accessed July 2015.

Appendix A. Construction Dust Method

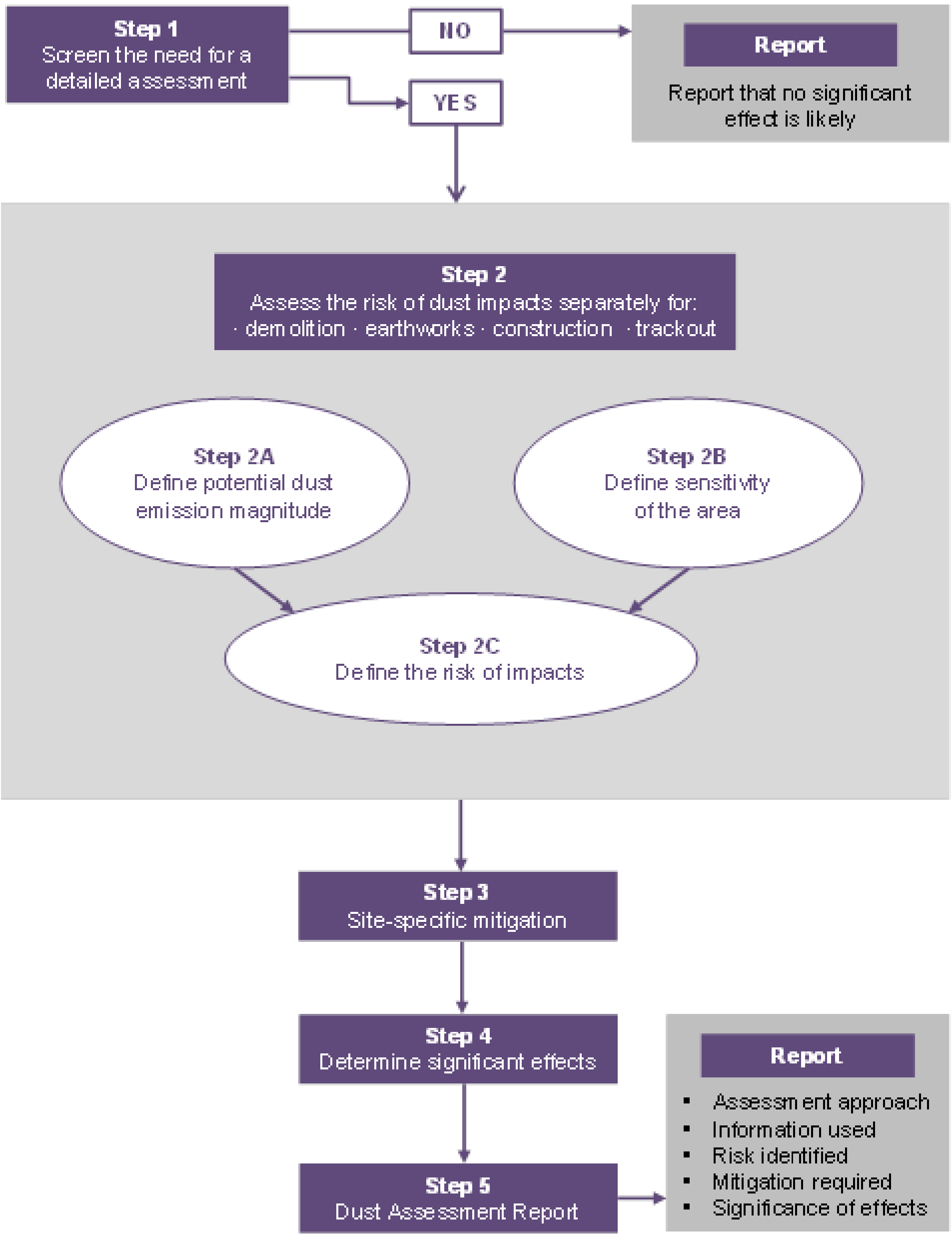
A.1 Introduction

This section sets out the methodology of the demolition and construction dust emissions assessment associated with the Proposed Development.

A.1.1 Outline of Method

The methodology for the assessment of the construction impacts is based on a five step approach laid out in Diagram A.1 below.

Diagram A.1: Dust assessment methodology



A.2 Assessment Methodology

A.2.1 Step 1 – Screen the Need for Detailed Assessment

"An assessment will normally be required where there are:

- *human receptors within 350m of the site boundary and / or within 50m of the access route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s); and / or*
- *ecological receptors within 50m of the site boundary and / or within 50m of the access route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s)."*

The requirement for a dust risk assessment can be screened out where the criteria are met and it can be concluded that the level of risk is "negligible" and any effects will not be significant. If the Proposed Development cannot be screened out, steps 2 to 4 should be undertaken, as shown in Diagram A.1.

For this assessment of sensitivities of people to dust soiling effects and health effects of $PM_{10,}$ the receptors are residential properties that can reasonably expect an enjoyment of a high level of amenity, and which may be exposed for eight hours or more in a day. Therefore, the sensitivity of receptors to dust soiling effects and health effects of PM_{10} is "*high*".

There are no local, national or European designated habitat sites within 50m of the site boundary which would be sensitive to dust deposition. However, there is one Ancient Woodland within 50m of the northern site boundary which would be sensitive to dust deposition.

A.2.2 Step 2 - Assess the Risk of Dust Impacts

A.2.2.1 Step 2A - Define potential dust emission magnitude

Demolition and Construction Impacts

a) Demolition

The following are descriptors for the different dust emission classes for demolition.

Large: Total building volume >50,000m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20m above ground level;

Medium: Total building volume 20,000 m^3 – 50,000m^3, potentially dusty construction material, demolition activities 10-20m above ground level; and

Small: Total building volume <20,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

b) Earthworks

The following are descriptors for the different dust emission classes for earthworks.

Large: Total site area >10,000m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8m in height, total material moved >100,000 tonnes;

Medium: Total site area 2,500m^2 – 10,000m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4m - 8m in height, total material moved 20,000 tonnes – 100,000 tonnes; and

Small: Total site area <2,500m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <10,000 tonnes, earthworks during wetter months.

c) Construction

The following are descriptors for the different dust emission classes for construction.

Large: Total building volume >100,000m^3, piling, on site concrete batching; sandblasting;

Medium: Total building volume 25,000m^3 – 100,000m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching; and

Small: Total building volume <25,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

d) Trackout

Trackout is used to describe construction traffic accessing the Proposed Development and refers to the transport of dust and dirt from the site onto the public road network, where it may be deposited and re-suspended by other vehicles using the road network. Only receptors within 50m of the route(s) used by vehicles on the public highway up to 500m from the site entrance(s) are considered to be at risk.

The following are descriptors for the different dust emission classes for Trackout.

Large: >50 HDV (Heavy Duty Vehicle) (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m;

Medium: 10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50m – 100m; and

Small : <10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50m.

A.2.2.2 Step 2B - Define the sensitivity of the area

The sensitivity of the area takes account of a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- the local background PM_{10} concentrations; and
- site-specific factors.

For this assessment of sensitivities of people to dust soiling effects and health effects of $PM_{10,}$ the receptors are residential properties that can reasonably expect an enjoyment of a high level of amenity, and which may be exposed for eight hours or more in a day. Therefore, the sensitivity of receptors to dust soiling effects and health effects of PM_{10} is “high”.

There is a local designated habitat site, an Ancient Woodland, within 50m of the Development Area which would be sensitive to dust deposition. The sensitivity of an Ancient Woodland to dust soiling effects and health effects of PM_{10} is “low”.

Table A.1 and Table A.2 set out the selection criteria for the sensitivity of the area to dust soiling effects on people and property, and the selection criteria for the sensitivity of the area to human health impacts, respectively.

Table A.1: Sensitivity of the surrounding area to dust soiling effects on people and property

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10 – 100	High	Medium	Low	Low
	1 – 10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A.2: Sensitivity of the surrounding area to human health

Receptor sensitivity	Annual mean PM_{10} concentration	Number of receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	> 18 µg/m^3	>100	High	High	High	Medium	Low
		10 – 100	High	High	Medium	Low	Low
		1 – 10	High	Medium	Low	Low	Low
	16 - 18 µg/m^3	>100	High	High	Medium	Low	Low
		10 – 100	High	Medium	Low	Low	Low
		1 – 10	High	Medium	Low	Low	Low
	14 - 16 µg/m^3	>100	High	Medium	Low	Low	Low
		10 – 100	High	Medium	Low	Low	Low
		1 – 10	Medium	Low	Low	Low	Low
	< 14 µg/m^3	>100	Medium	Low	Low	Low	Low
		10 – 100	Low	Low	Low	Low	Low
		1 – 10	Low	Low	Low	Low	Low
Medium	n/a	>10	High	Medium	Low	Low	Low
		1 – 10	Medium	Low	Low	Low	Low
Low	n/a	>1	Low	Low	Low	Low	Low

A.2.2.3 Step 2C - Define the Risk of Impacts

The dust emission magnitude is then combined with the sensitivity of the area to determine the overall risk of impacts with no mitigation measures applied. Matrices in Table A.3 provide a method of assigning the level of risk for each activity. This can then be used to determine level of mitigation that is required.

Table A.3: Dust emission magnitudes

Sensitivity	Dust emission magnitude		
	Large	Medium	Small
Demolition			
High	High risk	Medium risk	Medium risk
Medium	High risk	Medium risk	Low risk
Low	Medium risk	Low risk	Negligible
Earthworks			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible
Construction			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible
Trackout			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Low risk	Negligible
Low	Low risk	Low risk	Negligible

A.2.3 Step 3 – Site Specific Mitigation

During the demolition and construction phase of the Proposed Development it will be important to control dust levels for high, medium and low risk sources. In order to avoid significant impacts from dust during the construction phase, suitable mitigation measures should be adopted. Following the identification of the risk category for the demolition, earthworks, construction and trackout activities based on the tables set out in Step 2, appropriate mitigation measures can be identified. Activities identified as a "High risk" will require a greater level of mitigation than those identified as "Low risk".

A selection of these measures have been specified for low risk to high risk sites in the IAQM guidance as measures suitable to mitigate dust emissions for sites such as the Proposed Development. The considerations and controls set out in the guidance would be applicable to most developments of this nature in an urban setting.

A.2.4 Step 4 – Determine Significant Effects

Following Step 2 (definition of the site and the surroundings and identification of the risk of dust effects occurring for each activity) and Step 3 (identification of appropriate site-specific mitigation), the significance of the potential dust effects can be determined. The recommended mitigation measures should normally be sufficient to reduce construction dust nuisance to a minor or negligible impact.

Appendix B. Odour Stack Height Assessment

Appendix C. Acid and Nitrogen Deposition

C.1 Calculating Acid and Nitrogen Deposition

Nitrogen and acid deposition have been predicted using the methodologies presented in the EA Technical Guidance note: AQTAG 06 "Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air"[1] .

When assessing the deposition of nitrogen, it is important to consider the different deposition properties of nitric oxide and nitrogen dioxide. It is generally accepted that there is no wet or dry deposition arising from nitric oxide in the atmosphere, and that there is no wet deposition due to nitrogen dioxide. Thus it is normally necessary to distinguish between nitric oxide and nitrogen dioxide in a deposition assessment. In this case, the conservative assumption that 100% of the oxides of nitrogen are in the form of nitrogen dioxide was adopted.

Information on the existing nitrogen and acid deposition was obtained from the Air Pollution Information System (APIS) database[2] . Information on the deposition critical loads for each habitat site was also obtained from the APIS database using the Site Relevant Critical Loads function or the Search by Location function for sites without site relevant critical loads.

If the annual average ground level concentration of a pollutant is C ($\mu g/m^3$) and the dry deposition velocity for that pollutant is Vd (m/s) then the annual dry deposition rate D in kilograms per hectare per year (kg/ha/yr) is calculated from the following formula:

- D = Vd x C x R x 315.36

Where:

- R is 14/46 for NO_2 and converts from nitrogen dioxide to nitrogen;
- '315.36' converts to kg/ha/yr [3]

Dry deposition velocities vary depending on the type of land mass and weather conditions such as humidity. The following values have been used for Vd, as presented within the Technical Guidance note.

- NO_2 – 0.0015m/s for short vegetation (e.g. grassland)
- NO_2 – 0.0030m/s for tall vegetation (e.g. trees)

In order to calculate acid deposition in terms of kEqH+ / ha / year (kilo-equivalents hydrogen ion per hectare per year) from deposition data (calculated using the equation above), the following conversion factors are used:

- Nitrogen derived acid deposition: 1kg N / ha / yr is equal to 1/14keq N / ha / yr;

In order to calculate nitrogen deposition and acid deposition derived from emissions from the CPP and cumulative developments, the appropriate deposition velocities and conversion factors set out in the AQTAG 06 guidance were adopted.

C.2 Existing Deposition

Existing acid and nutrient nitrogen deposition levels were obtained from APIS[4]. These were selected for each habitat site at the locations modelled and the maximum deposition value for each vegetation type (e.g. tall vegetation such as trees or woodland or short vegetation such as grasses or plants) present at each designated site was used, regardless of whether than feature is present at that location. As for the approach adopted for

[1] AQTAG 06 "Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air, version 10, 20/04/10
[2] Air Pollution Information System (APIS), available at www.apis.ac.uk, accessed March 2015
[3] 315.36 = 10,000 (m2 in hectare) x 8,760 (hours in year) x 3,600 (seconds in an hour) divided by 1,000,000,000 (micrograms in kilogram)

the selection of critical loads, this represents a conservative approach. The existing deposition levels for the identified habitat sites are presented in **Table C.1**:

Table C.1: Existing deposition at modelled habitat sites

Ref	Site	Vegetation type (for deposition velocity)	Existing acid deposition (kEqH+/ha-year)		Existing nutrient N deposition (kgN/ha-year)
			Nitrogen	Sulphur	Nitrogen
E1	Kinloch and Kyleakin Hills	Grassland	0.41	0.19	5.7
E1a	Kinloch and Kyleakin Hills	Grassland	0.41	0.19	5.7
E1b	Kinloch and Kyleakin Hills	Grassland	0.41	0.19	5.7
E4	Mointeach nan Lochain Dubha	Grassland	0.37	0.16	5.2
E7	Coille Mhor	Forest	0.57	0.22	8.0
E10	Un-named Ancient Woodland	Forest	0.48	0.19	6.7
E10a	Un-named Ancient Woodland	Forest	0.48	0.19	6.7
E10b	Un-named Ancient Woodland	Forest	0.48	0.19	6.7
E11	Un-named Ancient Woodland	Forest	0.52	0.19	7.3
E11a	Un-named Ancient Woodland	Forest	0.48	0.19	6.7
E11b	Un-named Ancient Woodland	Forest	0.48	0.19	6.7
E12	Inner Hebrides & Minches	Water	0.37	0.18	5.2
E12a	Inner Hebrides & Minches	Water	0.37	0.18	5.2
E12b	Inner Hebrides & Minches	Water	0.37	0.18	5.2
E12c	Inner Hebrides & Minches	Water	0.37	0.18	5.2
E12d	Inner Hebrides & Minches	Water	0.37	0.18	5.2
E12e	Inner Hebrides & Minches	Water	0.37	0.18	5.2

C.3 Critical loads for Deposition at Habitat Sites

Critical loads for statutorily designated habitat sites in the UK have been published by the Centre for Ecology and Hydrology (CEH) and are available from the UK Air Pollution Information System (APIS). Critical Loads are defined on the APIS website as:

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

Compliance with these benchmarks is likely to result in no significant adverse effects on the natural environment at these locations. The critical loads for the designated habitat sites considered in this assessment are set out in Appendix C.

The selection of the critical load for each habitat site was based on a worst-case approach using the Site Relevant Critical Load (SRCL) function on the APIS[4] website. The SRCL function provides a list of the broad habitat features that are present at each designated habitat site. It then lists all the specific priority habitats within that broad habitat category, regardless of whether they are present at the designated site or not. These are listed in order of sensitivity to acid or nitrogen deposition (i.e. those specific habitat features with the lowest critical load are at the top of the list). The deposition assessment was carried out on the basis of choosing the specific priority habitat within each broad habitat category which has the lowest critical loads. In many cases, that specific habitat feature may not be present at the designated site. Therefore, the assessment of acid and nitrogen deposition was carried out on a conservative basis in order to screen out those habitats where no impact is predicted (i.e. those habitats where the critical load is not exceeded or where the contribution from the proposed power station is negligible).

Some of the designated sites were not available on the SRCL function or the habitat features were not fully listed. In those cases, the Search By Location (SBL) function was used to determine the critical loads for these habitats and the specific habitat features were required to be selected on the APIS website. For Local Wildlife Sites (LWSs) there is no information readily available for the specific types of vegetation present at each site. As a conservative approach, the worst case critical loads (i.e. the lowest critical loads) for each site were obtained using the SBL function and used in the assessment to identify the potential for any significant impacts to occur.

Deposition rates of air pollutants vary based on whether they are depositing on short or tall vegetation. Where a habitat site contained habitat types representing both tall and short vegetation, existing deposition rates and critical load values were obtained for each of these separately. These are labelled “tall vegetation” (tall vegetation such as trees and hedges) and “short vegetation” (short vegetation such as grasses) in this report.

The Environment Agency’s EU Habitats and Birds Directive Handbook provides guidance to Environment Agency inspectors for carrying out a screening assessment, and (if required) an “appropriate assessment” of effects on European designated habitat sites (Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)). The EA has also prepared Operational Instructions[5]. These operational instructions form Appendix 7 of the EU Habitats and Birds Directive Handbook on how the EA implements the Habitats Regulations for new and existing processes. This document states that where the PC is less than 1% of the critical load, the emission is not likely to have a significant effect alone or in combination irrespective of the background levels. The EA document states that where the PC is greater than 1% then the PEC must be calculated. If the PEC is less than 70% of the critical load it can be concluded that the emission is not likely to have a significant effect.

The above approach is used to give clear definition of what impacts can be disregarded as insignificant, and which need to be considered in more detail. This approach was also adopted for ecological sites designated at a national level (Sites of Special Scientific Interest (SSSIs)).

[4] UK Air Pollution Information System, http://www.apis.ac.uk/index.html. Accessed March 2015.
[5] Environment Agency Wales, Appendix 7, Stage 1 and 2 Assessment of new PIR permissions under the Habitat Regulations, Operational Instruction, Doc No 251_06, Version 2, issued 05/06/07.

EA guidance states that a proposal may not be acceptable where the process contribution to nitrogen or acid deposition exceeds 100% of the relevant critical load at local nature site.

The minimum critical loads were specified for each site using the Site Relevant Critical Loads tool on the APIS website. The minimum value for the whole site was used rather than the specific value for the assessment locations. The value for the most sensitive habitat feature listed for each habitat site was used to represent the critical load.

Critical load functions for acid deposition are specified on the basis of both nitrogen-derived acid and sulphur-derived acid. The critical load function contains a value for sulphur derived acid and two values for nitrogen derived acid deposition (a minimum and maximum value). The APIS website provides advice on how to calculate the process contribution (PC – emissions from the modelled process alone) and the predicted environmental concentrations (PEC – the PC added to the existing deposition) as a percentage of the acid critical load function and how to determine exceedances of the critical load function. The guidance was adopted for this assessment (see http://www.apis.ac.uk/clf-guidance).

The minimum of the range of nitrogen critical loads was used for the assessment in line with the advice on the APIS website.

The critical load data was collected for the identified habitat sites and is presented in the **Table C.2**.

Table C.2: Critical loads for modelled habitat sites

Ref	Site	Vegetation type (for deposition velocity)	Critical Load			
			Acid Deposition (kEqH+/ha-year)			Nitrogen (kg N/ha-year)
			CLMaxS	CLMinN	CLMaxN	Minimum
E1	Kinloch and Kyleakin Hills	Grassland	0.81	0.32	1.13	5
E1a	Kinloch and Kyleakin Hills	Grassland	0.81	0.32	1.13	5
E1b	Kinloch and Kyleakin Hills	Grassland	0.81	0.32	1.13	5
E4	Mointeach nan Lochain Dubha	Grassland	0.87	0.32	1.19	5
E7	Coille Mhor	Forest	1.45	0.36	2.34	10
E10	Un-named Ancient Woodland	Forest	1.94	0.36	2.30	10
E10a	Un-named Ancient Woodland	Forest	1.94	0.36	2.30	10
E10b	Un-named Ancient Woodland	Forest	1.94	0.36	2.30	10
E11	Un-named Ancient Woodland	Forest	2.11	0.28	2.39	10
E11a	Un-named Ancient Woodland	Forest	1.94	0.36	2.30	10
E11b	Un-named Ancient Woodland	Forest	1.94	0.36	2.30	10
E12	Inner Hebrides & Minches	Water	n/a			5
E12a	Inner Hebrides & Minches	Water				5
E12b	Inner Hebrides & Minches	Water				5
E12c	Inner Hebrides & Minches	Water				5
E12d	Inner Hebrides & Minches	Water				5
E12e	Inner Hebrides & Minches	Water				5