SLR

ENERGY FROM WASTE FACILITY
NEW ENGLAND RESOURCE RECOVERY CENTRE

AIR QUALITY – TECHNICAL APPENDIX 7-1
ATMOSPHERIC DISPERSION MODELLING
SLR Ref: 402.0036.00350

Viridor

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solutions for today's environment

CONTENTS

TABLES

FIGURES

DRAWINGS

1.0 INTRODUCTION

This Technical Appendix presents an air quality assessment for a proposed Energy from Waste (EfW) facility at New England Quarry near Plymouth, Devon. Specifically, this Technical Appendix reports the detailed atmospheric dispersion modelling undertaken in relation to emissions from stacks serving the waste thermal treatment process.

Viridor is proposing to develop a facility that would treat 275,000 tonnes of residual non-hazardous waste per annum which will be equipped with two process lines (Lines 1 and 2).

The site lies to the immediate south of the A38 dual carriageway.

1.1 Scope

This assessment quantifies and assesses the resultant impacts from the proposed EfW facility using Environment Agency approved techniques and then clarifies the significance of these impacts against published standards for the protection of human health and sensitive ecological receptors.

1.2 Structure of Report

The remainder of this report is structured as follows:

- Section 2 provides a summary of the legislation and guidelines relevant to the proposed activities at the site;
- Section 3 details the methodology applied in undertaking the assessment;
- Section 4 provides a description of the surrounding environment, including the identification of potentially sensitive receptors and a description of local climate and air quality conditions;
- Section 5 details how the emission rates and discharge characteristics from the installation have been calculated;
- Section 6 provides a detailed description of the dispersion modelling inputs reports the predicted potential impacts of the existing and proposed operations on air quality; and
- Section 7 assesses the sensitivity of the dispersion model and the effect on predicted impacts.

2.0 POLICY, LEGISLATION AND RELEVANT GUIDANCE

2.1 Ambient Air Quality

2.1.1 (National) Air Quality Strategy

The 'Air Quality Strategy for England, Scotland, Wales and Northern Ireland' (UKAQS) was first published in 2000 and updated with an addendum in February 2003. Following extensive consultation and developments in the applicable Regulations, the Strategy has been updated and a revised Air Quality Strategy[1] was released by in July 2007.

The UKAQS sets out a comprehensive strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, the Environment Agency, local government, business, individuals and transport have in protecting and improving air quality.

2.1.2 Air Quality Standards and Objectives

The UKAQS contains air quality objectives based on the protection of both human health and vegetation (ecosystems) and have been set taking into account the air quality standards defined in the Air Quality Standard Regulations 2007 (Statutory Instrument 2007 No. 64, 15th February 2007).

These standards in turn are defined by 'limit values' contained in the first, second, third and fourth Air Quality Daughter Directives. A summary of the current air quality standards for the pollutants detailed in the UKAQS 2007 for the purpose of Local Air Quality Management is provided in Table 2-1 below.

Table 2-1
UKAQS Air Quality Standards

Pollutant	Concentration	Measured as	Target date
Human Health Standards			
Benzene (C_6H_6)	16.25 µg/m^3	Running annual mean	31.12.2003
	5 µg/m^3	Annual mean	31.12.2010
1,3-butadiene (C_4H_6)	2.25 µg/m^3	Running annual mean	31.12.2003
Carbon monoxide (CO)	10 mg/m^3	Running 8 hour mean	31.12.2003
Lead (Pb)	0.5 µg/m^3	Annual mean	31.12.2004
	0.25 µg/m^3	Annual mean	31.12.2008
Nitrogen dioxide (NO_2)	200 µg/m^3	1 hour mean (18 exceedences per year 99.79%ile of hourly averages)	31.12.2005
	40 µg/m^3	Annual mean	31.12.2005
Sulphur dioxide (SO_2)	266 µg/m^3	15 minute mean (35 exceedences per year; 99.90%ile of 15-min averages)	31.12.2005
	350 µg/m^3	1 hour mean (24 exceedences per year; 99.73%ile of hourly averages)	31.12.2004

[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA. July 2007

Pollutant	Concentration	Measured as	Target date
	125 µg/m^3	24 hour mean (3 exceedences per year; 99.18%ile of 24-hr averages)	31.12.2004
Particulate matter (PM_{10}) (gravimetric)	40 µg/m^3	Annual mean	31.12.2004
	50 µg/m^3	24 hour mean (35 exceedences per year ; 90.41%ile of 24-hr averages)	31.12.2004
Particulate matter ($PM_{2.5}$) (gravimetric)	25 µg/m^3	Annual mean	31.12.2020
Polycyclic aromatic hydrocarbons (PAHs)	0.25 ng/m^3	Annual mean	31.12.2010
Ozone (O_3)	100 µg/m^3	Maximum daily running 8 hour mean	31.12.2005
Vegetation and Ecosystem Standards			
Nitrogen oxides (NO_x)	30 µg/m^3	Annual mean	31.12.2000
Sulphur dioxide (SO_2)	20 µg/m^3	Annual mean	31.12.2000
	20 µg/m^3	Winter mean (1 October to 31 March)	
Ozone	18 mg/m^3	5yr average of summer 1hr values AOT40*	01.01.2010
* Accumulated Ozone exposure over a Threshold of 40 ppb			

The UKAQS includes more exacting objectives for some pollutants than those required by EC legislation. This air quality assessment refers only to UK Air Quality Standards, as compliance with these standards will also ensure that the less demanding European Air Quality limit values would also be met.

In addition to these UKAQS objectives, the following additional 'target values' are defined within the Air Quality Standard Regulations 2007, and 4th EU Daughter Directive:

Table 2-2
Additional Air Quality 'Target Values'

Pollutant	Concentration	Measured as	Target date
Arsenic (As)	6 µg/m^3	Annual average in PM_{10} fraction	31.12.2012
Cadmium (Cd)	5 µg/m^3		
Nickel (Ni)	20 µg/m^3		

These 'target values' are different from the 'limit values' set for other pollutants in that they are not intended to be considered as 'Environmental Quality Standards' (EQSs)[2]. And have therefore not been applied in this assessment.

A new air quality Directive came into force in June 2008, and will be transposed into national legislation by June 2010: *Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe*. [3]

[2] Explanatory Memorandum to the Air Quality Standards Regulations 2007. DEFRA 15th January 2007.
[3] Available from EU website: http://ec.europa.eu/environment/air/legis.htm (accessed 07/10/08)

Fine Particulate Matter ($PM_{2.5}$)

The effect of particulate matter on human health has been the subject of considerable development in regulation over recent years. The key development is the acknowledgement that the finer fraction (typically considered to be <2.5µm aerodynamic diameter) of particulate matter can be more directly attributed to human health effects than the larger fraction (typically between 2.5µm and 10µm aerodynamic diameter). Considerable research has been undertaken (and is ongoing) and the findings have been used to inform the changes to regulation worldwide as summarised below. Whilst it is acknowledged that the composition of fine particulate matter (size and compounds) can influence its effect on health; all of the standards discussed below are based only on gravimetric $PM_{2.5}$.

In the UK, the 2008 Air Quality Strategy introduced targets and exposure reduction values for use in the UK. These have been applied in this assessment. The 2008 AQS sets an annual average target value of 25µg/m^3 by 2020 (for UK except Scotland) and an urban background exposure reduction of 15% between 2010 and 2020. These targets were informed by the findings of a review of research undertaken by the Committee on the Medical Effects of Air Pollutants[4] (COMEAP) which based its recommendations on a 10µg/m^3 increase in fine particles being associated with a 6% increase in risk of mortality.

In Europe, this issue has been recognised in the 'Directive on ambient air quality and cleaner air for Europe (2008/50/EC)' which is due to be transposed by member states by 2010. The EU Directive defines both limits values and exposure reductions targets based on the impact of $PM_{2.5}$ on human health. These are detailed in Annex XIV of the Directive and details a Stage 1 limit value (Article 16) of 25µg/m^3 by 2010 and a provisional Stage 2 limit value of 20µg/m^3 by 2015 (to be reviewed in 2013). The National exposure reduction targets for urban background $PM_{2.5}$ concentrations between 2010 and 2020 are set based on existing levels with reductions between 20% where baseline levels are >25µg/m^3 and 0% where levels are less than 8µg/m^3. The 2008 AQS may be revised once this Directive is transposed in the UK.

Future developments within Europe involve the revision of the National Emission Ceilings Directive 2001/81/EC (NECD) which is still under preparation and should introduce an emission ceiling for the primary emissions of $PM_{2.5}$. To inform this proposed revision of the NECD, an emission inventory of $PM_{2.5}$ has been prepared[5] for the EU which shows the small contribution of 'waste treatment' (including energy from waste) estimated at 0.2% of the total from the EU25, compared to 20% from agriculture, of which the largest contributor is wind erosion of soils.

A significant proportion of research and regulation of $PM_{2.5}$ has been undertaken in the USA where National Ambient Air Quality Standards (NAAQS) limits for $PM_{2.5}$ have be in place prior to 2000. An evaluation of the health and welfare effects of fine particulate matter[6] was completed in 2006 in accordance with the Clean Air Act. Following this review the 1997 NAAQS for fine particulate matter were revised[7] with the 24-hr average standard decreased from 65 µg/m^3 to 35µg/m^3 and the annual standard remaining at 15µg/m^3.

[4] Long-Term Exposure to Air Pollution: Effect on Mortality. A report by the committee on the Medical Effects of Air Pollutants (COMEAP). Draft report for comments, 2007. Available from: http://www.advisorybodies.doh.gov.uk/comeap/index.htm

[5] Estimation of emissions of fine particulate matter ($PM_{2.5}$) in Europe. Final report March 2007. TNO Report Ref: 2007-A-R0322/B, from http://ec.europa.eu/environment/air/pollutants/rev_nec_dir.htm

[6] USEPA website: http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_cr.html (accessed 07/10/08).

[7] USEPA website: http://www.epa.gov/oar/particlepollution/standards.html (accessed 07/10/08).

The World Health Organisation (WHO) have also updated their Air Quality Guidelines[8] for particulate matter with Interim Targets (IT) and Air Quality Guidelines (AQG) set for both 24-hr average and annual average $PM_{2.5}$ concentrations. The Interim Targets are intended to be used as an incremental step in progressive reduction of exposure. The WHO guidelines for annual average exposure to $PM_{2.5}$ include an IT-1 of 35µg/m^3, IT-2 of 25µg/m^3, IT-3 of 15µg/m^3 and an AQG of 10 µg/m^3. The WHO guidelines for 24-hr average exposure to $PM_{2.5}$ include an IT-1 of 75 µg/m^3, IT-2 of 50 µg/m^3, IT-3 of 37.5 µg/m^3 and an AQG of 25 µg/m^3.

In summary, whilst it is clear that different numerical limits or standards are being applied worldwide in relation to $PM_{2.5}$, the limits currently applied in the UK (as detailed in the 2008 AQS) are of a similar magnitude based on the findings of detailed research.

2.1.3 Local Authority Air Quality Review and Assessment

Part IV of the Environment Act 1995 requires local authorities to review and assess existing and predict future air quality in their areas as part of a rolling 'review and assessment' process. To date, almost all local authorities have completed the third round of the review and assessment process. At the end of the earlier rounds a number of local authorities designated Air Quality Management Areas (AQMAs) in which exceedences of one or more of the air quality objectives have been predicted. AQMAs cover the area in which exceedences have been predicted, and once designated the local authority must then draw up an Air Quality Action Plan (AQAP) setting out the measures it intends to take in pursuit of achieving the air quality objectives in the AQMA.

Review and assessment 'rounds' are separated into two stages; an updating and screening assessment, followed by a more detailed assessment if required. The aim of the updating and screening assessment is to establish and identify any areas where pollutant concentrations have changed since the last round of review and assessment, which might give rise to a risk of an air quality objective being exceeded.

The third round of the Review and Assessment process commenced in 2006 and the fourth round USA's were scheduled to commence in April 2009.

If the results of this part of the assessment conclude that there is a possibility of exceedences for one or more pollutants, then a detailed assessment must be carried out for each pollutant of concern. The detailed assessment will include further monitoring and modelling to determine whether there is a significant risk of any objectives being exceeded, leading to the designation of new AQMAs, and/or the revoking or resizing of AQMAs designated during earlier rounds.

Data provided by www.airquality.co.uk indicates that, as of April 2009, 224 Local Authorities had declared AQMA's for one or more of the following pollutants

- Benzene: 1;
- NO_2: 209;
- SO_2: 11; and
- PM_{10}: 73.

[8] WHO Air Quality Guidelines – Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide.

DEFRA Technical guidance document LAQM TG (09) is designed to support local authorities in carrying out their duties under the Environment Act 1995 and subsequent Regulations. It sets out the general approach to be used, together with detailed technical guidance, which is provided on a pollutant by pollutant basis.

2.2 Regulation of Industrial Processes

Industrial process emissions to air, such as those from the EfW are controlled under the Environmental Pollution (England and Wales) Regulations 2007 by the Environment Agency. Guidance Notes produced by DEFRA to provide a framework for regulation of installations and additional Technical Guidance Notes produced by the Environment Agency are used to provide the basis for permit conditions regards releases to air and mitigation measures. The proposed EfW facility would be classed as a Part A(i) process under these regulations, amongst other conditions of operation would be emission limits for various pollutants produced by the process, which must be demonstrated through various monitoring requirements as prescribed by the WID. The relevant Sector Guidance Note is EPR5.01[9].

Of particular relevance to the assessment of air quality impacts is the guidance document EPR H1 Environmental Risk Assessment[10]. The purpose of this guidance note is to provide supplementary information, relevant to all sectors, to assist applicants in responding to the requirements described in the EPR Sector and General Guidance Notes. The H1 assessment can be used to support an Environmental Assessment of the overall impact of the emissions resulting from the installation to confirm that the emissions are acceptable (i.e. do not cause significant pollution). The H1 guidance provides the assessor with Environmental Assessment Levels (EALs) for each pollutant against which impact may be assessed.

2.2.1 Environmental Assessment Levels (EAL)

The EALs used in this assessment have been reproduced from EPR Guidance H1, which are based upon the air quality standards and occupational exposure limits (OEL) and maximum exposure levels (MEL) presented in HSE EH40 (2005). A summary of the appropriate EALs for pollutants emitted by the proposed facility are included in Table 2-3. EALs have been applied in this assessment where no air quality standard exists, or where the EAL is lower than the corresponding air quality standard.

Table 2-3
Relevant EALs (µg/m^3)

Pollutant		Long Term EAL (Annual average)	Short Term (Hourly average) EAL
Nitrogen dioxide	(NO_2)	40	200
Carbon monoxide	(CO)	-	10,000
Sulphur dioxide	(SO_2)	50	267
Particulates	(PM_{10})	40	50
Hydrogen chloride	(HCl)	20	800 (EPAQS 750)[(a)]
Hydrogen fluoride	(HF)	-	250 (EAPQS 160)[(a)]
Benzene (surrogate for TOC)		5.0	208

[9] How to comply with your environmental permit - Additional guidance for The Incineration of Waste, EPR 5.01. Environment Agency, March 2009.

[10] EPR H1: Environmental Risk Assessment Part 2: Assessment of point source releases and cost-benefit analysis, version 080328. Environment Agency March 2008.

Pollutant		Long Term EAL (Annual average)	Short Term (Hourly average) EAL
Arsenic[c]	(As)	0.003	15
Antimony	(Sb)	5	150
Cadmium	(Cd)	0.005	1.5
Chromium (II and III)	(Cr)	5	150
Chromium (VI) [c]		0.0002	3
Cobalt	(Co)	0.2	6
Copper	(Cu)	2	60
Lead	(Pb)	0.5	-
Manganese	(Mn)	1	1500
Mercury	(Hg)	0.25	7.5
Nickel[c]	(Ni)	0.02	30
Thallium	(Tl)	1	30
Vanadium	(V)	5	20[b]
Ammonia	(NH_3)	180	2500

Table Note:
a) The Expert Panel on Air Quality Standards (EPAQS) has recommended lower short term limits for HCl and HF, and whilst these have not be carried forward into the H1 guidance, these have been applied in this assessment.
b) There is some uncertainty relating to the validity of the short-term EAL for Vanadium from H1 of 1μg/m^3. For all compounds, except Vanadium, the short-term EAL is higher than the long-term EAL (5μg/m^3); typically by a factor of 10 or more. It is therefore considered that a more appropriate short-term assessment level would be the World Health Organisation lowest observed adverse effect level (LOAEL) at 20μg/m^3.
c) The Expert Panel on Air Quality Standards (EPAQS) has recommended new limits for Arsenic, Nickel, and Chromium[11], and whilst these have yet be carried forward into the current H1 guidance, these have been considered in this assessment.

2.2.2 EALs for the protection of Ecosystems and Vegetation

In addition to the critical levels defined in the AQS for NOx and SO_2, the following EALs for the protection of ecosystems and vegetation are also defined in H1 as critical levels for ammonia.

Table 2-4
Additional EALs for Ecosystems

Pollutant	Averaging period	Concentration (μg/m^3)
Ammonia	Hourly	3300
	Daily	270
	Monthly	23
	Annual mean	3

The impact of ammonia on sensitive ecosystems is a matter of ongoing research and debate; however the 2007 workshop on atmospheric ammonia, convened by the Executive body for the convention on long-range transboundary air pollution[12] recommended that the

[11] DEFRA, Expert Panel on Air Quality Standards Guidelines for metals and metalloids in ambient air for the protection of human health (May 2009).

[12] Report on the Workshop on Atmospheric Ammonia, (http://www.ammonia-ws.ceh.ac.uk). Executive body for the convention on long-range transboundary air pollution, April 2007.

annual critical level for vegetation for ammonia be reduced from 8µg/m^3 to 3µg/m^3 for all 'higher plants' (i.e. heathland, grassland and forests) and 1µg/m^3 for lichen and bryophytes.

2.3 Waste Incineration Regulations

The Waste Incineration (England and Wales) Regulations 2002 (SI 2002 No, 2980) came into force on 28 December 2002 and transpose the Waste Incineration Directive, 2000/76/EC (WID) in UK legislation. The Directive applies to incineration and co-incineration plants which burn waste as defined in the Waste Framework Directive. Such wastes include municipal waste, clinical waste, hazardous waste, general waste and waste derived fuels. The Directive applies to the proposed operation.

The WID defines items such as:

- operating conditions, including gas temperatures and residence times, such as 850ºC / 2 seconds;
- emission limit values for a range of substance to air and water; and
- emissions monitoring requirements.

2.3.1 Emission Limit Values to Air

The WID sets out emission limit values for emissions to air as detailed in the Table 2-5; these emission limits would be set as Environmental Permit conditions by the Environment Agency as part of the permitting process.

Table 2-5
WID Emission Limit Values

Pollutant	Emission Limits (mg/Nm^3) (a)		
	Daily average values	Half hourly averages	
		100th Percentile	97th Percentile
Continuous Monitoring			
Particles	10	30	10
TOC	10	20	10
HCl	10	60	10
HF	1	4	2
SO_2	50	200	50
NOx	200	400	200
CO (b)	50	150	100
Spot sample measurements			
Group 1 metals (c)	0.05		
Group 2 metals (d)	0.05		
Group 3 metals (e)	0.5		
Dioxins and furans (f)	0.0000001		

Notes:
(a) Concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.
(b) 150 mg/Nm^3 of combustion gas for at least 95% of all measurements determined as 10 minute averages or 100 mg/Nm^3 of combustion gas of all measurements determined as half-hourly average values taken in any 24 hour period.
(c) Cadmium (Cd) and thallium (Tl)
(d) Mercury (Hg)
(e) Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and vanadium (V).

(f) The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence (TEQ).

2.3.2 Monitoring Requirements

In addition to the monitoring of process parameters such as temperature within the combustion chamber and the oxygen concentration, temperature, moisture and pressure of flue gases; the WID prescribes that continuous monitoring of emissions to air for NO_x, TOC, SO_2 and HCl and HF are to be undertaken. Although the requirement for continuous monitoring of HF may be omitted if treatment stages are applied which ensure that the emission limit for HCl is not exceeded; because the abatement of HCl to below the WID emission limits would also ensure the abatement of HF to below the WID limits.

Furthermore at least two measurements per year of metals, dioxins and furans, dioxin like PCBs and PAHs is required by the WID. Whilst dioxins and furans are specifically regulated under the WID, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) are not specifically regulated under the WID but are effectively controlled through the process conditions and limitation of TOC emissions.

2.4 Impacts on Sensitive Ecosystems

2.4.1 The Conservation (Natural Habitats andc) Regulations

The Conservation (Natural Habitats andc) Regulations 1994 ('Habitats Regulations') transpose Council Directive 79/409/EEC on the conservation of wild birds ('Birds Directive') and Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ('Habitats Directive') into national law (in conjunction with the Wildlife and Countryside Act, see below).

Regulation 48(1) states:

> *"A competent authority, before deciding to undertake, or give consent, permission or other authorisation for a plan or project which (a) is likely to have a significant effect on a European site in Great Britain (either alone or in a combination of projects), and (b) is not directly connected with or necessary to the management of the site, shall make an appropriate assessment of the site in view of the site's conservation objectives".*

Assessment under the Habitats Regulations

In order to clarify the procedure for assessing the impact of Process Industries Regulation permissions under the Habitat Regulations; the Environment Agency has prepared Operational Instructions. These operational instructions form Appendix 7[13] of the Agency's guidance (the EU Habitats and Birds Directive Handbook) on how the Agency implements the Habitats Regulations when they consider new consents and review old consents. They define a 4-stage assessment procedure as detailed below:

- Stage1 – identification of relevant application by distance from designated site;
- Stage 2 – identification of permissions that are likely to be significant;
- Stage 3 – the 'appropriate assessment'; and
- Stage 4 – determination of the permission.

[13] Appendix 7, Assessment of new PIR permissions under the Habitat Regulations, Operational Instruction. Environment agency, Version 2, 06/06/07.

The ‘stage 1’ assessment indicates that any EP application within 10km of a designated site and 15km for centrally dispatched coal or oil-fired power station is considered relevant. For this assessment a study area of 10km has been adopted.

As part of the ‘stage 2’ assessment, the significance of the long-term process contribution (PC) is assessed against the following criteria:

- If the PC is less than 1% of the relevant long-term benchmark (EAL, critical level or critical load), the emission is ‘not likely to have a significant effect alone or in combination irrespective of the background levels’

Where this criterion is exceeded; consideration of the predicted environmental concentration (PEC) is required and the following criteria applied:

- If the PEC is less than 70% of the relevant long-term benchmark, the emission is ‘not likely to have a significant effect’.

If on the basis of this Stage 2 assessment it cannot be concluded that the emission is not likely to have a significant effect, a Stage 3 ‘appropriate assessment’ is required.

Where it is identified that a Stage 3 ‘appropriate assessment’ is required in relation to emissions to air, the results of detailed atmospheric dispersion modelling are used to predict impacts of various pollutants at the sensitive locations. The procedure for undertaking such an ‘appropriate assessment’ has been defined by the Agency in conjunction with Natural England in the AQTAG06[14] guidance document.

The AQTAG06 procedure defines the dispersion modelling approach in terms of receptor location and arrays, use of topographical and terrain data, the calculation of deposition fluxes, how these should be considered alongside the background conditions and relevant critical levels and loads.

2.4.2 Wildlife and Countryside Act

The Wildlife and Countryside Act 1981 (as amended) is the principal mechanism for the legislative protection of wildlife in Great Britain. This legislation is the means by which the Convention on the Conservation of European Wildlife and Natural Habitats (the 'Bern Convention') and the European Union Directives on the Conservation of Wild Birds (79/409/EEC) and Natural Habitats and Wild Fauna and Flora (92/43/FFC) are implemented in Great Britain.

Planning authorities are required to consult Natural England (NE) before granting planning permission for the development of land in a Site of Special Scientific Interest (SSSI), or within the consultation area around a SSSI, as defined by NE.

The planning authority is also required to consult NE if the development is considered likely to affect a SSSI, even if the application site falls outside the SSSI and surrounding consultation area.

[14] AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, working Draft version 9, 12/05/06.

3.0 ASSESSMENT METHODOLOGY

3.1 Dispersion Modelling

Detailed atmospheric dispersion modelling has been undertaken with due consideration to relevant guidance[15,16] and the modelling approach is based upon the following stages:

- identification of sensitive receptors;
- review of emissions from other existing and proposed local industrial sources;
- review of process design proposals and emission sources;
- compilation of the existing air quality baseline with due regard to Review and Assessments of local air quality;
- calculation of process contribution to ground level concentrations and deposition for key pollutants emitted from the process;
- evaluation of effects on ecological receptors;
- consideration of cumulative effects; and
- sensitivity analyses of model input data.

A number of commercially available dispersion models are able to predict ground level concentrations arising from emissions to atmosphere from elevated point sources such as the New England Quarry EfW facility. No dispersion model is wholly accurate and all models will produce variations in results under certain conditions. For this assessment the AERMOD GIS Pro model[17] has been applied.

The AERMOD dispersion modelling program is widely used and accepted by the Environment Agency in the UK for undertaking such assessments and its predictions have been validated against real-time monitoring data by the USEPA[18]. It is therefore considered a suitable model for this assessment.

3.1.1 Combined Effects with Existing Air Pollution Sources

There are sources of air pollution within 2km of the application site. Predominately these are associated with traffic, domestic and small industrial sources.

During the EIA scoping consultation and public exhibitions, requests were made for assessment of any potential cumulative impacts associated with:

- operation of the Centrica operated Langage Power Station, commissioned in September 2009.
- Operation of the Hemerdon quarry, owned by Wolf Minerals; and
- Langage Farm Anaerobic Digestion Plant.

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[15] Air Dispersion modelling report requirements (for detailed air dispersion modelling). AQMAU, Environment Agency (not dated).
[16] Guidelines for the Preparation of Dispersion Modelling Assessment for Compliance with Regulatory Requirements – an update to the 1995 Royal Meteorological Society guidance. UK Atmospheric Dispersion Modelling Committee (ADMLC), Version 1.4, 2004.
[17] Software used: BREEZE AERMOD GIS Pro, v7.0.
[18] AERMOD: Latest Features and Evaluation Results. USEPA Report: EPA-454/R-03-003 June 2003, (http://www.epa.gov/scram001/dispersion_prefrec.htm#aermod)

It is considered that emissions from existing sources have been addressed through the selection of baseline ambient air quality data close to the proposed development. This includes existing impacts associated with existing traffic related and industrial facilities. However, further assessment of the cumulative impacts associated with the potential sources above are addressed in section 7.0 of this report.

3.2 Deposition Modelling – Metals and dioxins

In order to inform the assessment of potential impacts on human health, the air dispersion model has been interrogated to provide deposition rates of metals and dioxins. Full details are presented in the human health risk assessment (HHRA).

3.3 Assessment of Impacts on Vegetation and Ecosystems

3.3.1 Critical Levels

Critical levels are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Critical levels for the protection of vegetation and ecosystems are specified within relevant European air quality directives and corresponding UK air quality regulations.

For all European sites, SSSIs and other ecological sites in the study area, process contributions (and predicted environmental concentrations where required) of NO_x , NH_3, and SO_2 have been calculated for comparison against critical level thresholds.

3.3.2 Critical Loads

Critical loads are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge.

Critical loads are set for the deposition of various substances to sensitive ecosystems. Predicted contributions to acid deposition and nitrogen deposition have been calculated and compared with the relevant critical load range for the habitat types associated with each designated site as derived from the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/).

Deposition rates were calculated using dispersion modelling results processed by following empirical methods recommended by the Environment Agency in AQTAG06 and summarised in the following sections

3.3.3 Calculation of Contribution to Critical Loads

Deposition rates were calculated using empirical methods recommended by the Environment Agency (AQTAG06), as described below.

Calculate dry deposition flux using the following equation:

Dry deposition flux ($\mu g/m^2/s$) = ground level concentration ($\mu g/m^3$) x deposition velocity (m/s)

The applied deposition velocities for various chemical species are as shown in Table 3-1.

Table 3-1
Applied Deposition Velocities

Chemical Species	Recommended deposition velocity (m/s)	
NO_2	Grassland	0.0015
	Woodland	0.003
SO_2	Grassland	0.012
	Woodland	0.024
NH_3	Grassland	0.02
	Woodland	0.03
HCl	Grassland	0.025
	Woodland	0.06

The units are then converted from $\mu g/m^2/s$ to units of kg/ha/year by multiplying the dry deposition flux by standard conversion factors as summarised in Table 3-2.

Table 3-2
Applied Deposition Conversion Factors

Chemical Species	Conversion factor [$\mu g/m^2/s$ to kg/ha/year]	
NO_2	of N:	96
SO_2	of S:	157.7
NH_3	of N:	259.7
HCl	of Cl:	306.7

Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow, and is not considered significant over short distances (AQTAG06) compared with dry deposition and therefore for the purposes of this assessment, wet deposition has not been considered.

Critical Loads - Eutrophication

The contribution to critical loads for Nitrogen deposition are recorded as KgN/ha/yr.

Critical Loads - Acidification

The predicted deposition rates are converted to units of equivalents (keq/ha/year), which is a measure of how acidifying the chemical species can be, by dividing the dry deposition flux (kg/ha/year) by standard conversion factors as presented in Table 3-3.

Table 3-3
Applied Acidification Conversion Factors

Chemical Species	Conversion factor [kg/ha/year to keq/ha/year]
of N:	divide by 14
of S:	divide by 16
of Cl:	divide by 35.5

The predicted dry N, S and Cl deposition (keq/ha/year) are summed to determine total acid deposition.

3.4 Significance Criteria

Significance criteria are based on EP H1 guidance.

For process contribution:

- If the PC is less than 1% of the relevant long-term benchmark (EAL, critical level or critical load), the emission is ‘not likely to have a significant effect alone or in combination irrespective of the background levels’; and
- If the PC is less than 10% of the relevant short-term benchmark, the emission is ‘not likely to have a significant effect alone or in combination’.

If a long term PC is below 1% or a short term PC is below 10%, impact may be described as negligible. All PEC impacts above 100% of the EAL will be regarded as unacceptable.

4.0 BASELINE ENVIRONMENT

4.1 Site Location

The site is currently dominated by a mothballed quarry, of approximately 20 ha, with an existing access located to the south of the site on New England Hill, an unclassified rural lane. The application area is sited at National Grid Reference 2595 0548 with a new access being gained from the A38.

The site location plan identifies the context of the site in relation to the surrounding area.

The nearest residential properties to the site include Challonsleigh to the North West, Swainstone to the East, and Southwood Barn and the Corner Plantation to the West.

There are also a number of sensitive habitats and protected sites within a 10km radius of the application site. These include the Dartmoor SAC, for example.

4.2 Existing Local Sources

Air quality information obtained from the UK National Atmospheric Emissions Inventory (NAEI) (www.naei.org.uk) includes the contribution of key sectors to annual average total emissions within the UK. Data for the 1km grid square containing the proposed development and surrounding 1km squares presented in Table 4-1 demonstrates the significance of the existing transport and industrial sources. This data relates to the year 2006, which represents the most recent available at the present time.

Table 4-1
Existing Local Emissions within surrounding 1km grid squares of the Proposed Development (2006)

Category	NOx (t/yr)	PM_{10} (t/yr)	SO_2 (t/yr)	VOC (t/yr)
Energy Production and Transformation	0.00	0.00	0.00	0.00
Commercial, Institutional and Residential Combustion	0.0399	0.0412	0.0239	0.0357
Industrial Combustion	0.000643	0.000102	0.000524	7.77E-06
Industrial Processes	0.00	0.00143	0.00	0.00392
Production and Distribution of Fossil Fuels	0.00	0.00	0.00	0.00
Solvent Use	0.00	0.00	0.00	0.14
Road Transport	0.288	0.0204	0.0014	0.0991
Other Transport	0.263	0.0256	0.0202	0.0534
Waste Treatment and Disposal	0.00146	0.0092	0.000483	3.55
Agriculture	0.00	0.0216	0.00	0.00
Nature	0.0016	0.00456	0.00	0.983

The more recent sources of emission, including the newly commissioned Langage Power Plant, are not included in this data.

4.3 Local Air Quality Management

Although the site is located within the administrative area of South Hams District Council (SHDC), the A38 runs west to Plymouth and therefore the Plymouth City Council (PCC) administrative area is also of some relevance to this assessment.

SHDC has carried out regular Review and Assessment, reported as follows:

- 2003 Updating and Screening Assessment (SHDC 2003);
- 2004 Detailed Assessment (SHDC 2004);
- 2005 Progress Report (SHDC 2005);
- 2006 Updating and Screening Assessment (SHDC 2006);
- 2007 Detailed Assessment (SHDC 2007a);
- 2007 Additional Monitoring Results for Western Road, Ivybridge and Fore St., Kingsbridge (SHDC2007b);

- 2007 Further Review and Assessment; and
- 2008 Progress Report.

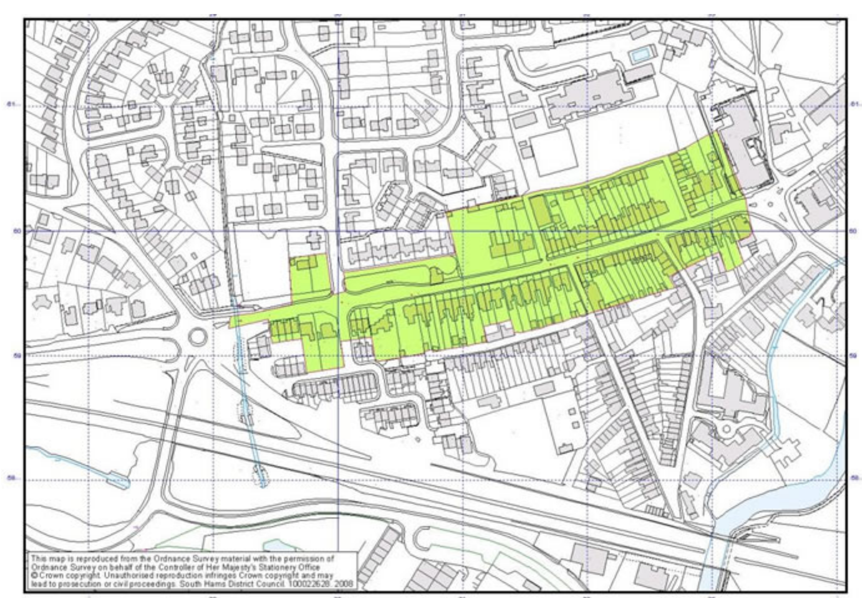
In summary, the following AQMAs have been declared within the SHDC area:

- Ivybridge AQMA: An area encompassing all properties fronting on to Western Road, Ivybridge. Declared for NO_2 only;
- A38 AQMA: An area encompassing The Old Parsonage, Dean Prior near Buckfastleigh. Declared for NO_2 only; and

- Totnes AQMA: An area encompassingall properties fronting on to Bridgetown Hill, Station Road and Ashburton Road in Totnes. Declared for NO_2 only.

Only the Ivybridge AQMA is of relevance to this assessment, and is shown below.

Figure 4-1
Ivybridge AQMA



Similarly, PCC has also carried out regular Review and Assessment in line with their statutory requirements. The following AQMA's have been declared:

- An area encompassing Mutley Plain, and Mannamead Road from the junction with Mutley Plain to the junction with College Road. Declared for NO_2 only;
- An area encompassing Exeter Street, between Charles Cross Roundabout and Cattedown Roundabout, and Embankment Road from Cattedown Roundabout to the junction of Stenlake Terrace and Hele's Terrace. Declared for NO_2 only; and

- An area encompassing Exeter Street Petrol Station, St Thomas House, 77-79 Exeter Street and Holy Cross Roman Catholic School, Beaumont Road. Declared for Benzene only.

None of the AQMA's declared within PCC are considered to be of relevance to this assessment of point source emissions from the EfW.

4.4 Background Levels and Predictions

This section reviews the existing baseline air quality in the region of the application site undertaken by local authorities and DEFRA as part of LAQM obligations and additional monitoring undertaken by SLR Consulting for the purposes of this assessment.

4.4.1 South Hams Council Monitoring

Automatic Monitoring Data

SHDC operate an automatic analyser at Bridgetown Hill on the A385. The analyser is a kerbside monitoring location 1m from the kerb.

Table 4-2
Automatic Monitoring Data: Annual Mean (µg/m^3).

Month	Monthly Mean concentration NO^2 (µg/m^3)	Number of exceedances of hourly objective of 200µg/m^3	% Data Capture
June	32.2	11	72
July	33.4	0	85
August	39.7	0	72
September	39.7	0	85
October	49.6	0	95
November	40.7	0	94
December	40.0	0	95
January	36.9	0	85
February	53.0	0	87
Mean 9 Months	41.0	0	86

Non-automatic monitoring data

In 2007 South Hams District council monitored nitrogen dioxide using diffusion tube techniques at 22 locations (including 7 at kerbside). Of these sites 5 exceeded the Air Quality Annual Mean for Nitrogen Dioxide limit of 40μg/m^3.

Monitoring locations represent urban background, suburban, roadside and kerbside locations and vary between annual mean concentrations of 12.3μg/m^3 and 71.6μg/m^3. The kerbside and roadside (where located on lamp-posts) annual mean concentrations are not all representative of actual exposure. A summary of urban background monitoring in the study area is presented in Table 4-3.

Table 4-3
Nitrogen Dioxide Diffusion Tube Survey Results (μg/m^3)

Town	Location	2007	Predicted 2010
Totnes town	Farwell Road	12.3	11.2
	Fore Street	21.5	19.5
Totnes A385/A381	Queens Terrace	38.3	34.7
	Barn Close	24.0	21.8
	Devon Ceramics	39.2	35.6
Kingsbridge	Fore Street: Solicitor	41.9	38.0
	Fore Street Shop	35.9	32.6
	Fore Street Embankment	30.9	28.0
	Fore Street Chapel Street	22.6	20.5
Dean Prior AQMA	Dean Prior Farm	30.1	27.3
	Façade of property (2m from kerb)	71.6	64.9
	Gable End of property (3m from kerb)	48.0	43.5
	Gable End of property (5m from kerb)	38.9	35.3
	Gable End of property (7m from kerb)	33.8	30.7
Totnes A385 Eastern Bridgetown Hill	Bridgetown Hill Terrace	42.7	38.7
	Bridgetown Hill bottom	45.4	40.9
	Lodge	30.3	27.5
	Semi	25.8	23.0
	House	40	35.6

4.4.2 Automatic Urban and Rural Monitoring Network

The Automatic Urban and Rural Monitoring Networks run on behalf of DEFRA provide automatic monitoring data from a network of stations in urban and rural locations across the UK.

DEFRA operate the AURN network which ensures the UK complies with its monitoring requirements stipulated under the Air Quality Regulations 2007. A summary of the monitoring results from these AURN monitoring stations is presented in Table 4-4 .

Table 4-4
AURN Monitoring Data: Annual Mean (µg/m^3).

Pollutant	Plymouth Centre			Yarner Wood		
	2007	2008	2009	2007	2008	2009
PM10	20.9	14.3	-	-	-	-
NO2	22.9	21.5	25.2	5.6	5.3	4.0
NOx	37.2	33.0	35.5	7.2	6.7	4.9
SO2	0.67	-	-	-	-	-
CO	180	-	-	-	-	-

Table Note:
Plymouth 2009 data provisional after 01/04/09 and data available until 20/9/09 and Yarner Wood Available till 23/9/09
Plymouth AURN 2007 monitoring commenced on 9/2/07
Plymouth AURN period of CO and SO_2 monitoring is 9/2/09- 30/9/07

4.4.3 National Air Quality Archive

Background pollutant concentrations have been obtained from the National Air Quality Archive UK Background Air Pollution Maps. These 1km grid resolution maps are derived from 2006 background annual mean pollutant concentrations which are then projected to future years.

The estimated annual mean background concentrations for the grid square containing the application site (259500, 54500) are as shown below for pollutants relevant to this assessment.

Table 4-5
Relevant Estimated Annual Mean Background Concentrations

Pollutant	Predicted 2009 (µg/m^3)	Predicted 2013 (µg/m^3)
NO_2	7.43	6.78
NO_x	8.29	7.40
PM_{10}	15.46	15.23
$PM_{2.5}$	9.55	9.35
CO	110	95

4.4.4 Dioxins and Furans

Dioxins are currently monitored at six sites by DEFRA within the UK as part of the Toxic Organic Micropollutants Network; Table 4-6 presents available data from these sites for 2007 (the most recent year available). None of these sites are in close proximity to New England Quarry.

It should be noted that the raw monitoring data for each dioxin or furan species have been multiplied by the associated World Health Organisation toxic equivalence factor to give a total dioxin and furan concentration in compliance with the I-TEQ reporting convention.

Table 4-6
Monitoring Data for Dioxins and Furans (2007)

Site	Site Classification	Dioxins and Furans (fg(TEQ)/m^3)[a]
Hazelrigg	Semi-Rural	6.68
High Muffles	Rural	1.35
London	Urban	7.25
Manchester	Urban	18.33
Middlesbrough	Urban	18.49
Stoke Ferry	Rural	5.90
Average UK		**9.67**

a) The Dioxin TEQ values are best case estimates. In samples in which a congener is not detected during analysis, the value used in calculating concentrations is zero rather than the detection limit.

4.4.5 Heavy Metals

Monitoring of metals is currently carried out by Defra at 27 sites around the UK (17 as part the UK Heavy Metals Monitoring Network and 10 as part of the Rural Heavy Metals and Mercury Network).

The closest station to the application site is Yarner Wood (part of the Rural Heavy Metals and Mercury Network rural metals network) located approximately 28km to the northeast of the application site, which monitors Arsenic (As), Cadmium (Cd), Nickel (Ni), Lead (Pb) and Mercury (Hg). Data from the site at Yarner Wood is summarised below.

Table 4-7
Heavy Metals Monitoring Data Yarner Wood (annual average ng/m^3)

Metal	2007	2008	Average
Arsenic (ng/m^3)	0.44	0.38	0.41
Cadmium (ng/m^3)	0.07	0.08	0.075
Mercury (ng/m^3)	1.48	1.03	1.255
Nickel (ng/m^3)	0.62	0.87	0.745
Lead (ng/m^3)	3.22	2.13	2.675

Monitoring results of the remaining other metals are available from the monitoring station located at Bristol Avonmouth, located approximately 140km to the northeast of the application site. Clearly given the distance from the application site and the specific issues at Bristol Avonmouth, a centre for heavy industry, it is not appropriate to use this data for anything other than providing a general indication of levels typically found for an industrial area.

Table 4-8
Heavy Metals Monitoring Data at Bristol Avonmouth (annual average ng/m^3)

Metal	2007	2008	Average
Chromium (ng/m^3)	2.8	1.3	2.0
Copper (ng/m^3)	6.4	6.1	6.3
Manganese (ng/m^3)	7.2	6.7	7.0
Vanadium (ng/m^3)	4.5	5.7	5.1
Zinc (ng/m^3)	38.6	34.7	36.7

Monitoring is not routinely undertaken for thallium, antimony and cobalt in the UK and therefore no background data are available.

4.4.6 Hydrogen Halides

Hydrogen Chloride

Hydrogen chloride is monitored as part of the nitric acid network (now part of the acid deposition monitoring network). The nitric acid network was established in 1999 and covers twelve rural sites around the UK. The mean concentration of HCl during the period 1999 – 2002 was 0.36µg/m3 for the Yarner Wood monitoring station.

Hydrogen Fluoride

In 2005 The Expert Panel on Air Quality Standards (EPAQS) published a draft report entitled 'Guidelines for halogen and hydrogen halides in ambient air for protecting human health against acute irritancy effects'. The report noted that only a small number of measurements of ambient concentrations of hydrogen fluoride have been made in the UK. All of these have been made in the vicinity of three industrial plants. Many samples were below the limit of detection. However, measurable values were in the range $5x10^{-5}$ to $3.5x10^{-3}$ mg/m^3 as approximate monthly averages.

4.5 Baseline Monitoring

During January 2009 SLR commenced a diffusion tube survey to quantify the current air quality in the area sounding the proposed New England Quarry site. Diffusion tubes were deployed in line with the NO_2 Diffusion Tube Network schedule set by NETCEN[19]. The year is divided into 12 pollution 'months', each consisting of 4 or 5 whole weeks. Table 4-9 shows the relevant monitoring schedule dates for the SLR diffusion tube survey.

Table 4-9
Monitoring Calendar for Year 2009

NETCEN Period	Start Date	End Date	Duration (weeks)
1	07/01/2009	04/02/2009	4
2	04/02/2009	04/03/2009	4
3	04/03/2009	01/04/2009	4
4	01/04/2009	29/04/2009	4
5	29/04/2009	03/06/2009	5
6	03/06/2009	01/07/2009	4
7	01/07/2009	29/07/2009	4
8	29/07/2009	02/09/2009	5
9	02/09/2009	30/09/2009	4
10	30/09/2009	04/11/2009	5

Diffusion tubes were situated in nearby areas, including Smithaleigh, Lee Mill and Yealmpton, in addition to selected background sites. The pollutants which were monitored are hydrogen chloride (HCl), hydrogen fluoride (HF), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and VOCs.

[19] UK National Air Quality Archive, NETCEN, www.airquality.co.uk

The locations of the diffusion tubes are presented in Table 4-10 below and Drawing AQ1.

Table 4-10
Location of Diffusion Tubes for Baseline Assessment

Location				Distance from Stack (m)	Direction from stack (deg)	Pollutants Monitored
No.	Setting*	NGR Coordinates				
		East	North			
DT1	6	255834	55877	3860	287	SO_2, HCl, HF, NO_2
DT2	3	257564	55265	2027	285	NO_2
DT3	5	258860	55480	1001	319	SO_2, HCl, HF, NO_2
DT4	1	259371	54312	439	200	SO_2, HCl, HF, NO_2
DT5	5	257211	51621	3868	217	SO_2, HCl, HF, NO_2
DT6	1	260605	54649	1090	94	VOC, SO_2, HCl, HF, NO_2
DT7	5	259440	55568	846	355	NO_2, NO_x
DT8	5	261107	55762	1897	057	NO_2, NO_x
DT9	1	262843	61270	7340	027	VOC, SO_2, HCl, HF, NO_2
DT10	3	263188	55991	3882	071	NO_2
DT11	3	263870	53189	4615	109	VOC, SO_2, HCl, HF, NO_2
DT12	7	263866	55680	4451	078	NO_2
DT13	3	281047	60499	22290	075	NO_2
DT14	5	261702	56167	2617	057	VOC, SO_2, HCl, HF, NO_2

*The UK Air Quality Archive recognises 11 distinct Monitoring Site Environment Types. These include: 1: Rural, 2: Urban, 3: Kerbside, 5: Roadside 6: Suburban and 7: Urban Background

4.5.1 Baseline Monitoring Results

The results of the diffusion tube monitoring are presented in Table 4-11 below. Results have been bias and period / annual mean adjusted in accordance with DEFRA Guidance LAQM TG(09). The results are presented as an average for 8 months sampling (8th January 2009 until 4th September 2009.

Table 4-11
NO2 Baseline Diffusion Tube Monitoring Results (µg/m^3)

Diffusion Tube Location	Number of months data*	NO_2 (Raw Data)	NO_2 (Bias Adjusted)	NO_2 (Annual / Period Mean Adjusted)
1	7	14.5	14.2	14.7
2	8	40.2	39.4	40.8
3	8	21.2	20.8	21.6
4	5	9.2	9.0	9.3
5	8	16.8	16.5	17.1
6	7	6.9	6.8	7.0
7	8	43.5	42.7	44.2
8	7	61.4	60.2	62.3
9	8	5.2	5.1	5.3

Diffusion Tube Location	Number of months data*	NO_2 (Raw Data)	NO_2 (Bias Adjusted)	NO_2 (Annual / Period Mean Adjusted)
10	8	35.2	34.5	35.7
11	8	18.5	18.1	18.8
12	8	22.4	22.0	22.8
13	7	38.8	38.0	39.4
14	8	19.3	18.9	19.6

Notes: Tube location 13 co-located with Torbay real-time monitor. Bias adjustment factor of 0.98 applied, with annual – period mean factor of 1.04.

*Tubes were deployed for 8 months, however tubes are sometimes missing (stolen / removed / damaged)

The measured concentrations are generally in line with those expected of the area with high concentrations found close to the A38. Results for the other pollutants are shown below. These do not require adjustment.

Table 4-12
Baseline Diffusion Tube Monitoring Results (µg/m^3)

Diffusion Tube Location	NO_x	SO_2	Total VOC	HCl	HF
1	n/m	1.53	n/m	3.64	0.82
3	n/m	0.77	n/m	3.25	0.72
4	n/m	1.26	n/m	2.46	0.76
5	n/m	1.11	n/m	2.70	0.76
6	n/m	1.10	0.43	2.69	<ldl
7	69.8	n/m	n/m	n/m	n/m
8	80.0	n/m	n/m	n/m	n/m
9	n/m	1.10	0.16	2.39	0.76
11	n/m	1.80	0.80	3.01	0.77
14	n/m	1.07	0.80	3.85	0.76
Max result	**80.0**	**1.8**	**0.8**	**3.8**	**0.8**

n/m = not measured at this location

<ldl = below detection limits

Note: averages have been taken for valid results (i.e. results below lower detection limit have been disregarded).

4.6 Summary of Applied Background Concentrations

From the monitoring and predicted background concentrations detailed in the previous section, the background concentrations in Table 4-13 have been applied in this air quality assessment in accordance with EP H1 Guidance.

Table 4-13 Applied Background Concentrations

Pollutant	Units	Background Concentration		Data Source
		Short Term	Long Term	
NO_2	µg/m^3	13.56	6.78	Air Quality Archive
PM_{10}	µg/m^3	30.46	15.23	Air Quality Archive
$PM_{2.5}$	µg/m^3	18.70	9.35	Air Quality Archive
CO	µg/m^3	950.0	95.0	Air Quality Archive
SO_2	µg/m^3	3.60	1.80	SLR Monitoring
HCl	µg/m^3	7.70	3.85	SLR Monitoring
HF	µg/m^3	1.64	0.82	SLR Monitoring
TOC (as C_6H_6)	µg/m^3	1.60	0.80	SLR Monitoring
Cadmium	ηg/m^3	0.15	0.08	Rural Heavy Metals Network (Yarner Wood)
Mercury	ηg/m^3	2.51	1.26	
Arsenic	ηg/m^3	0.82	0.41	
Lead	ηg/m^3	5.35	2.68	
Nickel	ηg/m^3	1.49	0.75	
Chromium	ηg/m^3	4.00	2.00	Rural Heavy Metals Network (Avonmouth)
Copper	ηg/m^3	12.60	6.30	
Manganese	ηg/m^3	14.00	7.00	
Vanadium	ηg/m^3	10.20	5.10	
Dioxins	fg(TEQ)/m^3	N/A	9.67	UK Average
Ammonia	µg/m^3	N/A	1.20	APIS

*Note: A sensitivity assessment for NO_2 at differing locations has also been undertaken given the high backgrounds near the A38 and extremely low levels on Dartmoor.

The conversion factor between short term and long term CO of 10 is based on typical observed ratios. For all other pollutants the hourly background has been calculated from the annual average using a factor of 2 as recommended in EPR H1.

4.7 Sensitive Receptors: Human

The term 'sensitive receptors' includes any persons, locations or systems that may be susceptible to changes as a consequence of the proposed development.

According to the LAQM TG(09), air quality standards should only apply to all locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant objective. Thus short term standards such as the 1 hour standard for NO_2 should apply to footpaths at site boundaries and other areas which may be frequented by the public even for a short period of time. Longer term standards such as the 24 hour for PM_{10}, or annual means, should apply at houses other locations which the public can be expected to occupy on a continuous basis. These standards do not apply to exposure at the workplace.

The proposed development is in proximity to isolated residences and settlements (potentially long term sensitive receptors). The closest receptor is located over 350m from the EfW stack.

Identified discrete receptors are listed in Table 4-14 and locations are shown in Drawing AQ2. This ensures that a selection of actual receptors are assessed in addition to the stratified grid.

Table 4-14
Modelled Human Receptor Locations

		Location (NGR)		Proximity to New England Quarry EfW	
Ref.	**Receptor**	**X**	**Y**	**Distance (m)**	**Direction (°)**
HR1	Challonsleigh 1	259283	55355	672	340
HR2	Challonsleigh 2	259257	55323	652	336
HR3	Challonsleigh 3	259231	55312	652	334
HR4	Challonsleigh 4	259180	55312	676	330
HR5	Challonsleigh 5	259211	55360	704	334
HR6	Challonsleigh 6	259186	55409	760	334
HR7	Beacon view	258772	55179	873	301
HR8	Smithaleigh 1	258815	55444	1004	316
HR9	Smithaleigh 2	258799	55417	997	314
HR10	Smithaleigh 3	258765	55407	1016	312
HR11	Smithaleigh 4	258775	55362	978	311
HR12	Smithaleigh 5	258835	55492	1026	318
HR13	Smithaleigh 6	258879	55505	1008	321
HR14	Smithaleigh 7	258929	55481	957	322
HR15	Smithaleigh 8	258960	55452	915	322
HR16	Smithaleigh 9	258998	55448	889	324
HR17	Smithaleigh 10	259024	55451	877	326
HR18	Smithaleigh 11	259045	55456	870	327
HR19	Smithaleigh 12	259041	55496	906	328
HR20	Smithaleigh 13	259013	55494	919	327
HR21	Smithaleigh 14	258993	55493	929	326
HR22	Smithaleigh 15	258976	55501	945	325
HR23	Smithaleigh 16	258961	55515	966	325
HR24	Smithaleigh 17	258948	55484	949	323
HR25	Smithaleigh 18	258935	55509	976	323
HR26	Holmleigh	259157	55580	927	337
HR27	Higher Challonsleigh 1	259180	55891	1213	344
HR28	Higher Challonsleigh 2	259217	55935	1246	346
HR29	Higher Challonsleigh 3	259196	55976	1291	346
HR30	Higher Challonsleigh 4	259168	55939	1263	344
HR31	Higher Challonsleigh 5	259135	55928	1262	342
HR32	Higher Challonsleigh 6	259121	55975	1311	342
HR33	Higher Challonsleigh 7	259162	56022	1344	345
HR34	Higher Challonsleigh 8	259147	55909	1239	343
HR35	Mount Pleasant 1	258964	56336	1702	341
HR36	Mount Pleasant 2	258948	56395	1764	341
HR37	Lyndhurst 1	258569	56516	2026	332
HR38	Combe Farm	258558	56264	1813	328
HR39	Moorcot	258519	56639	2159	332
HR40	Canly	259659	56097	1378	6
HR41	Spurham	260089	56411	1780	19

Ref.	Receptor	Location (NGR) X	Location (NGR) Y	Proximity to New England Quarry EfW Distance (m)	Proximity to New England Quarry EfW Direction (°)
HR42	Lee Mill 1	259589	55651	927	4
HR43	Lee Mill 2	259653	55672	955	8
HR44	Lee Mill 3	259725	55647	944	13
HR45	Lee Mill 4	259785	55668	979	16
HR46	Lee Mill 5	259811	55683	1001	17
HR47	Lee Mill 6	259841	55701	1027	18
HR48	Lee Mill 7	259771	55709	1015	14
HR49	Lee Mill 8	259722	55684	980	12
HR50	Lee Mill 9	259688	55710	998	10
HR51	Lee Mill 10	259666	55725	1010	8
HR52	Lee Mill 11	259637	55723	1004	7
HR53	Lee Mill 12	259604	55711	989	5
HR54	Lee Mill 13	259561	55744	1019	2
HR55	Lee Mill 14	259617	55745	1024	6
HR56	Lee Mill 15	259648	55747	1030	7
HR57	Lee Mill 16	259630	55788	1068	6
HR58	Lee Mill 17	259677	55784	1070	9
HR59	Lee Mill 18	259714	55782	1074	11
HR60	Lee Mill 19	259773	55782	1086	14
HR61	Lee Mill 20	259822	55774	1091	16
HR62	Lee Mill 21	259819	55806	1121	16
HR63	Lee Mill 22	259837	55829	1148	16
HR64	Lee Mill 23	259861	55828	1154	17
HR65	Lee Mill 24	259885	55811	1145	19
HR66	Lee Mill 25	259871	55782	1114	18
HR67	Lee Mill 26	259932	55881	1227	20
HR68	Lee Mill 27	259954	55929	1280	20
HR69	Lee Mill 28	259972	55898	1257	21
HR70	Lee Mill 29	259985	55934	1295	21
HR71	Lee Mill 30	259991	55853	1222	23
HR72	Lee Mill 31	259954	55854	1209	21
HR73	Lee Mill 32	259941	55806	1160	21
HR74	Lee Mill 33	259936	55773	1128	22
HR75	Lee Mill 34	259982	55793	1164	24
HR76	Lee Mill 35	260025	55765	1156	26
HR77	Lee Mill 36	260066	55782	1190	27
HR78	Lee Mill 37	260107	55784	1211	29
HR79	Lee Mill 38	259924	55736	1089	22
HR80	Lee Mill 39	259901	55708	1054	21
HR81	Lee Mill 40	260028	55721	1118	27
HR82	Lee Mill 41	260158	55733	1193	32
HR83	Lee Mill 42	260294	55809	1332	36
HR84	Lee Mill 43	260436	55863	1461	39
HR85	Lee Mill 44	260540	56032	1659	38
HR86	Lee Mill 45	260579	55980	1643	40
HR87	Lee Mill 46	260601	55954	1637	41
HR88	Lee Mill 47	260634	55898	1618	44

Ref.	Receptor	Location (NGR)		Proximity to New England Quarry EfW	
		X	Y	Distance (m)	Direction (°)
HR89	Lee Mill 48	260662	55833	1592	46
HR90	Lee Mill 49	259937	56126	1461	17
HR91	Lee Mill 50	259903	56127	1453	15
HR92	Lee Mill 51	259857	56125	1439	14
HR93	Lee Mill 52	259828	56145	1453	12
HR94	Lee Mill Hospital	260654	56331	1966	35
HR95	Strashleigh 1	260840	55216	1410	70
HR96	Strashleigh 2	260827	55146	1374	72
HR97	Strashleigh 3	260746	55179	1309	70
HR98	Swainstone 1	260604	54713	1086	91
HR99	Swainstone 2	260651	54672	1134	93
HR100	Brook Farm 1	260784	54583	1274	96
HR101	Brook Farm 2	260863	54568	1354	97
HR102	Coyton 1	260856	54053	1498	117
HR103	Coyton 2	260928	53998	1587	117
HR104	Coyton 3	260863	53990	1533	119
HR105	Oakhill Farm 1	260059	53894	992	147
HR106	Oakhill Farm 2	260002	53888	968	150
HR107	Lotherton Bridge 1	259663	53851	887	171
HR108	Lotherton Bridge 2	259280	53985	779	198
HR109	East Pitton Farm 1	258869	54125	885	227
HR110	Furzehill 1	258316	53751	1548	231
HR111	Mackarell Parks Wood 1	259148	54670	374	261
HR112	Mackarell Parks Wood 2	259155	54566	397	246
HR113	Southwood Barn	259243	54357	460	217
HR114	Choakford Farm 1	258715	54586	815	260
HR115	Choakford Farm 2	258660	54593	868	261
HR116	Choakford Farm 3	258595	54652	926	265
HR117	New England Hill 1	259695	54369	398	154
HR118	New England Hill 2	259825	54334	498	142
HR119	New England Hill 3	259561	54346	383	174
HR120	West Pitton House	258363	54196	1271	245

Whilst there are more than 120 sensitive receptors in the vicinity of the site, these discrete receptors are considered to be representative of sensitive locations around the site. Given that dispersion modelling has been completed using a receptor grid, impact concentration for assessing impacts may effectively be determined at any location surrounding the site.

4.7.1 Receptor Heights

Conventionally dispersion models are utilised to predict ground level impacts of pollutant for comparison with suitable assessment levels. This approach has been adopted for this assessment in the absence of any nearby urban areas with a high density of tall buildings.

4.8 Sensitive Receptors: Ecological

Horizontal Guidance Note: EPRH1 states that receptors such as Sites of Special Scientific Interest (SSSI) or European sites (e.g. Special Area of Conservation), within 10km of Permitted processes should be considered when determining the impacts. A radius of 10km has therefore been applied in this assessment. Table 4-15 lists the sites of local, national and international ecological value within the zone of influence of the study area.

Table 4-15
Designated Sites within Zone of Influence of the Study Area

Geographical Frame of Reference	Site	Reference	Designation
Local	Forder Valley	1008906	Local Nature Reserve
	Efford Marshes	1008883	Local Nature Reserve
National	Dendles Wood	1006045	National Nature Reserve
	Faraday Road	1001582	Site of Special Scientific Interest
	Plymbridge Lane & Estover Road	1001097	Site of Special Scientific Interest
	Piles Copse	1001506	Site of Special Scientific Interest
	Lady's Wood & Viaduct Meadow	1001487	Site of Special Scientific Interest
	Billacombe	1001032	Site of Special Scientific Interest
	South Dartmoor	1001535	Site of Special Scientific Interest
	Wheal Emily	1001563	Site of Special Scientific Interest
	Wembury Point	1001553	Site of Special Scientific Interest
	Erme Estuary	1001463	Site of Special Scientific Interest
	Yealm Estuary	1006542	Site of Special Scientific Interest
	Dendles Wood	1001228	Site of Special Scientific Interest
International*	Plymouth Sound & Estuaries	UK0013111	Special Area of Conservation
	Dartmoor	UK0012929	Special Area of Conservation

* The Plymouth Sound and Dartmoor SAC's contain multiple SSSI's. The South Dartmoor SSSI, which itself consists of multiple units, is almost entirely encompassed within the Dartmoor SAC for example.

In accordance with AQTAG06, discrete receptors have been used to represent those sensitive sites which have been designated on ecological grounds. Those SSSI's designated solely on geological interest are therefore not required to be taken further in the assessment.

In accordance with AQTAG06, either discrete or array receptors have been used to represent these sensitive sites depending on their distance to the application site.

4.8.1 Existing Levels

The location of the discrete receptors was then used alongside the citation of the SSSI to obtain the existing critical level of NOx and SO_2, critical loads (and current loads) of nitrogen and acid deposition from the UK Air Pollution Information System (www.apis.ac.uk) as summarised in Table 4-16 below.

Table 4-16
Existing Levels of Deposition at Ecological Receptors (source: APIS)

Ref	Feature	Acid Deposition (keq/ha/yr)		Nitrogen Deposition (kgN/ha/year)	
		Critical Load	Current Load	Critical Load	Current Load
ER1	Piles Copse	1.61	1.95	10-20	38.8
ER2	Dendles Wood	1.61	1.95	10-20	38.8
ER3a	Lady's Wood	1.61	1.95	10-20	37.8
ER3b	Viaduct Meadow	0.75	1.95	10-25	21.4
ER4	Billacombe	0.75	1.95	10-25	16.1
SAC1	Dartmoor SAC	See text for critical load function		5-10	17.1
SAC2	Plymouth Sound And Erme Estuary SAC	Not acid sensitive	Not acid sensitive	30-40	9.9

Note:
For Erme Estuary SSSI and South Darmoor SSSI see the SAC's.
No critical loads / levels for the Plymbridge lane & Estover road SSSI pear trees, Wheal Emily SSSI (earth heritage), Wembury Point SSSI (Rock), Blackstone Point SSSI (Rock), yealm Estuary (sediment) or Faraday Road SSSI.
Where a range is given, the lower has been applied for critical loads and the higher for current levels/loads.
Where habitat designations are not detailed on the APIS resource, the most suitable APIS designation has been applied.
Current levels of Acid and nitrogen deposition are based on 2003-2005 3-yr average.

APIS provides specific critical load functions for Special Areas of Conservation (SAC's), in this case Plymouth Sound and Estuaries and Dartmoor.

Plymouth Sound and Estuaries SAC

The Plymouth Sound and Estuaries SAC contains the following habitats / species of interest ('Interest Features'):

- Sandbanks which are slightly covered by sea water all the time (H1110);
- Estuaries (H1130);
- Mudflats and sandflats not covered by seawater at low tide (H1140);
- Large shallow inlets and bays (H1160);
- Reefs (H1170);
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (H1330);
- *Alosa alosa* (Allis shad) (S1102); and
- *Rumex rupestris* (Shore dock) (S1441).

APIS gives the baseline 2010 levels of N and S deposition of:

- N Deposition: 0.71 keq/ha/yr :: 9.9 kg/ha/yr; and
- S Deposition: 0.34 keq/ha/yr :: 5.4 kg/ha/yr.

None of the Interest Features above are sensitive acidity, hence no critical load functions exist for the Plymouth Sound and Estuaries SAC. Similarly H1110, H1160 and H1170 are not sensitive to eutrophication. Although the broad habitat of *Alosa alosa* and *Rumex rupestris* (i.e moist to wet dune slacks) is sensitive to eutrophication the species themselves have no critical load function for acidity or eutrophication and are therefore assessed through the empirical critical load for this habitat. The empirical critical load for Eutrophication for all other Interest Features in this SAC is 30-40 Kg N/ha/yr.

It can be seen that, at the Plymouth Sound and Estuaries SAC, the existing levels of nutrient nitrogen are well below the critical load range (i.e. below the minimum) for all Interest Features. There is therefore no exceedence of the critical load.

Dartmoor SAC

The Dartmoor SAC contains the following Interest Features:

- Northern Atlantic wet heaths with *Erica tetralix* (H4010);
- European dry heaths (H4030);
- Blanket bogs (H7130);
- Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles (H91A0);
- *Coenagrion mercuriale* (Southern damselfly) (S1044);
- *Salmo salar* (Atlantic salmon) (S1106); and
- *Lutra lutra* (Otter) (S1355).

The general site character as described in the designation is as follows:

- Inland water bodies (standing water, running water) (1%);
- Bogs. Marshes. Water fringed vegetation. Fens (42%);
- Heath. Scrub. Maquis and garrigue. Phygrana (40%);
- Humid grassland. Mesophile grassland (12%);
- Improved grassland (2%);
- Broad-leaved deciduous woodland (1%); and
- Inland rocks. Screes. Sands. Permanent snow and ice (2%)

APIS gives the baseline 2010 levels of N and S deposition as follows for H4010, H4030, and H7130:

- N Deposition: 1.22 keq/ha/yr :: 17.1 kg/ha/yr; and
- S Deposition: 0.54 keq/ha/yr :: 8.6 kg/ha/yr.

The baseline 2010 levels of N and S deposition as follows for H91A0 are higher as follows. This is a result of the deposition velocity of the broad leaves (see section 3.3):

- N Deposition: 1.95 keq/ha/yr :: 27.3 kg/ha/yr
- S Deposition: 0.71 keq/ha/yr :: 11.4 kg/ha/yr

Although the broad habitat of *Salmo salar* and *Lutra lutra* (i.e freshwater) is sensitive to eutrophication and / or acidity, the species themselves have no critical load function for acidity. This is the same as *Coenagrion mercuriale*, which is sensitive to changes in its habitat rather than directly impacted. However, the acidity critical load functions for the other Interest Features are as shown in the Table below.

Table 4-17
Critical Load Functions, Dartmoor SAC

Interest Feature	MaxCLmaxN	MinCLmaxN	MaxCLmaxS	MinCLmaxS	MaxCLminN	MinCLminN
H4010	4.84	1.13	4.20	0.46	1.39	0.64
H4030	4.84	1.13	4.20	0.46	1.39	0.64
H7130	1.30	0.82	0.98	0.50	0.32	0.32
H91A0	4.61	0.96	4.32	0.67	0.50	0.14

Note: A full description of the critical load function terminology can be found at www.apis.ac.uk

At the Dartmoor SAC, the existing levels of nutrient nitrogen and acidity are within the critical load range (i.e. above the minimum and below the maximum) for heathland and woodland. There is therefore an exceedence of the minimum critical load.

Existing levels of nutrient nitrogen and acidity within the Dartmoor SAC are already above the maximum critical load for blanket bogs. There are a total of 13 upland bog SSSI units within the South Dartmoor SSSI (broadly comparable to the Dartmoor SAC).

4.9 Meteorological Conditions

The most important meteorological parameters governing the atmospheric dispersion of pollutants are as follows:

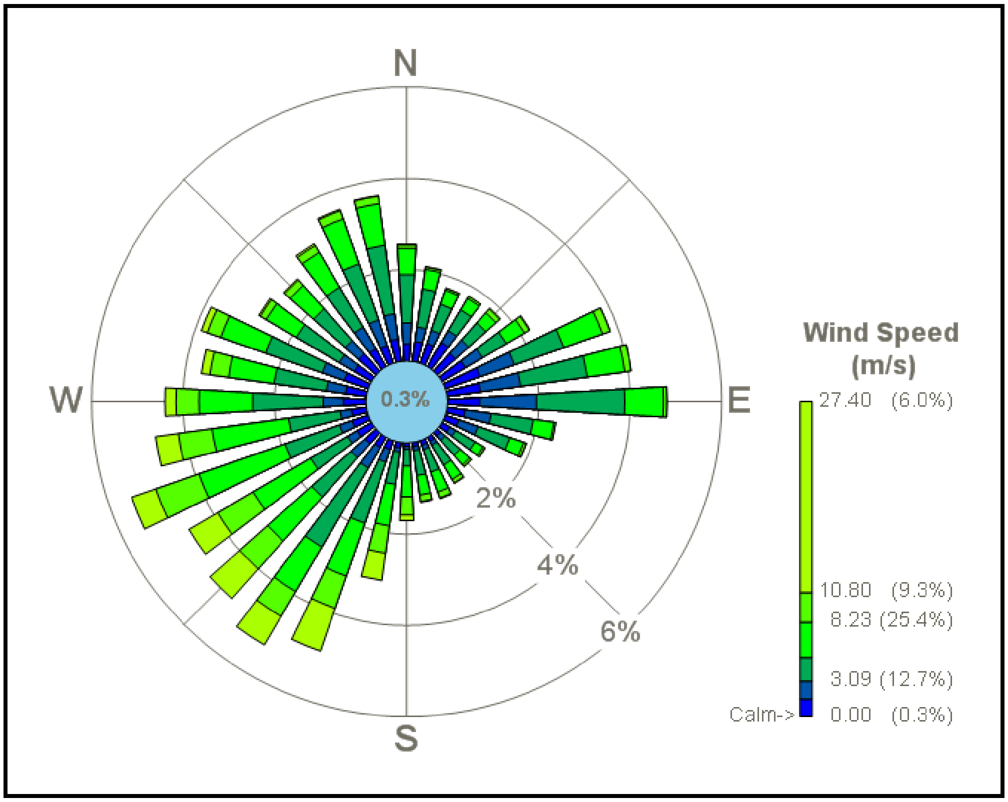
- wind direction determines the broad transport of the emission and the sector of the compass into which the emission is dispersed;
- wind speed will affect ground level concentrations of emissions by increasing the initial dilution of pollutants in the emission; and
- Atmospheric stability: is a measure of the turbulence, particularly of the vertical motions present. Advanced dispersion models use Monin-Obukhov lengths - a more advanced method of determining stability[20] than Pasquill.

Following consultation with the meteorological data provider, it was concluded that Plymouth Mountbatten (airfield, OS GR 249483,52152), located 10.3km WSW of the application site would provide the most complete and representative dataset for purposes of this assessment. Meteorological data used in this assessment was for the period 1st January 2004 to 31st December 2008 (inclusive). This data set has some missing cloud data which the supplier has supplemented with data from Exeter and then Culdrose as appropriate.

A windrose for Plymouth Mountbatten for the period 2004 to 2008 (inclusive), providing the frequency of wind speed and direction, is presented in Figure 4-2.

[20] Defined as: '*the height over the ground, where mechanically produced (by vertical shear) turbulence is in balance with the dissipative effect of negative buoyancy, thus where Richardson number equals to 1*.' Essentially it is a more quantitative method of estimating stability than the previously used Pasquill Stability Classes. It requires two quantities not routinely measured by national meteorological networks: the friction velocity *u* and flux of sensible heat *H*.

Figure 4-2
Windrose for Plymouth Mountbatten Observing Station (2004 – 2008)



As is apparent from this windrose, the predominant wind direction is from the south western quarter. There is also a marked easterly component. Wind directions from the north east and south east occur relatively infrequently.

4.10 Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants and the resulting ground level concentration in a number of ways. Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away.

The topography of the surrounding area covered by the modelling grid (within 10km in each direction) is highly variable lying between see level at the coast and 491m AOD to the north onto the Dartmoor SAC. Elevations have been included within the dispersion model.

5.0 QUANTIFICATION OF EMISSIONS TO ATMOSPHERE

5.1 Sources of Emission

The combustion of waste gives rise to emissions of a number of pollutants which are abated to low concentrations which are regulated under the WID. Emissions from the proposed New England Quarry EfW facility would be ducted through 2 separate flues of 90m in height.

5.2 Concentration of Emissions

The pollutants emitted from the proposed New England Quarry EfW facility and their emission limit values, as stated in the Waste Incineration Directive (WID) are shown in Table 2-5.

In order to predict a realistic 'worst case' scenario, the proposed New England Quarry EfW facility has been assumed to be in operation continuously throughout the year, and to have pollutant emission rates at the daily average emission limits permitted by the WID. This ensures that the maximum possible long term impacts on air quality are predicted with the facility in operation within its authorisation limits. In reality operational hours would be between 8000 and 8200 per year and emissions significantly below the WID emission limits.

5.2.1 Pollutant Specific Issues

Particulate Matter – Particle Size

Emissions of particulate matter from the proposed New England Quarry EfW would range in particle size, with only a proportion being PM_{10} or smaller. There is little monitoring data available as to the particle size distribution from any industrial facility; however published literature[21] does provide an indication that approximately 50% of particulate matter, from the combustion of MSW using similar technologies, is likely to comprise PM_{10} and approximately 30% as $PM_{2.5}$.

The proposed flue gas treatment would utilise a fabric filter (amongst other stages) which published data indicates has high collection efficiencies for a range of particle sizes. For example USEPA guidance for generation of particle size distributions[22] indicates a 99% collection efficiency for particle sixes <2.5 μm and 99.5% for particle sizes between 2.5 μm and 10 μm.

For the purposes of this assessment 100% of particulate matter has been assumed to be PM_{10} and also 100% to be $PM_{2.5}$. This approach ensures that the absolute worst case scenario has been considered for the smallest particles.

Total Organic Carbon

There are no relevant air quality assessment levels or background for Total Organic Carbon. Whilst it is unlikely that any benzene would be released from the process due to the high temperature of combustion a cautious approach has been adopted by assuming all the organic carbon would be in the form of benzene in line with guidance in EPR H1.

[21] AP42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Appendix B1. (http://www.epa.gov/ttn/chief/ap42/index.html)

[22] AP42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Appendix B.2. (http://www.epa.gov/ttn/chief/ap42/index.html)

Heavy Metals

As shown in Table 2-5, the WID emission limits for heavy metals are based on total emission rates for 3 different groups of compounds. The emission rate for Group 1 Metals has been divided by 2 (i.e. each metal at 50% of the WID emission limit for the group). The emission rate for Group 3 Metals has been divided by 9 (i.e. each metal at 11.1% of the WID emission limit for the group). This is discussed further in the sensitivity assessment.

Ammonia

The plant would be provided with a non catalytic deNOx system (SNCR). As a result of this abatement of NO_2, there is the potential for residual ammonia to be released in small quantities from the stack. The manufacturers have indicated this would be limited to an annual average of 6mg/m^3.

Chromium

In relation to chromium, it is important to note that different EALs apply depending on the oxidation state of chromium. The EPAQS recommended annual mean limit of 0.2ηg/m^3 relates specifically to chromium (VI) (i.e. hexavalent chromium), with the long-term EAL of 5μg/m^3 applying to all other oxidation states of chromium. Data indicates that the actual fraction of chromium in the oxidation state VI is approximately 10% for combustion process burning solid fuels[23] and this factor has been applied to the predicted impacts.

5.3 Process Conditions

The following process conditions were used to determine the pollutant emission rates and during the dispersion modelling process:

Table 5-1
Emission Characteristics from Stack

Parameter / Source	Line 1	Line 2
Stack Location NGR (x,y)	259518, 54726	259520.8, 54726.9
Stack Diameter (m)	1.6	1.6
Basal Stack Elevation (m AOD)	60.0	60.0
Stack Exhaust Height (m)	90.0	90.0
Volume Flow [(a)] (m^3/s) (273K, 11%, dry)	26.31	26.31
Emission Temperature [(a)] (ºC)	140.0	140.0
Oxygen Content [(a)] (% O_2 wet gas)	7.82	7.82
Moisture content [(a)] (% H_2O)	16.28	16.28
Actual Flow Rate (Am^3/s)	40.72	40.72
Emission velocity (m/s)	20.25	20.25
(a) Design flow rate provide by manufacturers.		

[23] UK Particulate and Heavy Metal Emissions from Industrial Processes, Appendix B1. DEFRA 2002.

5.4 Applied Emission Rates

The applied emission rates are presented in Table 5-2 and have been calculated from the process conditions detailed in Table 5-1 above and the daily average WID emission limits as detailed in Table 2-5.

Table 5-2
Emission Rates from New England Quarry EfW (per line)

Pollutant	Reference	Emission Rate (g/s) per unit
Nitrogen Dioxide	NO_X	5.263
Particulate Matter	PM_{10}	0.263
Sulphur Dioxide	SO_2	1.316
Carbon Monoxide	CO	1.316
Hydrogen Chloride	HCL	0.263
Hydrogen Flouride	HF	0.026
Organics	TOC	0.263
Metals (Group 1)	G1M	$6.58E^{-04}$
Metals (Group 2)	G2M	$1.32E^{-03}$
Metals (Group 3)	G3M	$1.46E^{-03}$
Dioxins	DIOX	$2.63E^{-09}$
Ammonia	NH_3	0.158

5.5 Dispersion Model Set-up

The Agency's H1 guidance provides a screening methodology for determining those pollutants that require detailed modelling. For the purposes of the EIA the full H1 assessment has not been undertaken as all pollutants have been subjected to detailed dispersion modelling.

5.5.1 Modelling Scenarios

For the purposes of the dispersion modelling of emission (i.e. process contribution) from the New England Quarry EfW stacks; one scenario has been defined (2013, the year of first operation).

5.5.2 Stack Height Determination

Viridor have designed the facility with a stack height of 90m. This height in line with other EfW's in the UK and has been demonstrated at other sites to achieve sufficient dispersion and minimisation of building wake effects. Further increases in stack height do not achieve significant increases in dispersion and are therefore not considered to be justified. Indeed, further increases lead to increased ground level impacts due to the site specific topography (i.e. sharply rising ground to the north). Further investigation is considered in the sensitivity assessment.

5.5.3 Meteorological Data

As described briefly earlier, meteorological data used in this assessment comprised a 5-year sequential hourly average dataset from Plymouth Mountbatten observation station, over the period 1st January 2004 to 31st December 2008 (inclusive). Five year met data was used to comply with current EA modelling guidance. This accounts for inter-year variability in meteorological conditions, with the average of the 5-year data set being used.

The meteorological data for Plymouth Mountbatten was obtained in .met format from the data supplier and converted to .the required surface and profile formats for use in AERMOD using AERMET Pro (v6.2). Details specific to the exact site location were used for the conversion, such as latitude, longitude and surface characteristics in accordance with the latest guidance[24]. The surface characteristics were applied as shown in Table 5-3. The Bowen / albedo has been calculated on a ratio of 10% forest, 35% cultivated land, 50 % grassland and 5% urban.

Table 5-3
Met Data Preparation – Applied Surface Characteristics

Zone (Start)	Zone (end)	Landscape Character	Albedo	Bowen	Roughness
000	030	Grassland	0.2749	0.8938	0.0403
030	090	Deciduous Forest	0.2749	0.8938	0.9
090	180	Cultivated land	0.2749	0.8938	0.0725
180	270	Grassland	0.2749	0.8938	0.0403
270	300	Cultivated land	0.2749	0.8938	0.0725
300	000	Grassland	0.2749	0.8938	0.0403

From the dataset used, a total of 132 'calm hours', representing 0.3% of the total, were recorded over the 5-year period with 958 missing hours (2.18%). This is well within the acceptable limits of a modelling dataset (typically 10% missing data permitted).

5.5.4 Urban/Rural Classification

For the purposes of this assessment the ‘urban’ classification option is not appropriate. The ‘urban’ option utilises different calculations to estimate the night time boundary layer based on the urban heat island effects associated with schemes within larger cities. This results in a lowering of boundary layer from a ‘rural’ setting and therefore the potential for increased ground level impacts.

5.5.5 Terrain Data

The model was run with OS 1:50,000 scale digital height contour data at 10m vertical intervals. Data was processed by the AERMAP function within AERMOD to calculate terrain heights, and interpolate data to calculate terrain heights for sources, buildings etc. The ground level elevations for buildings within the application site have been manually corrected to reflect site survey data.

5.5.6 Assessment Area

The potential air quality impact of the proposed plant was assessed over an area covering 10km radius from the development site. A stratified (polar) object array was selected in order to give more precise pollutant concentration predictions in the immediate vicinity of the site:

- 50m grid spacing within 2km of the site;
- 150m grid spacing 2km – 5km from the site; and
- 250 m grid spacing 5km – 10km from the site.

[24] AERMOD Implementation guide. AERMOD implementation workgroup, USEPA. Last revised January 8, 2008.

The resolution of the finer grid (50m) is approximately ½ the proposed New England Quarry EfW stack height (90m). Discrete receptor points were identified at the locations indicated in Table 4-14 and Table 4-15. In total, impact was determined at 14223 receptors.

5.5.7 Building Downwash

The integrated Building Profile Input Programme (BPIP) module within AERMOD was used to assess the potential impact of building downwash upon predicted dispersion characteristics. Building downwash occurs when turbulence, induced by nearby structures, causes pollutants emitted from an elevated source to be displaced and dispersed rapidly towards the ground, resulting in elevated ground level concentrations. Building downwash should always be considered for buildings that have a maximum height equivalent to at least 40% of the emission height, and which within a distance defined as five times the lesser of the height or maximum projected width of the building.

5.5.8 Nitric Oxide to NO_2 Conversion

Oxides of nitrogen (NO_x) emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO_2. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar radiation and the availability of oxidants, such as ozone (O_3).

The Environment Agency's guidance on conversion ratios for NOx and NO_2 (issued by AQMAU) has been applied and a 'worse case' scenario has been used for calculations. On this basis, 35% of NOx is presented as NO_2 in relation to short term impacts and 70% of NOx is present as NO_2 in relation to long term impacts.

5.5.9 Sulphur Dioxide – 15 minute averaging period

As dispersion models utilise hourly average meteorological data, calculation of 15-minute averages, such as required for SO_2, requires the application of conversion factors. For the purposes of detailed modelling of SO_2, a conversion factor of 1.34 is applied to hourly average data as detailed in EP Guidance Note H1.

6.0 PREDICTION OF IMPACTS

6.1 Predicted Short-term Impacts

Predicted short-term impacts from the detailed modelling are presented isopleth plots of the modelled scenarios in Drawings AQ3 to AQ5. Isopleths have only been generated for pollutants where the predicted short-term process contributions are greater than 1% of the relevant air quality standard.

A summary of the peak predicted short-term process contributions (PC) from the proposed New England Quarry EfW facility is presented in Table 6-1.

Table 6-1
Predicted Short-term Process Contributions PC (µg/m^3)

Pollutant	Applied Standard	Av. Period	PC Max	PC Max as % of Standard
NO_2	200	1-hr 99.79%ile	9.26	4.63%
PM_{10}	50	24-hr -90.41 %ile	0.09	0.19%
SO_2 (15-min)	267	15-,min, 99.90%ile	7.35	2.75%
SO_2 (1-hr)	350	1-hr, 99.73%ile	5.49	1.57%
SO_2 (24-hr)	125	24-hr, 99.18%ile	1.08	0.86%
CO	10000	1-hour max	3.70	0.04%
HCl	800	8 hour	1.14	0.14%
HF	250.0	1-hour max	0.34	0.13%
TOC	208.0	1-hour max	3.36	1.61%
Cadmium	1.50	1-hour max	0.00840	0.56%
Thallium	30.00	1-hour max	0.00840	0.03%
Mercury	7.50	1-hour max	0.01852	0.25%
Antimony	150.0	1-hour max	0.01667	0.01%
Arsenic	15.0	1-hour max	0.01667	0.11%
Chromium (II and III)	150.0	1-hour max	0.01500	0.01%
Chromium (VI) (c)	3.0	1-hour max	0.00167	0.06%
Cobalt	6.0	1-hour max	0.01667	0.28%
Copper	60.0	1-hour max	0.01667	0.03%
Manganese	1500.0	1-hour max	0.01667	0.00%
Nickel	30.0	1-hour max	0.01667	0.06%
Vanadium	20.0	1-hour max	0.01667	0.08%

These maximum impacts relate to the highest predicted level of impact at any location on the receptor grid and impacts at all other locations will be lower. All short term process contributions are significantly below relevant limits and only 5 cannot be regarded as ‘insignificant’ (i.e. 17 are below 1%).

The predicted short-term PC is combined with the background concentration to identify the predicted environmental concentrations (PEC). The resultant significance of impact is presented in Table 6-2.

Table 6-2
Predicted Short-term Predicted Environmental Concentrations (PEC) (µg/m^3)

Pollutant	Applied Standard	Background	PEC Max	Max PEC as % of Standard
NO_2	200	13.56	22.82	11.41%
PM_{10}	50	30.46	30.55	61.10%
SO_2 (15-min)	267	3.60	10.95	4.10%
SO_2 (1-hr)	350	3.60	9.09	2.6%
SO_2 (24-hr)	125	3.60	4.68	3.74%
CO	10000	950.00	953.70	9.54%
HCl	800	7.70	8.84	1.11%
HF	250	1.64	1.98	0.79%
TOC	208	1.60	4.96	2.38%
Cadmium	1.5	1.50E^{-04}	8.55E^{-03}	0.57%
Thallium	30	---	---	---
Mercury	7.5	2.51E^{-03}	2.10E^{-02}	0.28%
Antimony	150	---	---	---
Arsenic	15	8.20E^{-04}	1.75E^{-02}	0.12%
Chromium (II & III)	150	---	---	---
Chromium (VI)	3	---	---	---
Cobalt	6	---	---	---
Copper	60	1.26E^{-02}	2.93E^{-02}	0.05%
Manganese	1500	1.40E^{-02}	3.07E^{-02}	<0.01%
Nickel	30	1.49E^{-03}	1.82E^{-02}	0.06%
Vanadium	20	1.02E^{-02}	2.69E^{-02}	0.13%

*There are no appropriate background values to apply for Thallium, Antimony, Chromium phases and Cobalt to determine a PEC.

All short term predicted environmental concentrations are significantly ‘well below’ relevant limits (i.e. are below 75%).

6.2 Predicted Long-term Impacts

Predicted long-term impacts from the detailed modelling are presented in isopleth plots of the modelled scenarios in Drawings AQ6 and AQ7. Isopleths have only been generated for pollutants where the predicted long-term process contributions are greater than 1% of the relevant air quality standard.

A summary of the peak predicted long-term process contributions (PC) from the New England Quarry EfW is presented in Table 6-3.

Table 6-3
Predicted Long-term Process Contributions (µg/m^3)

Pollutant	Applied Standard (Annual Mean)	PC Max	PC Max as % of Standard
NO_2	40.0	0.38	0.94%
PM_{10}	40.0	0.03	<0.1%
$PM_{2.5}$	25.0	0.03	0.11%
SO_2	50.0	0.13	0.27%
HCl	20.0	0.03	0.1%
TOC	5.0	0.03	0.5%
Cadmium	0.005	6.70E^{-05}	1.3%
Thallium	1.00	6.70E^{-05}	<0.1%
Mercury	0.25	1.34E^{-04}	0.1%
Antimony	5.00	1.49E^{-04}	<0.1%
Arsenic	0.20	1.49E^{-04}	0.1%
Chromium III	5.00	0.00013	<0.1%
Chromium VI	0.0002	0.00001	7.4%
Cobalt	0.20	1.49E^{-04}	0.1%
Copper	2.00	1.49E^{-04}	<0.1%
Lead	0.50	1.49E^{-04}	<0.1%
Manganese	1.00	1.49E^{-04}	<0.1%
Nickel	1.00	1.49E^{-04}	<0.1%
Vanadium	5.00	1.49E^{-04}	<0.1%

All process contributions except cadmium and chromium VI are less than 1% of the applicable standard.

The predicted peak long-term process contribution of $PM_{2.5}$ is 0.11% of the AQS target value of 25µg/m^3. As discussed, the standards for assessing $PM_{2.5}$ are the subject of ongoing research and developing regulation. If the most stringent of these limits for $PM_{2.5}$ were applied (the WHO annual average AQG of 10µg/m^3); the peak long-term process contribution from the New England Quarry EfW would only be 0.25% of this limit (assumes both lines are operating continuously at WID emission limits with 100% of particulate as $PM_{2.5}$). The WHO also sets guideline for 24-hr average $PM_{2.5}$ exposure, which are not part of UK regulation

The predictions for dioxins have been used to inform the human health impact assessment in the absence of a concentration limit. Similarly, the impacts of ammonia have been used to inform the ecological assessment rather than the human impact assessment.

The predicted long-term PCs from the New England Quarry EfW are combined with the background concentration to identify the predicted environmental concentrations (PEC) as presented in Table 6-4.

Table 6-4
Predicted Long-term Predicted Environmental Concentrations (µg/m^3)

Pollutant	Applied Standard	Background	PEC Max	PC Max as % of Standard
NO_2	40	6.78	7.16	17.90%
PM_{10}	40	15.23	15.26	38.15%
$PM_{2.5}$	25	9.35	9.38	37.52%
SO_2	50	1.80	1.93	3.86%
HCl	20	3.85	3.88	19.40%
TOC	5	0.80	0.83	16.60%
Cadmium	0.005	$8.00E^{-04}$	$8.67E^{-04}$	17.34%
Thallium	1	---	---	---
Mercury	0.25	$1.26E^{-03}$	$1.39E^{-03}$	0.56%
Antimony	5	---	---	---
Arsenic	0.2	$4.10E^{-04}$	$5.59E^{-04}$	0.28%
Chromium III	5	$2.00E^{-03}$	$2.13E^{-03}$	0.04%
Chromium VI	0.0002	---	---	---
Cobalt	0.2	---	---	---
Copper	2	$6.30E^{-03}$	$6.45E^{-03}$	0.32%
Lead	0.5	$2.68E^{-03}$	$2.83E^{-03}$	0.57%
Manganese	1	$7.00E^{-03}$	$7.15E^{-03}$	0.71%
Nickel	1	$7.50E^{-04}$	$8.99E^{-04}$	0.09%
Vanadium	5	$5.10E^{-03}$	$5.25E^{-03}$	0.10%

*There are no appropriate background values to apply for Thallium, Antimony, Chromium 6 and Cobalt to determine a PEC.

For all pollutants, the predicted long-term PEC are below 40% of the relevant limit.

6.3 Deposition to Land

The predicted deposit rates of metals and dioxins have been used as input to the Human Health Assessment as presented in Chapter 13 of the full Environmental Statement.

6.4 Results –Sensitive Ecosystems

For all of the impacts described below, the result has been presented which represents the highest impact within the interest feature. For example, the result for the Dartmoor SAC is the highest of 1616 discrete points. Clearly in the event that a process contribution appears significant, this would be discussed in more detail for that particular interest feature.

6.4.1 Critical Levels

Nitrogen Oxides

The predicted concentration of NOx at sensitive ecosystem receptors is provided in the table below. All results are presented as annual averages.

Table 6-5
Predicted Nitrogen Oxide Impacts on Sensitive Ecosystems (µg/m^3)

Ref	Critical Level	Process Contribution	PC as % of Critical Level
ER1	30	0.07	0.22%
ER2	30	0.07	0.24%
ER3a	30	0.04	0.13%
ER3b	30	0.04	0.13%
ER4	30	0.05	0.15%
SAC1	30	0.07	0.24%
SAC2	30	0.04	0.13%

Predicted impacts (PC) from the New England Quarry EfW are less than 1% of the applied critical level at all assessed receptors and the impact is therefore insignificant.

Sulphur dioxide

The predicted concentration of SO_2 at sensitive ecosystem receptors is provided in the table below. All results are presented as annual averages.

Table 6-6
Predicted Sulphur Dioxide Impacts on Sensitive Ecosystems (µg/m^3)

Ref	Critical Level	Process Contribution	PC as % of Critical Level
ER1	20	0.023	0.12%
ER2	20	0.026	0.13%
ER3a	20	0.014	0.07%
ER3b	20	0.014	0.07%
ER4	20	0.016	0.08%
SAC1	20	0.025	0.13%
SAC2	20	0.014	0.07%

Predicted impacts (PC) from the New England Quarry EfW are less than 1% of the applied critical level at all assessed receptors and the impact is therefore insignificant.

6.4.2 Acid Deposition

A summary of the predicted impacts on the SSSI's are presented in the following table.

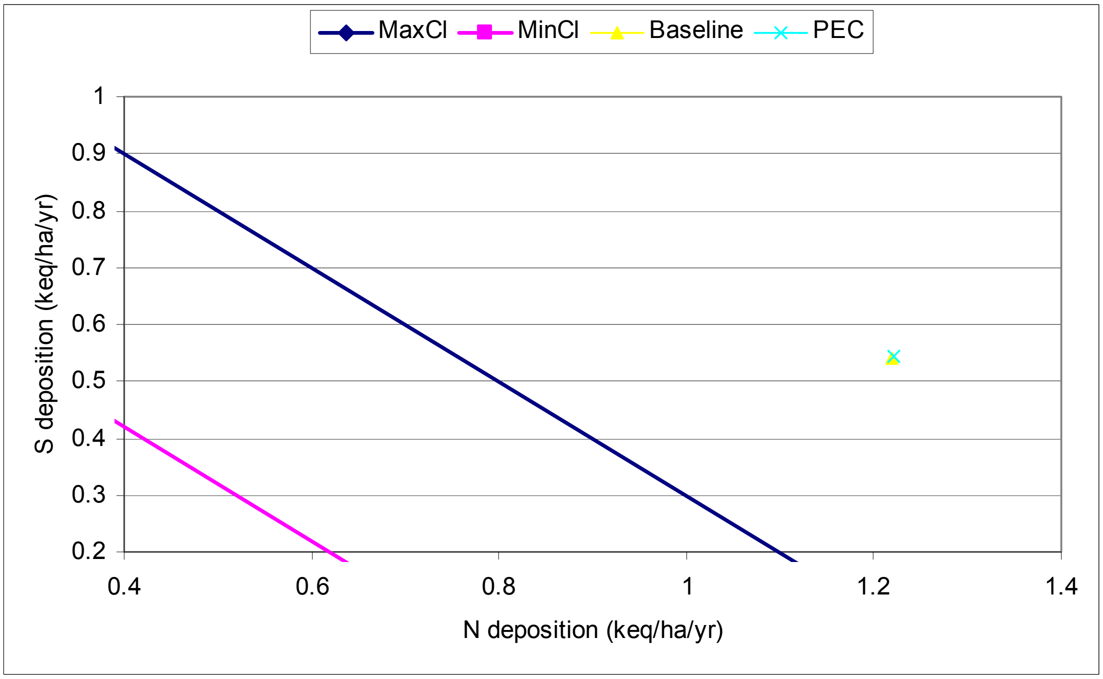
Table 6-7
Predicted Acid Deposition on Sensitive Ecosystems (kg$_{eq}$/hr/yr)

Ref	Critical Load	Process Contribution	% of CL	Current Level
ER1	1.61	0.009	0.58%	1.95
ER2	1.61	0.010	0.64%	1.95
ER3a	1.61	0.006	0.36%	1.95
ER3b	0.75	0.003	0.37%	1.95
ER4	0.75	0.007	0.87%	1.95

Predicted impacts (PC) from the New England Quarry EfW are a maximum of 0.87% of the applied critical load and therefore no further assessment is required.

For the SAC's, a different approach is required given the multiple critical load functions. On this basis, a critical load function graph has been provided for the SAC in line with the approach taken by APIS.

Figure 6-1
Dartmoor SAC Critical Load Function



The critical load function demonstrates that the acidity is already above the critical load for the Dartmoor SAC bog habitat and will remain so with the EfW in place. There is a negligible change (less than 1%). The Plymouth Sound and Erme Estuary SAC is not acid sensitive.

6.4.3 Eutrophication (Nitrogen Deposition)

A summary of the predicted impacts are presented in the following table with deposition rates for nitrogen as NOx and as NH_3 presented separately.

Table 6-8
Predicted Nitrogen Deposition on Sensitive Ecosystems (kg/hr/yr)

Ref	Critical Load (CL)	NOx-N deposition		NH_3 N deposition		Combined NOx and NH_3-N Deposition	
		PC	PC as % of lower CL	PC	PC as % of lower CL	PC	PC as % of CL
ER1	10-20	0.019	0.19%	0.086	0.86%	0.105	0.5 - 1.0%
ER2	10-20	0.021	0.21%	0.096	0.96%	0.117	0.6 - 1.2%
ER3a	10-20	0.012	0.12%	0.053	0.53%	0.065	0.3 - 0.6%
ER3b	10-25	0.006	0.06%	0.022	0.22%	0.028	0.1 - 0.3%
ER4	10-25	0.007	0.07%	0.025	0.25%	0.031	0.1 - 0.3%
SAC1	5-10*	0.010	0.20%	0.003	0.06%	0.013	0.1 - 0.3%

Ref	Critical Load (CL)	NOx-N deposition		NH_3 N deposition		Combined NOx and NH_3-N Deposition	
		PC	PC as % of lower CL	PC	PC as % of lower CL	PC	PC as % of CL
SAC2	30-40	0.005	0.02%	0.001	0.00%	0.006	0.02%

*Critical load and deposition velocity for bog habitat as most sensitive to eutrophication.

The highest Predicted impacts (PC) from the New England Quarry EfW as a proportion of the critical load are at Dendles Wood and are in the range 0.6-1.2% at the point of highest impact. There is no significant impact at the sensitive Dartmoor SAC.

6.5 Plume Visibility

A plume visibility model (ADMS) has been used to assess the hours when a plume is likely to be visible, and the length of the plume. This has been reported in the landscape assessment prepared as part of the Environmental Statement.

7.0 DISPERSION MODEL SENSITIVITY

The sensitivity of a dispersion model is defined in the ADMLC guidance[25] as the differential of model output by model input. This guidance identifies the following key input variables for the dispersion model:

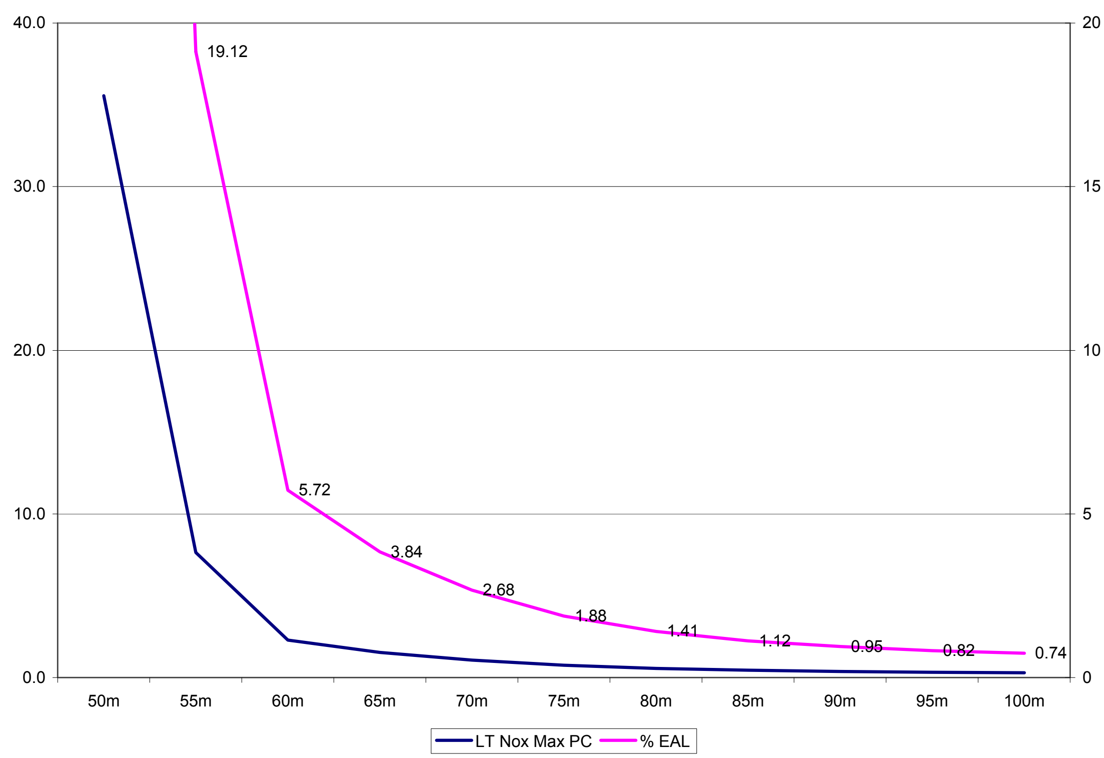
- Emission characteristics (including rate, height and velocity);
- Meteorology, both annual and spatial variability;
- Atmospheric chemistry;
- Terrain;
- Building effects;
- Coastal effects; and
- Receptor spacing.

The possible variation in emission rates from the process has been discussed (in Section 0) separately to the sensitivity of the dispersion model itself in Section 7.4.

7.1 Stack Height Variation

A stack height determination was completed as part of the design process. The graph below shows the improvement in impact attributable entirely to height.

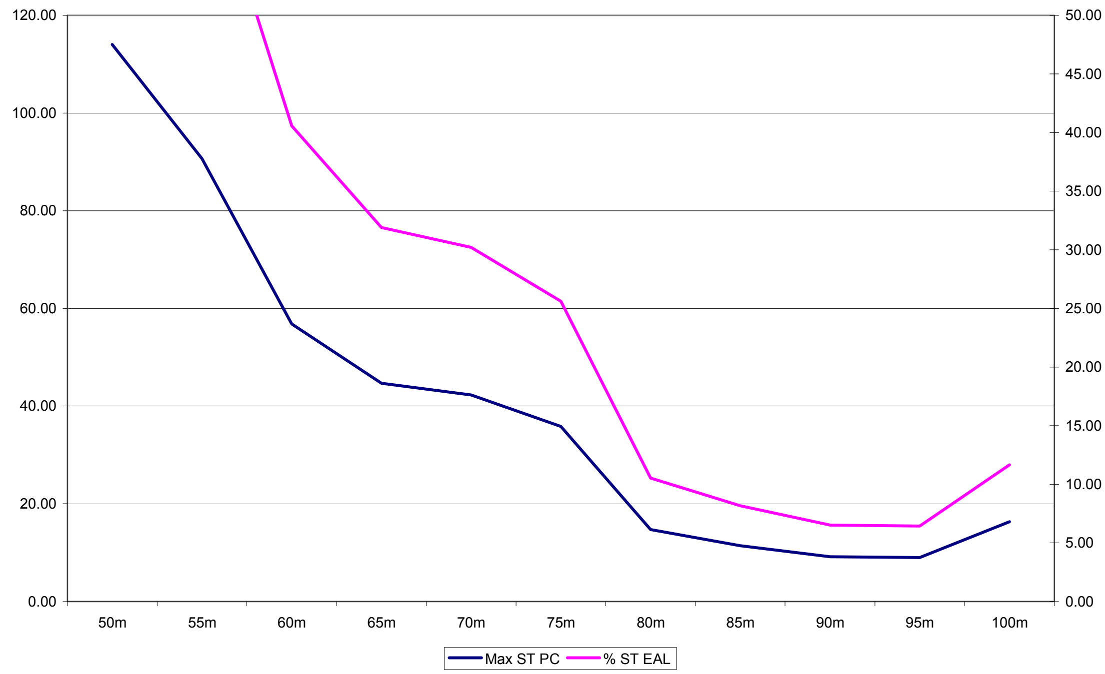
Figure 7-1
Stack Height Implications – Long Term NO_2



[25] Guidelines for the Preparation of Dispersion Modelling Assessment for Compliance with Regulatory Requirements – an update to the 1995 Royal Meteorological Society guidance. UK Atmospheric Dispersion Modelling Committee (ADMLC), Version 1.4, 2004

There is a clear decrease in long term impacts to 70m, above this the decrease in impacts is less marked as stack height increases.

Figure 7-2
Stack Height Implications – Short Term NO_2



There is a clear influence of topography on the short term impacts. Above 95m the impacts increase as the plume grounds at higher elevations to the north. There is a clear benefit here of a stack of between 80m and 95m.

7.2 Atmospheric Chemistry

Following the Environment Agency AQMAU guidance on conversion ratio for NOx and NO_2, a worst case scenario has been applied in that 35% of NO_x is presented as NO_2 in relation to short term impacts and 70% of NO_x is present as NO_2 in relation to long term impacts. As a result of this 'worst case' approach, no further sensitivity assessment is considered to be required.

7.3 Variation in Emission Rates

The emission rates applied in this assessment are the applicable daily average WID emission limits; the variability of emissions from MSW EfW processes, typical operating hours, half-hourly WID emission limits and the variability of partition of metals is discussed in the following sections.

7.3.1 Typical MSW EfW Emissions

The emissions to air from EfW plants are designed to ensure compliance with the requirement of the WID and achieve significantly lower emission for the majority of pollutants. Therefore on this basis, it can be concluded that actual impacts are likely to lower than modelled for this assessment.

7.3.2 Accident Scenarios (Abnormal Events)

The WID does allow for abnormal operating conditions (Article 13), under very limited conditions relating to short-term disturbance or failure of the FGT or continuous emission monitoring equipment. Under such abnormal operating conditions, waste feed to the plant must be stopped (article 6(3)) and the plant is required to cease the incineration of waste as soon as practicable, within an absolute maximum timeframe 4 hours.

During these abnormal operating conditions emission limits still apply in relation to dust (150mg/m^3 as a half-hourly average) and the WID emission limits for TOC and CO. Such abnormal operating conditions are only allowed to occur for 60-hours per year per line. For these reasons it is not considered realistic to model these abnormal (event driven emissions).

7.3.3 Short Term Emissions

In addition to the daily average emission limits assessed in the main text of this report, the WID also stipulates half-hourly emission limit values (97^{th} percentile) as presented in Table 2-5. In theory this means that emissions can be at these elevated values for 3% of the time as long as compliance with the daily average values are still achieved.

To ensure a robust assessment is carried out, the significance of the half-hourly emission limits have been investigated for NO_2, SO_2, TOC, HCl and HF. This has not been investigated for PM_{10} or CO as the short term air quality standard for PM_{10} and CO are based on a 24-hr and 8-hr periods, and would not be affected by the half-hourly WID limit.

The results are presented below, it should be noted that these are peak impact which assume that the half-hourly limits are met for a whole hour and that this coincides with the worst possible weather conditions for dispersion. Even under this unlikely scenario, impacts are below the applicable standards.

Table 7-1
Maximum ground level concentration using 100% Half-hour WID Limits (µg/m^3)

Pollutant	Applied Standard	PC Max	Back-ground	PEC Max	PC Max as % of Standard
NO_2	200	18.5	13.6	32.1	16.0%
SO_2 (15-min)	267	29.4	3.6	33.0	12.4%
SO_2 (1-hr)	350	22.0	3.6	25.6	7.3%
HCl	800	6.8	7.7	14.5	1.8%
HF	250	1.4	1.6	3.0	1.2%
TOC	208	6.7	1.6	8.3	4.0%

7.3.4 Annual Operating Hours

A typical EfW line requires a minimum of 3-weeks shutdown fro maintenance per year, therefore operational hours will never be in excess of 8256 hours and in the UK typically achieve between 8000 and 8200 operational hours per annum.

Therefore on this basis, it can be concluded that actual long-term (annual) emissions, (and resultant impacts) are likely to between 5.7% and 8.6% lower than modelled for this assessment.

7.3.5 Variation in Heavy Metal Partitioning

As discussed previously in Section 5.2.1, the metals in Groups 1 & 3 have been split on the basis of monitoring data, as is the standard practice in the UK. It is however acknowledged that a true 'worst-case' scenario would be that only 1 metal (that with the lowest EAL) is emitted, at the WID emission limit for group.

This scenario has been investigated in relation to Cadmium in Group 1 and for Chromium (VI) in Group 3, which have the respective lowest short-term and long-term EALs. For Cadmium, it has been assumed that 100% of the group consists of this metal. For Chromium, it has been assumed that 50% of the group consists of this metal given that the group consists of 9 metals total and it would be unrealistic to consider any one as 100% of the group. The results are summarised below, which indicate that even under this unlikely scenario, impacts are still a small proportion of the applicable standards.

Table 7-2
Predicted Worst-case Metal Impacts (PC) (µg/m^3)

Pollutant	Av. Period	Applied Standard	PC	Max PC as % of Standard
		Short Term		
Cadmium	1 hour max	1.5	0.0168	1.12%
Chromium (III)	1 hour max	150	0.0675	0.05%
Chromium (VI)	1 hour max	3	0.0075	0.25%
		Long Term		
Cadmium	annual	0.005	1.48E-05	0.30%
Chromium (III)	annual	5.00	0.00060	0.01%
Chromium (VI)	annual	0.0002	0.00007	33.51%

7.4 Assessment of Model Sensitivities

In order to investigate the sensitivity of the dispersion model to variation in the remaining critical input parameters detailed previously, the following scenarios were investigated:

- Sensitivity 0 - Baseline;
- Sensitivity 1 - Met Data: Filton Met Data used;
- Sensitivity 2 - Met Data Preparation: Urban Roughness
- Sensitivity 3 - Met Data Preparation: Water Roughness
- Sensitivity 4 - decreased velocity (75% of Sc0). All other parameters unchanged.;
- Sensitivity 5 - increased velocity (125% of Sc0) All other parameters unchanged.;
- Sensitivity 6 - temperature reduced by 30ºC (to 110 ºC) All other parameters unchanged;
- Sensitivity 7 - temperature increased by 30ºC (to 170 ºC) All other parameters unchanged;
- Sensitivity 8 – Flat terrain;
- Sensitivity 9 – No buildings;

These model sensitivity assessments were assessed using meteorological data from 2004, results are summarised in Table 7-3.

Table 7-3
Results of Model Sensitivity Assessment

Scenario	Peak ST NO_2	% of Sc0 ($\mu g/m^3$)	Peak LT NO_2	% of Sc0 ($\mu g/m^3$)
0	10.52	100%	0.39	100%
1	16.35	155%	0.70	181%
2	4.42	42%	0.58	150%
3	13.78	131%	0.46	118%
4	12.26	117%	0.44	114%
5	10.14	96%	0.35	90%
6	11.37	108%	0.42	107%
7	10.62	101%	0.37	95%
8	4.24	40%	0.44	114%
9	12.54	119%	0.33	85%

The sensitivity modelling results show that the greatest influence tested is due to the meteorological data, in this case substituting Filton Airport for Plymouth Mountbatten. Scenario 8 demonstrates the strong influence of terrain in the region of the New England Quarry EfW on short term impacts.

On the basis of the results, none of the variations in the parameters investigated result is a material change to the conclusions, i.e. that the impact of the New England Quarry EfW does not lead to any breach of the NO_2 objectives. The range of influence may also be applied across all other pollutants, albeit the differences associated with percentiles and averaging periods must be considered.

7.5 Cumulative Impacts

As discussed in section 3.1.1. potential cumulative impacts associated with the following sites have been identified during scoping:

- operation of the Centrica operated Langage Power Station, commissioned in September 2009.
- Operation of the Hemerdon quarry, owned by Wolf Minerals; and
- Langage Farm Anaerobic Digestion Plant.

7.5.1 Langage Power Station

The Langage Power Station, on the eastern outskirts of Plymouth, is an 885 MW CCGT (Combined cycle gas turbine) plant for which planning permission was granted in 2000. The facility is being commissioned at the time of writing (October 2009). The Environment Agency has provided the detailed dispersion modelling undertaken in support of the Permit Application for the power station.

The detailed dispersion modelling undertaken in support of the Permit Application for the power station indicates that, despite the extremely large volume flows emitted, the low concentrations of the exhaust ensure that all impacts from the power station are significantly below relevant limits. It is for this reason that the Power Station was granted a Permit.

This data has been used to construct a cumulative impacts sensitivity model. Model 0 as described in section 7.4 above has been used for the basis of this sensitivity model, although a larger modelling grid (20km x 20km at 100m spacing) has been used to ensure that peak ground level impacts have been assessed. The model has been constructed without buildings as it is not possible to derive building width, lengths or orientations from the dispersion modelling report as provided by the Environment Agency. Notwithstanding the simplifications above, it is considered that the cumulative modelling provides an indicative guide to the cumulative impact from the facilities given the available information. The Langage facility has been modelled on the basis of gas firing, to ensure consistency with the other model. The model inputs are shown below:

Table 7-4
Emissions from Langage

Parameter / Source	Value
Stack Location NGR (x,y)	257190,56146
Stack Diameter (m, per flue)	6.87
Basal Stack Elevation (m AOD)	90
Stack Exhaust Height (m)	65
NOx flow rate (g/s, total, 2 flues)	48.6
Emission Temperature (ºC)	79
Actual Flow Rate (Am^3/s)	926
Emission velocity (m/s)	25.0

The results of the cumulative modelling indicate that the maximum ground level PC from the two sources is:

- 0.58μg/m^3 for annual average NO_2 (assuming 70% NOx conversion). This impact is predicted at OS GR 257700, 57164. This is to the north east of the Langage Power Station, where impact from the New England Quarry EfW is predicted to be less than 0.1μg/m^3.
- 14.93μg/m^3 for hourly average NO_2 (assuming 35% NOx conversion). This impact is predicted at OS GR 260500, 61364. This is on the higher ground (248.5m AoD) at Hillsons Brake to the north east of the EfW. The impact attributable to the New England Quarry EfW is predicted to be 0.97μg/m^3 at this location, with the impact attributable to the Power Station at 14.91μg/m^3. [It is important to note that these contribution figures do not add up because the 99.79th percentile has been applied for each impact individually and then for the cumulative model].

In conclusion, the cumulative NOx impact of the Langage Power station and the New England Quarry EfW does not make a material difference to the conclusions of this report, in that the maximum ground level impact of the two plants would be at differing locations as would be expected given that they are over 2.7km from each other. Impacts for other pollutants are predicted to be similarly small and the risk of exceedance of any EAL as a result of a cumulative impact from the two schemes is negligible.

7.5.2 Hemerdon Quarry

Hemerdon is one of the largest tungsten and tin resources in the western world. Hemerdon is located in the South West of England near Plympton in Devon and lies to the north of the villages of Sparkwell and Hemerdon adjacent to large Imerys china clay pits.

The Wolf Minerals website indicates that the intention is to commence mining operations in September 2010.

During the public exhibitions, the possibility of emissions of sulphur dioxide from the ore crushing process was raised. Having considered the planning review and available documentation, we consider that there is no evidence to suggest that cumulative emissions of sulphur dioxide from the quarry and the proposed EfW would lead to a breach of the air quality standards for this pollutant.

7.5.3 Langage Farm Anaerobic Digestion Plant

It is understood that this scheme is a small scale AD facility, intended to provide heat and power to the yoghurt making operations at the farm. This facility is designed to handle 12800 tonnes per annum of waste:

- source separated municipal kitchen waste (catering waste) 8,000;
- cattle slurry (Langage herd) 3,000;
- maize and grass silage 1,000;
- Whey waste 300; and
- Milk rich factory waste 500.

The generation is only 0.1MWe. It is considered that no cumulative modelling is required.

7.6 NOx Backgrounds

The NOx monitoring undertaken by SLR demonstrates that, as would be expected for a generally rural area intersected by a major trunk road, levels of NO_x and NO_2 vary significantly within the region. Although it is considered best practice to derive a general background level for modelling on industrial sources (in accordance with EP H1, for example), it may be appropriate to consider other sites where the source contribution is significant. In the case of properties very close to the A38, any significant additional contribution could result in requirement for an AQMA declaration, for example.

In this case, the maximum ground level impact of NO_2 attributable to the New England EfW stack emissions is insignificant, at 0.94% of the long term objective for this pollutant. Therefore, no further consideration of localised background levels is required.