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Atmospheric Dispersion Modelling Assessment of Proposed Emissions from

Enviroparks Wales Ltd
Hirwaun Industrial Estate
Aberdare

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Executive Summary

Enviroparks Wales Ltd (EWL) has planning consent for the development of an eco-park at their site in Hirwaun, South Wales. Since the original consent was granted (2010), the technologies to be employed at the site have changed, and EWL now plan to install three gasifier lines which will each treat Refuse Derived Fuel (RDF) to create energy in a single turbine. As the processes to be installed at the site have changed, EWL has commissioned a dispersion modelling assessment of the likely emissions to atmosphere from the proposed plant, which will inform an Addendum to the original Environmental Statement (ES Addendum), to be submitted with an application to amend the current planning consent. This assessment has been prepared by Environmental Visage Limited (Envisage), and considers the likely regulated releases from the three main gasification units.

Where appropriate, results of the modelling exercise have been compared with the current Air Quality Standards and Objectives, or, to the relevant Environmental Assessment Level (EAL), collectively referred to as Environmental Quality Standards (EQS).

In summary, the results of the modelling exercise have demonstrated that, with often reduced emissions and an increased stack height from 40 m to 45 m, the potential impact of the emissions from the plant now proposed for the Enviroparks facility are acceptable. The process contributions of several species reduce from the original scheme and earlier modelling, and while some do increase, these are generally screened as insignificant at the primary or secondary screening stage. Where this is not the case, that is for emissions of Nitrogen Dioxide, contributions are in fact lower than those currently consented and hence, in this case, the revised scheme can be seen as having a beneficial effect.

Process contributions to local sensitive receptors can often be screened as insignificant, either during a primary or secondary assessment. Although this is not necessarily the case for some specific potential deposits at the Blaen Cynon and Cwm Cadlan Special Protection Areas or the Dwr Cymru Penderyn Reservoir and service reservoir, the contributions from the proposed Enviroparks site are much less significant than the current background levels and / or the potential impact of deposition should the air quality be at the nationally accepted Air Quality Standards.

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1. Introduction

Enviroparks Wales Ltd (EWL) are in the process of developing a site on the Hirwaun Industrial Estate in Hirwaun, Aberdare. The company plans to operate a resource recovery and energy production plant using the concept of integrated technologies to extract recyclables from the incoming waste stream, and to create a Refuse Derived Fuel (RDF) for use in an advanced thermal treatment process. The site will include three gasification lines which will each serve a single site electricity generating turbine.

The proposed development ensures maximum efficiency by sorting the feedstock materials that arrive at the site to extract recyclable materials, before preparing the remaining feedstock for gasification. Some of the energy produced by the site will be used by a 'high energy user' – a manufacturing facility with high energy needs, occupying an industrial unit proposed in the northern part of the site, with the remainder being exported to the grid.

Point source emissions to atmosphere include three gasification flue discharge points which are all located within a single chimney stack, now proposed at 45 m high. Other releases of warm air will occur across the site, including from air cooled condensers, and building ventilation. Consideration has been given to all release points across the site, although pollutant emissions are only associated with the gasification line releases. Consideration has also been given to the cumulative effects of other, third party plant in the area which are planned but not yet, or only recently in-situ.

This report details the modelling work undertaken, and presents the findings of the study.

2. Principal Objectives and Scope of Work

The principal aim of the work undertaken was to determine the nature of the dispersion of air borne pollutants from the proposed EWL site, in order to predict the environmental impact of the development on the surrounding area. As the site already holds planning consent for the operations originally proposed by the Company, the key concern of this study is to identify where differences exist in the dispersion of emissions now proposed, from those previously considered. The local area includes a number of sensitive receptors including the Penderyn Reservoir; Blaen Cynon, Coed Nedd a Mellte, and Cwm Cadlan which are all Special Areas of Conservation (SACs); and a number of Sites of Special Scientific Interest (SSSI), as well as human workplaces and residents. As such, the impact of the proposed operations must be sufficiently small to ensure the continued protection of human health, and the protection of sensitive ecological sites.

The only definitive means of quantifying the impact of process emissions on air quality and the surrounding area is to undertake a comprehensive programme of environmental monitoring around the site in question. As an alternative, atmospheric dispersion modelling provides a means of estimating the potential impacts of emissions with a reasonable degree of confidence, by modelling the dispersion of a plume or plumes exiting a chimney in relation to a number of key parameters. This enables the calculation of an estimated contribution to ground level pollutant concentrations arising from the releases, prior to the development of new, or modification of existing plant.

For the purpose of this study, the latest version of the UK Atmospheric Dispersion Modelling System was used (ADMS 5.2). The ADMS model is one of the leading atmospheric dispersion models available in the UK and can be used to assess ambient pollutant concentrations from a wide variety of emissions sources associated with an industrial installation.

3. Study Parameters

Details of the release characteristics to be considered were supplied by the Enviroparks design team and have their base in the maximum allowable emission limits which will be imposed on the site operations. These are taken from Annex VI (Technical provisions relating to waste incineration plants and waste co-incineration plants) of the Industrial Emissions Directive (Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on Industrial Emissions (Integrated Pollution Prevention and Control) (Recast)).

Modelling a proposed site which is not yet built and operational enables full consideration to be given to the potential for dispersion, and thus enables the design of the chimney structure and process equipment to take the results of the modelling work into account. It does however also mean that all of the input data is calculated rather than being drawn from actual measured values, and some additional assumptions may also have to be made.

3.1 Emission Parameters

The main pollutant releases will comprise three discharge flues, each serving a single gasification Line (1 – 3). These will be housed within a single chimney stack, and will be referred to as A1 – A3. The characteristics of the individual release points and the pollutant parameters to be modelled are presented in Tables 1 to 3.

Table 1 Stack Central Grid References, Enviroparks Wales Limited

Gasifier Line Number	Reference Number	Grid Reference	
		X (m)	Y (m)
Gasifier 1	A1	293843	206822
Gasifier 2	A2	293843	206819
Gasifier 3	A3	293846	206820

Table 2 Emission Point Parameters, Enviroparks Wales Limited

Release Points A1 – A3	Stack Design Data
Internal Flue Diameter (m)	1
Stack Height (m)	45
Temperature of Release (K)	428
Actual Flow Rate (Am^3/s at 6 % Oxygen)	15.9
Emission Velocity at Stack Exit (m/s)	20.2

Table 3 Modelled Emissions to Atmosphere, Enviroparks Wales Limited

Emission Concentration (Daily Average)	Maximum Emissions (IED Limit)			Estimated Likely Emissions		
	At 11 % O_2 (mg/Nm^3)	Emissions at stack Conditions	A1, A2, and A3 Release Rate (g/s)	At 11 % O_2 (mg/Nm^3)	Emissions at stack Conditions	A1, A2, and A3 Release Rate (g/s)
PM_{10}	10	8.23	0.1308	3	2.47	0.0392
$PM_{2.5}$ (assumed to be the same as PM_{10})	10	8.23	0.1308	3	2.47	0.0392
VOC	10	8.23	0.1308	2	1.65	0.0262
HCl	10	8.23	0.1308	7	5.76	0.0916
HF	1	0.82	0.0131	0.4	0.33	0.0052
CO	50	41.14	0.6541	5	4.11	0.0654
SO_2	50	41.14	0.6541	10	8.23	0.1308
NO_x	200	164.54	2.6162	150	123.41	1.9622
Group I (Cd, Tl)	0.05	0.04	0.0007	0.005	0.0041	0.0001
Group II (Hg)	0.05	0.04	0.0007	0.005	0.0041	0.0001
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.5	0.41	0.0065	0.05	0.041	0.0007
Dioxins and Furans (2,3,7,8 TCDD TEQ)	1 x 10-7	8.23E-08	1.31E-09	1 x 10-8	8.23E-09	1.31E-10
Ammonia (NH3 slip)	10	8.227	0.1308	10	8.227	0.1308
PAHs (as B[a]P)	0.001	0.0008	0.000013	0.001	0.0008	0.000013
PCB	0.005	0.0041	0.000065	0.005	0.0041	0.000065

Emissions of Oxides of Sulphur are assumed to consist wholly of Sulphur Dioxide.
No information on emissions of fine particulate matter ($PM_{2.5}$) were specified by the technology providers. Emissions of $PM_{2.5}$ have therefore been assumed to be identical to PM_{10}, although this is likely to result in an over-estimate.

Emissions concentration data was provided as per the Industrial Emissions Directive reference conditions, although was input into the model, along with details of the emission flow rate at stack conditions, or as measured temperature, pressure, moisture and 6 % Oxygen. Hence, the corrected concentration appears to suggest a lower discharge than the maximum Industrial Emissions Directive limit, but results in the same mass release (g/s) as the discharge at the reference conditions specified in the Directive.

The mass release of emissions from the gasifiers differs from that considered in studies from 2008 and 2009, and reduces for several species. In summary, the maximum mass emission of particulate (as PM_{10}), VOC, CO and NO_x reduce from the earlier scheme, whereas SO_2, HCl, HF, all metals and dioxins increase slightly. Ammonia, $PM_{2.5}$, PAH, and PCBs were not modelled previously. When considering the estimated likely emissions, which are generally lower than the limit values specified in the Industrial Emissions Directive, only the mass release of HCl remains higher with the revised scheme than when modelled previously, although only the limit values were previously modelled.

Emissions of Oxides of Nitrogen (NO_x) will comprise contributions of Nitric Oxide (NO) and Nitrogen Dioxide (NO_2). Air quality assessments are made against the concentration of NO_2. As emissions of NO_2 are only ever a proportion of the total emissions of NO_x, an allowance for the NO_2 proportion of NO_x has to be made. Historically, the recommendation has been that initial assessments consider 100 % NO_x as NO_2, before the following calculations are applied to determine the likely contributions of NO_2 to the total:

- Long term NO_2 (e.g. annual averaging period) = NO_x * 0.7 + background;
- Short term NO_2 (e.g. hourly averaging period) = NO_x * 0.35 + (background * 2).

In current risk assessment guidance[(1)] (https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit) consideration of NO_2 is recommended to include:

- Short-term process contributions (PC) and predicted environmental concentrations (PEC), assume only 50% of emissions of NO_x convert to NO_2 in the environment;
- Long-term process contributions and predicted environmental concentrations assume all NO_x convert to NO_2.

This is more in line with the approach proposed by Professor Duncan Laxen and Dr Ben Marner of Air Quality Consultants[(2)], which confirms that, close to a source it is usual for the proportion of NO_2 in NO_x from industrial sources to be lower than the proportion of NO. As such, they identify an assumption of 50 % NO_2 in NO_x release as being a robust approach. It is still considered appropriate to apply twice the long-term background concentration as the short-term background.

Table 3 in Appendix A provides results for each of the NO_2 assessment methodologies detailed above.

Laxen and Marner also identify that NO does not deposit at a significant rate and that, during the course of their study, which considered sites detailed in the Bournemouth, Dorset and Poole Waste Local Plan, in close proximity to SACs, wet deposition could be ignored. Wet deposition was not included in the Laxen and Marner study as it was considered that this would be restricted to wash-out or below cloud scavenging. For this to occur, Laxen and Marner point out that the rain droplets must come into contact with the gas molecules before they hit the ground, and as falling raindrops displace the air around them, they effectively push the gases away. Coupled with the low solubility of NO_2 and NO, the effects of wet deposition were considered negligible.

This corresponds with deposition information from CERC, the company which developed the ADMS model, and which has confirmed that for SO_2, NO_2, and NH_3, wet deposition from a short-range plume is much less significant compared with dry deposition, and therefore does not usually need to be considered. Wet deposition due to a primary release of Sulphur Trioxide or Sulphuric Acid would need to be considered if the release were significant, however this does not apply in this instance.

Rates of dry deposition were included where these could be estimated and are based on the following parameters identified by CERC:

Dry deposition velocity for NO_2: 0.0015 m/s for short vegetation and 0.003 m/s for forest.
Dry deposition velocity for SO_2: 0.012 m/s for short vegetation and 0.024 m/s for forest.
Dry deposition velocity for HCl: 0.025 m/s for short vegetation and 0.06 m/s for forest.
Dry deposition velocity for NH_3: 0.02 m/s for short vegetation.

On the basis that the area surrounding the Enviroparks site is a mixture of short vegetation with trees and areas of woodland and forest locally, the following dry deposition rates were included in the assessment:

NO_2: 0.002 m/s; SO_2: 0.016 m/s; HCl: 0.037 m/s; NH_3: 0.03 m/s.

Where a dry deposition velocity could not be specified, pollutants are identified as reactive or un-reactive depending on whether or not the gas will undergo a significant chemical reaction with the surface of the ground. Hydrogen Fluoride was assumed to be reactive, whereas all other pollutants were assumed to be unreactive. Although some volatile organic compounds would be considered to be reactive, Benzene has a low solubility and hence was assumed to be a less reactive compound.

Where different pollutants are listed together, the emission stated is the total release of all of the specified pollutants. For example, the release of emissions of Cadmium and Thallium from each gasifier flue are in combination, not 0.0007 g/s Cadmium and 0.0007 g/s Thallium. Where the resultant concentrations of these pollutants are reported in Appendix A, the concentration stated is the total pollutant level of the group, and not the pollutant concentration of any one of the substances, unless otherwise calculated and stated as such.

The chosen pollutant parameters and discharge concentrations have been prepared with full consideration of the likely regulatory limits that will be imposed on the discharges, and therefore represent the emission limit values specified in Annex VI of the Industrial Emissions Directive. Background concentrations of pollution have been included within the assessment where these are available in order that the new ground level concentration of each pollutant, can be assessed. By including a background concentration of pollution, existing facilities in the area are accounted for by the modelling exercise, although it is noted that a number of newer installations are expected in the vicinity of the Enviroparks site in due course, and the cumulative effect of these has also been considered by the modelling assessment.

Background data was sourced from the UK Air Quality Archive (https://uk-air.defra.gov.uk)[(3)], which provides estimates of background levels of pollution across the country. Data from the heavy metals monitoring network, which consists of a number of rural, urban and industrial monitoring sites around the country, have been taken from the Pontardawe Brecon Road (urban background) site. Where more than one source of data is available, the background data considered to be most appropriate has been applied within the study and is highlighted in Table 4.

During the pre-application consultation period, Natural Resource Wales noted that the Air Pollution Information System (www.apis.ac.uk)[(4)] reports a local Ammonia background concentration of 0.64 µg m^{-3} and hence, this figure has now been applied as the background to ensure a robust assessment.

Table 4 Background Pollutant Concentrations Applied in the Enviroparks Study

Pollutant	Pollution Maps Data	Measured Network Data
NO_x as NO_2 (µg m^{-3}) 2016	8.692	
PM_{10} (µg m^{-3}) 2016	13.157	
$PM_{2.5}$ (µg m^{-3}) 2016	9.335	
SO_2 (µg m^{-3}) 2001	2.79	
CO (mg m^{-3}) 2016	0.095	
Benzene (µg m^{-3}) 2016	0.207	
Mercury (ng m^{-3}) - 2013		0.0217 (Mercury in PM10)
Cadmium (ng m^{-3}) – 2015		0.155 (Heavy Metals)
Arsenic (µg m^{-3}) – 2015		0.00104 (Heavy Metals)
Chromium (µg m^{-3}) – 2015		0.0199 (Heavy Metals)
Cobalt (µg m^{-3}) – 2015		0.00024 (Heavy Metals)
Copper (µg m^{-3}) – 2015		0.0050 (Heavy Metals)
Lead (µg m^{-3}) – 2015		0.00643 (Heavy Metals)
Manganese (µg m^{-3}) – 2015		0.00357 (Heavy Metals)
Nickel (µg m^{-3}) – 2015		0.00923 (Heavy Metals)
Vanadium (µg m^{-3}) – 2015		0.000654 (Heavy Metals)
Ammonia (µg m^{-3}) 2015	**0.64***	0.299 (National Ammonia)
Hydrogen Chloride (µg m^{-3}) Dec 2014 - Nov 2015		0.262 (Acid Gas and Aerosol)
PAH (ng m-3) 2015		0.188 (PAH)
PCBs (pg m-3) 2015		46.2 (TOMPS)
Dioxins (fg m-3) 2010		2.76 (TOMPS)

*2016 data as identified by Natural Resources Wales.

Data in Table 4 is presented as the annual average concentrations. As monitoring sites only measure specific pollutants, it is not possible to use a single site for all background data. The data above has been drawn from the following locations:

- Mercury and Heavy Metals data is taken from the Pontardawe Brecon Road, suburban industrial monitoring site.
- National Ammonia data is taken from the Llyn Brianne rural background monitoring site in Wales, the nearest Ammonia monitoring site to the Enviroparks development.
- Acid gas data is taken from the Rosemaund rural background monitoring site in Hereford, the nearest such site to the Enviroparks development.
- PAH data is taken from the Newport urban background monitoring site.
- PCB and Dioxin data is taken from the High Muffles rural background site.

Predicted data taken from the Air Quality Archive Background Pollution Maps, comprise 2016 data for Nitrogen Dioxide and Particulate Matter (PM_{10}), year adjusted 2001 data (to 2016) for Carbon Monoxide and Benzene, and 2001 data for Sulphur Dioxide, as per the instruction in the use of the maps[3]. The chosen data point for the general area background levels to be taken from, is national grid reference 293500 206500, and is representative of the nearest upwind data record from the discharge points.

3.2 Nearby Buildings and Structures

For processes which have a stack or stacks located on top of a building, or adjacent to a tall building, the effect of surrounding structures may need to be taken into account. As a general guide, building downwash problems (where emissions are caught in the turbulent wake of the wind blowing around a building), may occur if the stack height is less than 2.5 times the height of the building upon which it sits. Buildings which sit adjacent to stacks may need to be considered if they are within 5 stack heights of the point of release. Although a stack height of 45 m would suggest minimal impact from the site buildings, the most significant buildings and structures around the site were included in the model to ensure a robust approach. Building shapes must be simplified for incorporation into the ADMS model, and hence a series of shapes denote the site buildings. The data included in the model were obtained from the proposed site plans, and are presented in Table 5.

Table 5 Details of the Building Data Applied to the Enviroparks Study

Building Data	Shape	X	Y	Height	Length	Width
Fuel Preparation	Rectangular	293923	206737	14	36	132
Fuel Storage	Rectangular	293839	206720	16	105	36
Gasifier Building	Rectangular	293846	206774	18.465	77.5	70
High Energy User	Rectangular	293843	206893	14	151.54	61
Biomax Building	Rectangular	293949	206875	14	36.2	64.46

Additionally, sensitivity assessments were made to confirm the influence or otherwise of other site buildings and hot or warm discharge points. Assessments were made by either calculating the potential for each item to impact on the stack releases, or by incorporating physical structures and potential discharges into the modelling. The buildings and discharge points considered are listed in Table 6 below, but had no effect on the results calculated by the model without their inclusion.

Table 6 Details of the Additional Site Structures and Releases Considered Within the Enviroparks Study

Structure / Release	Height (m)	Discharge?	Calculated or Modelled
Chemical Storage Tanks	8.5	No	Calculated
Fire Water Tanks	7.8	No	Calculated
Fire Pumphouse	3.5	No	Calculated
Process Water Tank	8.3	No	Calculated
Towns Water Tank	3	No	Calculated
Water Pumphouse	3.5	No	Calculated
Effluent Treatment Control Kiosk	3.5	No	Calculated
Gas Kiosk	3.5	No	Calculated
Gas Booster Station	3.5	No	Calculated
Diesel Storage Tank	2	No	Calculated
Diesel Generator	2.5	No	Calculated
Visitor Centre	10	No	Calculated
16 x Gasification Building Ventilation Fans	18.9 m	Air at 35 ^{o}C	Modelled
4 x Air Cooled Condenser Fans	15 m	Air at 38.17 ^{o}C	Modelled

3.3 Meteorological Data

One of the key factors affecting the dispersion characteristics of a plume is the height it can gain above the release point, as a result of momentum and buoyancy. The higher the plume rises, the greater the volume of the atmosphere in which it can disperse, and the lower the potential contribution to ground level concentrations of pollutants. This in turn results in a lower potential impact on the environment. Additionally, meteorological conditions affect the dispersion of a plume, and thus the ADMS model uses comprehensive data to determine the impact of the weather on emissions. As a minimum requirement for modelling plume dispersion, details of wind speed, direction, stability conditions and mixing height are required.

A total of five years' worth of meteorological data has been employed in this modelling exercise. The data used has been drawn from the closest suitable meteorological station at Sennybridge, which is situated approximately 35 km North of the subject site, close to Tirabad in Powys. However as approximately 10% of the cloud cover data is missing from that site, additional cloud data has been included from the next most local station at St. Athan (approximately 39 km South of the Enviroparks site). Although some distance from the study site, it is considered that data from Sennybridge is the most appropriate to be used for a site in this location and in the absence of any more local, appropriate data. The latest five years of full data (2011 – 2015) have been applied to the modelling exercise.

During the preparation of the modelling exercises for the original Environmental Statement, a sensitivity analysis was run on the meteorological data used, which also came from Sennybridge. Whilst a prevailing wind from the north or north east was suggested as possibly giving rise to higher pollutant concentrations, the actual measured meteorological data was still deemed to be appropriate. The Sennybridge data is from a relatively local site, and includes data of the prevailing wind direction as well as any other wind direction detected over the course of a year. Manipulating a data set to give a differing prevailing wind direction, was therefore considered to provide a less robust approach to the modelling, unless firm evidence should exist to suggest that the prevailing wind is likely to differ significantly. Additionally, prevailing wind from the south west quarter (as per that from Sennybridge) is most likely to impact on the sensitive receptors in the immediate vicinity of the site, including Cors Bryn-y-Gaer, Woodland Park and the Welsh Water Reservoirs, thereby providing a worst-case scenario for the assessment of this particular site.

Since the original Environmental Statement and from September 2013, Enviroparks have undertaken their own meteorological monitoring for the site using a weather station which they have installed at the Dwr Cymru Welsh Water service reservoir compound. Whilst the information collected is insufficient for use in running the dispersion models, consideration of the average monthly wind directions from this data reveals that over 28 months, a single month (3.6 % of the period) had prevailing winds of south east, south south-east, or east south-east directions, easterly and south south-westerly winds prevailed over two months each (7.1 % of the period each), and winds from the south west, west, and west south-west prevailed generally, accounting for a total of 75 % of the period, with the overall prevailing wind being west south-westerly (39 %).

3.4 Surface Roughness

For the purpose of running the ADMS model, it is necessary to assign a surface roughness figure to the area to be modelled. This describes the degree of ground turbulence caused by the passage of winds across surface structures. The degree of ground turbulence is much greater in urban areas than in rural areas due to the presence of tall buildings increasing the level of turbulence. ADMS requires the selection of a surface roughness factor to be input into the model, or for a complex surface roughness file to be produced to identify different areas of ground turbulence. As most of the site structures will be housed within buildings which have either been input into the model directly, or have been screened as inconsequential for the modelling exercise as detailed in Section 3.2 above, a surface roughness factor of 0.5 was chosen to represent the site and its local area, which is characteristic of parkland or open suburbia.

3.5 Terrain Data

The use of terrain data was considered prior to running the model. Although the necessity of using detailed terrain data can generally be assessed using a screening model which utilises worst-case emission rates to undertake a simplified calculation, and subsequently assessing the results against the relevant air quality standards or environmental assessment levels, it was considered that due to the location of the site, which is situated in the shadow of the Penderyn Reservoir embankment, terrain data would need to be incorporated. Thus, Landform Panorama digital data was included in the model in order to map the terrain local to the Enviroparks site.

3.6 Model Output Parameters

The ADMS 5.2 model calculates the likely contribution to ground level concentrations within a definable grid system, which is pre-determined by the user. For the purpose of this study a Cartesian co-ordinate grid system was chosen, to cover an area of 5 square km, with a point representing the emission points identified at the approximate centre of the grid. The Cartesian style grid has regular, pre-defined increments in both northerly and easterly directions from the specified bottom left corner of the grid, and ground level concentrations are specified at the intersections of these grid lines. Each grid modelled was based on a 100 x 100-point system, giving a total of 10,000 points (or intersections) across the grid, or a result at every 50 m. The use of the grid in this way aids the generation of pollutant contours.

A selection of points have also been included in the model to represent sensitive receptors in the area, and consideration of the requirements of the Part IV of the Environment Act 1995: Local Air Quality Management Technical Guidance LAQM.TG(16)[(5)], was made in choosing these receptors. With regards to air quality for human health, this states that an assessment of the quality of the air should be made at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present.

Additionally, other key areas have been included, such as the Dwr Cymru service reservoir located close to the site, which is covered but which would draw air in from the local environment as the reservoir empties, and sensitive ecological receptors such as Special Areas of Conservation or Sites of Special Scientific Interest, where these are located within 10 km of the site. It should be noted, that although only a selection of receptors has been chosen, such as key commercial or residential sites, or a single grid reference to represent a sensitive ecological area, the purpose of the Cartesian grid is to comprehensively model the pollutant dispersion across a designated area, and thus other residential properties within the 5 km^2 modelled grid, and the wider industrial estate are considered by the model. The concentration contour plots presented in the Figures at the end of this report demonstrate the process contribution of pollutants to the local area.

Details of the sensitive receptors included in this study are presented in Table 7, and the models have considered both the contribution to the ground level concentration of each pollutant, and the dry deposition of pollutants across the grid and at the receptor locations.

During initial modelling, it was noted that due to the location of some of the sensitive receptors being outside of the gridded area, small differences in some results could be observed when running the grid and receptors within a single model, or when running the models separately. An investigation by CERC identified that this was due to the larger plot area identified to include the receptors resulting in more instances of terrain induced recirculation, for which the model cannot assess building effects. This meant that for some pollutants during some averaging periods and with some years of meteorological conditions, the results could be marginally different if the grid and receptor runs were modelled separately. For completeness therefore, this issue of the report includes updated figures which have been obtained by re-running all of the models as individual grid or receptor assessments. It is noted here that the revised results do not impact on the overall conclusions of the assessment.

The output for the model was set as 'long term', which provides a single concentration averaged over all of the lines of meteorological data, for each point on the grid, that is, providing an annual average concentration for each pollutant at each grid point or receptor. Pollutants were modelled over 15 minute, 1 hour, 8-hour (rolling), or 24-hour averaging periods, in line with their respective air quality limits, as presented in Table 8. Additionally, percentile concentrations were calculated to demonstrate the worst predicted contribution to ground level concentrations (the 100th percentile), minus any allowable exceedances (other percentile values). In running the model this way, all lines of meteorological data are considered in the calculations, and any allowable number of exceedances can be taken into account. Where the model output is set as 'short term', only the first 24 lines of the meteorological file are considered (that is, data for 1st January on any given year), and the model cannot give consideration to any relevant percentile values.

Part IV of The Environment Act 1995 sets provisions for protecting air quality in the UK and for local air quality management. The Air Quality Standards (Wales) Regulations 2010[(6)] which came into force on 11 June 2010, implement Directive 2008/50/EC on ambient air quality and cleaner air for Europe, and Directive 2004/107/EC relating to Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in ambient air. The Regulations specify a number of limit values, target values, and objectives for key pollutants, which must be adhered to or aimed at, and where these pollutants are considered by this modelling exercise, the relevant limit, target or objective is summarised in Table 8.

Table 7 Sensitive Receptors Modelled in the Enviroparks Study

Receptor Number	Receptor Name	Grid Reference		Location from Stack	
		X (m)	Y (m)	m	Direction
1	Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294600	206600	787	E
2	Cwm Cadlan SAC	296100	209800	3,736	NNE
3	Coedydd Nedd a Mellte SAC	291900	209300	3,151	N
4	Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	291963	209323	3,131	NW
5	Cwm Gwrelych and Nant Llynfach Streams SSSI	290552	205212	3,665	W
6	Craig-y-Llyn SSSI	291766	203223	4,155	SSW
7	Bryn Bwch SSSI	292056	210947	4,497	NNW
8	Caeau Nant-y-Llechau SSSI	290178	210332	5,077	NW
9	Gweunedd Dyffern Nedd SSSI	291466	211553	5,296	NNW
10	Bryncarnau Grasslands Llwyncoed SSSI	299833	206502	5,996	E
11	Blaenrhondda Road Cutting SSSI	293072	200784	6,086	S
12	Blaen Nedd SSSI	291639	213639	7,166	NNW
13	Ogof Ffynnon Ddu Pant Mawr SSSI	288138	215120	10,072	NNW
14	Caeau Ton-y-Fildre SSSI	286271	210738	8,527	WNW
15	Penmoelallt SSSI	301713	209502	8,312	NE
16	Mynydd Ty-Isaf Rhondda SSSI	292851	196797	10,073	S
17	Plas-y-Gors SSSI	292106	215519	8,870	NNW
18	Daren Fach SSSI	301914	210477	8,859	NE
19	Cwm Glo a Glyndyrys SSSI	303248	205630	9,478	E
20	Waun Ton-y-Spyddaden SSSI	286404	212193	9,178	NW
21	Gorsllwyn Onllwyn SSSI	285408	210752	9,308	W
22	Cwm Taf Fechan Woodlands SSSI	303945	208684	10,270	NE
23	Nant Llech SSSI	283539	212245	11,646	NW
24	Caeau Nant Y Groes SSSI	302833	202232	10,092	SE
25	Tir Mawr A Dderi Hir, Llwydcoed SSSI	298270	206284	4,457	E
26	Penderyn Reservoir	293839	207170	349	N
27	Eden UK	294020	206800	176	E
28	House at Penderyn Reservoir	294100	207270	516	N
29	Ty Newydd Hotel	294600	206940	764	ENE
30	Caer Llwyn Cottage	293253	207151	678	NW
31	Rhombic Farm	292958	206712	894	W
32	Castell Farm	292871	206783	975	W
33	TY Newydd Cottage	294514	207025	699	NE
34	Residence Woodland Park	294824	207560	1,227	NE
35	Pontbren Llwyd School	295057	208264	1,884	NNE
36	Ffynnon Ddu (spring)	292273	208364	2,203	NNW
37	Ton-Y-Gilfach	289565	208712	4,679	NNW
38	Rose Cottage	291284	208150	2,885	NNW
39	The Don Bungalow	291512	207044	2,344	W
40	Werfa Farm	291944	206721	1,904	SW
41	Willows Farm	294129	205879	984	SSE
42	Trebanog Uchaf Farm	294063	207416	634	NE
43	Tai-Cwpla Farm	293519	207024	384	NNW
44	Neuadd Farm	294906	207282	1,157	NE
45	John Street Allotments, Hirwaun	296180	205605	2,633	SE
46	Dwr Cymru Service Reservoir	294068	206939	252	NE

Table 8 Welsh / UK Air Quality Limits, Targets and Objectives for Pollutants Modelled

Pollutant	Objective Concentration	Averaging Period
Nitrogen Dioxide (Limit Value)	200 µg m^{-3} not to be exceeded more than 18 times a year (99.79 percentile)	1 Hour Mean
Nitrogen Dioxide (Limit Value)	40 µg m^{-3}	Calendar Year
Oxides of Nitrogen (Critical level for the protection of vegetation)	30 µg m-3	Calendar Year
Sulphur Dioxide (UK Objective)	266 µg m^{-3} not to be exceeded more than 35 times a year (99.90 percentile)	15 Minute Mean
Sulphur Dioxide (Limit Value)	350 µg m^{-3} not to be exceeded more than 24 times a year (99.73 percentile)	1 Hour Mean
Sulphur Dioxide (Limit Value)	125 µg m^{-3} not to be exceeded more than 3 times a year (99.18 percentile)	1 Day Mean
Sulphur Dioxide (Critical level for the protection of vegetation)	20 µg m-3	Calendar Year
Particulate (PM_{10}) (Limit Value)	50 µg m^{-3} not to be exceeded more than 35 times a year (90.4 percentile)	1 Day Mean
Particulate (PM_{10}) (Limit Value)	40 µg m^{-3}	Calendar Year
Particulate (PM2.5) (Limit Value)	25 µg m-3	Calendar Year
Carbon Monoxide (Limit Value)	10 mg m^{-3}	Maximum Daily 8 Hour Mean
Benzene (Limit Value)*	5 µg m^{-3}	Calendar Year
Lead (Limit Value)	0.5 µg m^{-3}	Calendar Year
Lead (UK Target Value)	0.25 µg m^{-3}	Annual Mean
Arsenic (Target Value)	0.006 µg m^{-3}	Calendar Year
Cadmium (Target Value)	0.005 µg m^{-3}	Calendar Year
Nickel (Target Value)	0.020 µg m^{-3}	Calendar Year

* Benzene limit is applied to VOC emissions in this study.

Air Quality Standards (AQS) are considered to be the relevant Environmental Quality Standards (EQS) when considering the protection of human health and the environment as a whole and are used to define the upper bound concentration of a substance in the environment that is considered tolerable. For pollutants which do not have AQS', the modelling results have been compared to Environmental Assessment Levels (EALs). EALs have been derived by the Environment Agency as provisional benchmarks for substances released to each environmental medium from a variety of published UK and international sources. The Natural Resources Wales website links to these EALs for use in risk assessments, as appropriate EQS levels where no AQS' are available. These benchmarks are relevant to the protection of the environment as a whole, rather than specifically for areas where people may be present in any number or for any defined period.

The EALs for the pollutants considered in this study which do not have an AQS, are presented in Table 9 below:

Table 9 Relevant Assessment Levels for Other Pollutants Modelled

Limit Type	Pollutant	Concentration	Measured As
EAL	Ammonia (Human Health)	180 µg m^{-3}	Annual Average
EAL	Ammonia (Conservation where lichens or bryophytes are present)	1 µg m^{-3}	Annual Average
EAL	Ammonia (Conservation other areas)	3 µg m^{-3}	Annual Average
EAL	Mercury	0.25 µg m^{-3}	Annual Hourly Average
EAL	Hydrogen Chloride	750 µg m^{-3}	Hourly Limit
EAL	Hydrogen Fluoride	160 µg m^{-3}	Hourly Limit
EAL	PAH	1 ng m^{-3}	Annual Mean

3.7 Additional Model Considerations

In addition to the basic model parameters included in the study, consideration has been given to the potential for abatement system failures, and the increases in emissions which could reasonably result over a short period until such time as the operation is shut-down.

Abatement processes include Urea dosing (for control of Oxides of Nitrogen), Lime dosing (for Acid gas control), Activated Carbon dosing (for control of Metals and Dioxins), and bag filtration for the removal of air pollution control residues and other Particulate from the gasification process. As a worst-case scenario, all three gasification lines are assumed to be affected by a failure at any one time. The abatement failure input data is presented in Table 10 below:

Table 10 Abatement Failure Scenarios

Potential Release	At 11 % O_2 (mg/Nm^3)	Emissions at stack Conditions (mg/m^3)	A1, A2, and A3 Release Rate (g/s)
Particulate	150	123.41	1.9622
NOx	305	250.93	3.9898
HCl	160	131.63	2.0930
SO2	79	64.99	1.0334
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	5	4.11	0.0654
Dioxins	3 x 10-7	2.47E-07	3.92E-09

Finally, models were run to consider potential contributions to ground level concentrations of pollutants in the local area due to planned or recently built processes which have the potential to emit the same pollutants as the Enviroparks facility. These include the Green Frog Short Term Operator Reserve (STOR) facility, which has been operational since 2012, the Hirwaun Energy Centre, which is a biomass (wood) fired pyrolysis plant, and the Hirwaun Power facility, all of which are located within the Hirwaun Industrial Estate.

Details of emission points, and discharges were largely taken from the Hirwaun Power Development Consent Order Application documentation[(7)], which also considered the combined effect of these processes and the Enviroparks facility from the original site planning application. The exception to this were the details for the Green Frog STOR, which were confirmed with Green Frog prior to modelling. Although the STOR includes 48 generator discharge points, these have been combined and modelled as a single release for ease of modelling. The emissions from the STOR have been calculated from the maximum annual operating hours of the site (520 hours), which have then been input as a continuous release (over 8,760 hours per year). In reality, the STOR is understood to have thus far operated for approximately 10 hours per year. Emissions from the Hirwaun Power development were however considered differently, being input as continuous releases at the levels identified in the Development Consent Order Application, despite only being operational for a maximum of 1,500 hours per year. This was to maintain consistency with the information available, and to ensure the impact of the Hiwaun Power operation could be fully considered at all times of the year, as it can operate for approximately 1/6th of the year in total. The details included within the models to assess the cumulative effects of these processes are presented in Table 11 over page. Emissions of NO_x are understood to be total NO_x, rather than Nitrogen Dioxide.

Where amendments have been made to the base models to assess the effect of abatement failures, cumulative effects, or other sensitivity analysis or check models, only one year's-worth of meteorological conditions was generally applied to these further assessments. The meteorological conditions experienced in 2015 resulted in the majority of the highest process contribution results from the basic models, and hence this was the meteorological file applied.

Table 11 Local Processes Considered In-Combination with the Enviroparks Facility

Development	Emission Point Number	Grid Reference	Stack Height (m)	Diameter (m)	Temperature (oC)	Discharge Velocity (m/s)	NOx Emission Rate (g/s)	CO Emission Rate (g/s)	SO2 Emission Rate (g/s)	PM_{10} Emission Rate (g/s)
Hirwaun Power	HP A1	293491 206328	30	4.486	479	8.352	6.61	13.23	0	0
	HP A2	293520 206325	30	4.486	479	8.352	6.61	13.23	0	0
	HP A3	293545 206322	30	4.486	479	8.352	6.61	13.23	0	0
	HP A4	293570 206319	30	4.486	479	8.352	6.61	13.23	0	0
	HP A5	293602 206316	30	4.486	479	8.352	6.61	13.23	0	0
Hirwaun Energy Centre	HEC A1 (Pyroliser)	294327 206120	20	0.9	180	19.1	0.0706	0	0.353	0
	HEC A2 (Engine 1)	294330 206124	20	0.55	533	28.5	0.0406	0	0	0
	HEC A3 (Engine 2)	294332 206128	20	0.55	533	28.5	0.0406	0	0	0
	HEC A4 (Engine 3)	294335 206132	20	0.55	533	28.5	0.0406	0	0	0
	HEC A5 (Engine 4)	294338 206136	20	0.55	533	28.5	0.0406	0	0	0
Green Frog STOR	GF A1	293762 206107	2.26	1.38564	550	51	1.591	0	0.114	0.0399

3.8 Modelling Assumptions

In addition to the parameters described in the sections above, some assumptions have had to be made for the modelling study and these are listed below:

- All emissions are assumed to be continuous although operations may not necessarily be running constantly, with for example time for scheduled and un-planned shut downs. Thus, the model can be seen to represent a worst-case as emissions are considered to occur on a 24 hour, 365 days per year basis, whereas in reality, the planned gasifier operations will include up to 4 weeks' shut-down per year.

- Emissions data has been provided by the technology providers. As worst-case emissions concentrations are in line with the anticipated emission limit values which will likely be assigned to the site, these are considered to present a realistic, yet robust assessment. However, the potential for lower emissions discharge does exist, and where these levels can be estimated by the technology providers, they have also been modelled to provide more likely, long-term release details.

- The discharges from the flues have been combined within the model, to account for the fact that emissions from multiple flues within the same stack will effectively act as a single plume with combined source characteristics. Data of the individual sources and emissions were entered into the model, which was then set to calculate the combined source parameters and model all of the Enviroparks flues together as a single source.

- Although a number of wind farms have been constructed in the area or are undergoing construction currently, the potential for modified wind flow field effects on the Enviroparks plume has not been taken into account during this modelling exercise. This is because, although wake effects including velocity deficit and enhanced turbulence are thought to potentially still be noticeable after fifteen turbine diameters downstream of a wind turbine[(8)], and thus within a wind farm it is considered appropriate that turbines are placed at least fifteen turbine diameters apart for a cost-efficient power generation[(9)], the turbine dimeters in the locality are understood to be up to 101 m in diameter, but are located more than 3.5 km from the Enviroparks facility. Therefore, it is considered that, at approximately twice the distance where wake effects can impact on the operation of other turbines, there are unlikely to be significant negative effects on the dispersion of the plume from the Enviroparks site, and hence no further consideration of the local wind farms has been made.

4. Results and Discussion

Tabulated results are presented in Appendix A and consider the process contribution to ground level concentrations of pollutants, and the deposition of pollutants to sensitive infrastructure and ecological receptors.

Appendix A Tables 1 and 2 present the maximum process contribution of each pollutant for each year of meteorological data studied, with the maximum value of each species highlighted. Table 1 presents the results of modelling at the maximum discharge values, and Table 2 presents the results of modelling at the estimated, more likely discharge values.

The process contribution of all pollutants, and the predicted environmental concentrations of the pollutants across the area remain within the Air Quality Standards or Environmental Assessment Levels. This is true whether considering the impact on individual receptors, or the maximum calculated concentration across the modelled grid.

In addition, the impact of a number of pollutants is reduced when considering the current proposal from the original Enviroparks scheme. Process contributions of Oxides of Nitrogen, Sulphur Dioxide, PM_{10}, Carbon Monoxide and Volatile Organic Compounds all reduce from the 2008 / 2009 studies, in part due to reduced emissions, but also due to the proposal to increase the stack height to 45 m.

While the process contributions of all Metals, Hydrogen Chloride, Hydrogen Fluoride, and Dioxins are seen to increase slightly, the short-term averaging periods are most affected, with the annual average contributions of Hydrogen Chloride and Hydrogen Fluoride equating to 0.24 µg/m^3 and 0.024 µg/m^3 during each of the studies.

Appendix A Table 3 presents the estimated contributions of Nitrogen Dioxide from the total Oxides of Nitrogen release. Although various methodologies have been applied as discussed in Section 3.1, only the currently approved methodology, where long-term NO_2 is considered to equate to 100 % NO_x, and short-term NO_2 is 50 % of the total NO_x value, has been applied in further calculations in this study.

The significance or otherwise of the process contributions from these modelled scenarios and worst-case years of data are assessed in Appendix A Table 4, and where available, background concentration data has been included in order to provide the predicted environmental concentration of the pollutants.

An assessment of 'insignificance' can be made by comparing the process contribution, or the predicted environmental concentration (where available), to the relevant Environmental Quality Standard. The link to risk assessment guidance from the Natural Resources Wales website, specifies that, in order to screen out the process contribution of a substance as insignificant:

- the short-term process contribution must be less than 10% of the short-term environmental standard; and
- the long-term process contribution must be less than 1% of the long-term environmental standard.

Appendix A Table 4 demonstrates that, with the exception of the annual average contribution of Sulphur Dioxide when comparing against the Environmental Quality Standard for sensitive vegetation, process contributions of Sulphur Dioxide, Particulate, Carbon Monoxide, Mercury, Hydrogen Chloride, Hydrogen Fluoride, and Ammonia are screened as insignificant in terms of their impact. Where process contributions cannot immediately be screened as insignificant, Natural Resources Wales propose a second stage of screening whereby results which meet both of the following requirements are insignificant:

- the short-term process contribution is less than 20 % of the short-term environmental standards minus twice the long-term background concentration; and
- the long-term predicted environmental concentration is less than 70 % of the long-term environmental standards.

For many of the un-screened emissions, there is no short-term environmental standard to compare against. However, with the exception of Nitrogen Dioxide, all pollutants pass the second stage of the screening, and can therefore be considered as insignificant. The short-term process contribution of Nitrogen Dioxide cannot be screened as it equates to 25.45 % of the short-term Environmental Quality Standard, minus twice the long-term background concentration. However, the contribution is less when considering the proposed revised scheme than previously, where the short-term contribution of NO_2 (60.48 µg/m^3 with NO_2 representing 35 % of NO_x as opposed to 50 % modelled currently), equated to 33.23 % of the short-term Environmental Quality Standard, minus twice the long-term background concentration. Thus, although the process contribution of NO_2 cannot be screened as insignificant at either the primary or secondary stage, the contributions proposed by the revised Enviroparks scheme result in a lower process contribution of Nitrogen Dioxide than the scheme already consented. All pollutants pass the long-term screening for insignificance.

Appendix A Table 5 considers combined pollutants in more detail, dividing them by the number of pollutants considered in each group to estimate the possible impact of each individual species. Although noting that two of the eleven species considered, Thallium and Cobalt, do not have Environmental Quality Standards to make an assessment against, of the remaining nine species, only three, Cadmium, Arsenic, and Nickel are not screened as insignificant using the primary assessment methodology, due to their very low Environmental Quality Standards. However, the predicted environmental concentration of all species remains within 70 % of their Standard.

Appendix A Table 6 considers the potential impacts of abatement system failures. As would be anticipated, the short-term process contributions of pollutants when one or more abatement system fails do increase, and range from approximately 8 % of the short term Environmental Quality Standard where these can be compared (hourly SO_2), 13.4 % for the very short-term 15 minute SO_2, and almost 60 % for the hourly average of NO_x (assuming all NO_x is NO_2). However, all of the predicted environmental concentrations continue to remain within 70 % of the Environmental Quality Standards, and any abatement failure would be identified and attended to immediately, meaning that any elevated release would be for a very short period, and should not have any significant effect on annual average concentrations.

Table 7 in Appendix A summarises the results of models assessing the cumulative effects of other local third party emissions. The process contributions identified as the 'Third Party PC' represent the impact of the Hirwaun Power, Hirwaun Energy, and Green Frog STOR facilities without any contribution from Enviroparks. The 'Total PC' column in the table represents these third-party contributions and the maximum gridded process contribution result for Enviroparks for the same year. This can be considered to present a worst-case assessment of the pollutant concentrations, as the location of maximum contribution from the Enviroparks site does not necessarily coincide with the location of the maximum concentration from the other sources. Using this worst-case assessment, the cumulative impacts of the discharges have been calculated and suggest that the combined process contributions cannot necessarily be screened as insignificant. The predicted environmental concentrations of all pollutants do however remain below 70 % of the relevant standards, with the exception of the hourly results for NO_2 in 2011 which equate to 71.92 % of the Environmental Quality Standard. It must be remembered however, that emissions from Enviroparks are assumed to be discharged at their maximum possible rate, and the maximum impact of this discharge actually occurs approximately 525 m to the north north-east of the point where the maximum impact of the other cumulative releases occurs. It must also be noted that estimates have had to be made as to the releases from the third-party operations, with data drawn from planning documentation, and the Green Frog STOR modelled at its maximum capacity when in reality, it operates for a fraction of this period.

Further models were run by way of a sensitivity analysis, and included emissions from Enviroparks alongside the third-party discharges, and usually resulted in much lower process contributions than were calculated by combining the maximum results. By way of demonstrating the spread of the locations of the maximum contributions, Figure 20 shows the NO_x discharges from the third-party stacks only, whilst Figure 21 shows the Enviroparks release in addition to the third-party discharges. These models used a grid covering a slightly different area than otherwise applied in this study, in order to incorporate the extent of the most significant impacts from all of the discharges. However the grid is still 5 km^2 with intersections at every 50 m. The contour plots indicate that, when modelling all NO_x as NO_2, the maximum combined process contribution is 110 - 120 µg m^{-3} for the third-party discharges alone, and 120 - 140 µg m^{-3} when including the Enviroparks discharges. If this figure is halved to represent short-term NO_2 only, and a short-term background concentration of 17.38 µg m^{-3} is added, the total equates to approximately 39 – 44 % of the Environmental Quality Standard.

Tables 8 – 11 in Appendix A present the process contribution results at sensitive receptors. From this data, Table 12 in Appendix A details the sensitive receptors where process contributions of Oxides of Nitrogen as Nitrogen Dioxide, Volatile Organic Compounds, Ammonia, and Polycyclic Aromatic Hydrocarbons cannot be screened as insignificant when applying the primary screening methodology. As previously, the long-term predicted environmental concentrations of all species remain within 70 % of the Environmental Quality Standards, and with the exception of predicted levels of Ammonia at Cwm Cadlan, represent less than 40 % of the EQS. Although the predicted environmental concentration of Ammonia is approximately 65 % of the EQS at Cwm Cadlan, the process contribution is just 1 %. Similarly, Table 13 in Appendix A details receptors where the process contributions of combined species (Cadmium, Thallium, and Heavy Metals) cannot be screened as insignificant when applying the primary screening methodology, although some are then screened when applying the relevant proportion of the process contribution to individual species. The long-term predicted environmental concentration of all pollutants at all receptors remain within 30 % of the Environmental Quality Standards.

The secondary screening assessment methodology is applied to the short-term process contributions of NO_x and NO_2 in Appendix A Table 14. Process contributions of Nitrogen Dioxide (as 50 % total NO_x) at Eden UK represent 10.8 % of the EQS, against a primary screening insignificance threshold of 10 %, whilst contributions of Nitrogen Dioxide at all other receptors can be screened at this primary stage. However, when applying the secondary screening assessment, process contributions of Nitrogen Dioxide at all receptors can be screened as insignificant. Where total Oxides of Nitrogen are assumed to represent NO_2, the short-term process contributions cannot be screened as insignificant at either Eden UK, or at the neighbouring Dwr Cymru service reservoir.

Due to the ecological sensitivity of the local area, which includes three Special Areas of Conservation (SACs) within 10 km of the site and 22 additional Sites of Special Scientific Interest, further consideration has been given to the potential for impacts on the SACs, where pollutants cannot immediately be screened as insignificant. Appendix A Table 15 considers the maximum likely process contributions of the combined local releases, to the Blaen Cynon, Cwm Cadlan, and Coed Nedd a Mellte SACs. The results demonstrate that the annual average process contributions of NO_x and SO_2 at Blaen Cynon cannot be screened as insignificant against the Environmental Quality Standards for vegetation, with NO_x equating to approximately 10 % of the Standard, and SO_2 representing 2.35 % of the Standard. Similarly, Oxides of Nitrogen cannot be screened as insignificant at Cwm Cadlan, with the contribution representing 2.5 % of the Standard. However, even cumulatively, the contributions to Blaen Cynon are reduced with the proposed Enviroparks scheme and their neighbouring facilities to that already consented for both Oxides of Nitrogen and Sulphur Dioxide. Process contributions of Oxides of Nitrogen to Cwm Cadlan do increase both when modelling the Enviroparks facility alone, or when modelling the cumulative effects of the local facilities, although again, the long-term predicted environmental concentration remains within 30 % of the Environmental Quality Standard.

An assessment of the short term, daily process contribution of Nitrogen Dioxide can be made against the daily target for Oxides of Nitrogen at Conservation sites, which is set at 75 $\mu g/m^3$. Modelling Oxides of Nitrogen as a 24-hour average with meteorological data from 2015 results in a maximum process contribution of 25.62 % of the daily average when considering the combined effects of Enviroparks and other local sites, or 10 % contribution from Enviroparks alone. At Cwm Cadlan and Coed Nedd a Mellte, the process contributions equate to 4.87 % and 5.43 % respectively for the combined process effects, and 1.5 % and 1.3 % contribution from Enviroparks alone. As such, and despite a predicted increase in the contribution of Oxides of Nitrogen to Cwm Cadlan, these can be screened as insignificant at the secondary assessment stage.

Appendix A Tables 16 and 17 consider the potential for Nitrogen and Acid deposition to the SACs. Assessment has consistently been made against the lower end of any identified Critical Loads and, coupled with the fact that the study assumes that the Enviroparks facility is constantly discharging pollutants at the emission limit values which will be applied to the site, this can be considered to represent a worst-case assessment. Deposition of nutrient Nitrogen from deposited concentrations of Oxides of Nitrogen and Ammonia can be screened as insignificant at both Cwm Cadlan and Coed Nedd a Mellte. The deposition at Blaen Cynon is calculated to represent 4.58 % of the lower critical load for nutrient Nitrogen, however, despite the contribution of both Oxides of Nitrogen and Ammonia in the current study, the contributions calculated from the revised scheme appear to be significantly less than those calculated during the original Environmental Statement, which equated to 60.54 % of the lower Critical Load[10]. It is important to note that the presence of Ammonia within the flue gas is a function of the inclusion of Selective Non-Catalytic Reduction techniques to abate emissions of Oxides of Nitrogen. Such abatement was considered for the original scheme but was not included. It is however employed here, as it is considered to represent Best Available Techniques for the gasification technologies now proposed.

It must be noted here that the current assessment has included some variations to the original one, including different deposition rates and combining the discharges of the flues which are in close proximity to one another. All of these variations will impact on the results obtained, and account in part for the significant differences seen in the comparison detailed above. Further modelling during the 2009 study considered combined flues and 50 % of the NO_x being deposited, and equated to a total deposition rate of 0.19 kg N/ha/year. If this figure is doubled to compare roughly with the current assessment, the total rate of nutrient Nitrogen deposition from NO_x would be 0.38 kg/ha/year. This is higher than the deposition of nutrient Nitrogen from NO_x for the proposed scheme (0.16191 kg N/ha/year), but slightly lower than the combined nutrient Nitrogen deposited in total from Oxides of Nitrogen and Ammonia (0.45822 kg N/ha/year). No release of Ammonia was anticipated for the currently consented scheme. If applying these figures to the assessment, the proposed scheme could contribute 78 g nutrient Nitrogen more per hectare per year to the Blaen Cynon SAC than the currently consented scheme, although this assumes that a level of 'Ammonia slip', the release of unreacted Ammonia from the incomplete reaction of the reagent with the flue-gas NO_x, occurs from the gasifiers.

It is also important to note that the current minimum background nutrient Nitrogen deposition identified for the Blaen Cynon site from the UK APIS website (http://www.apis.ac.uk/)[4] is 21.98 kg N/ha/year, which represents approximately 220 % of the lower Critical Load. Additionally, if the National Objective for the protection of vegetation for Oxides of Nitrogen in air (30 µg/m^3) were experienced at any of the sensitive ecological sites, the applied deposition rate would result in approximately 5.75 kg N/ha/year being deposited (assuming a deposition velocity of 0.002 m/s as applied in this study). This represents 57.5 % of the lower Critical Load at Blaen Cynon and such air quality could reasonably be experienced anywhere in the UK as an annual mean with no question as to the impact on human health or vegetation. Therefore, the predicted emissions from the proposed Enviroparks site are much less significant at the Blaen Cynon site than either the current background levels of nutrient Nitrogen, or the potential impact of the nationally accepted Objective for the protection of vegetation.

Contributions of total Acid deposition also exceed 1 % of the EQS at both Blaen Cynon and Cwm Cadlan. Where Oxides of Nitrogen continue to assume 100 % contribution, the process contributions to the lower Critical Loads at these sites are 9.8 and 3.5 % respectively. Where 50 % of the total NO_x is considered to be deposited as NO_2 (because Nitric Oxide does not deposit at a significant rate), these contributions reduce to 9.3 % and 3.3 %. Whilst the contribution of total Acid deposition at Blaen Cynon, Cwm Cadlan, and Coed Nedd a Mellte have increased from earlier studies, largely due to the assumed contribution of Ammonia, the Critical Loads applied in the current study have also changed. At Coed Nedd a Mellte, the process contribution remains below 1 % of the lower Critical Load. At Blaen Cynon, where the combined lower Critical Load is believed to be 1.018 kg eq/ha/year, the percentage contribution has reduced on previous studies where a more stringent lower Critical Load was applied (0.35 kg eq/ha/year).

However, at Cwm Cadlan, the opposite is true, with a higher contribution and a more stringent Critical Load now predicting a process contribution of up to 3.5 % of the total Acid loading. However, as in the assessment of nutrient Nitrogen deposition, the background concentrations already experienced by the sensitive ecological receptors are understood to be by far the main contributor to deposition at the sites, with the background Acid deposition at Coed Nedd a Mellte already constituting 133 % of the Critical Load, 206 % at Blaen Cynon, and 232 % at Cwm Cadlan. Therefore, the predicted emissions from the proposed Enviroparks site are much less significant than the current background levels, and as the modelled pollutant concentrations in air are well within the Environmental Quality Standards, they also remain much less significant than potential contributions which could occur from the nationally accepted Air Quality Objectives for the protection of vegetation.

When considering the combined impact of the Enviroparks development with potential deposition from other new and prospective local sources, the contributions of nitrogen and acid deposition do increase, as detailed in Table 18. However, the basic conclusion remains the same, with the process contributions remaining well within the critical loads, and by far the majority of any impact already being observed in the background deposition values. Copies of the Critical Load charts for the cumulative acid deposition rates are presented as Figures 22 – 24.

Finally, an assessment has been made of the potential impact of emissions on the Penderyn Reservoir, and the Dwr Cymru service reservoir, which comprise two critical infrastructure items. Previous detailed studies provided to Dwr Cymru Welsh Water highlighted that compliance with the air quality objectives ensures that the majority of releases are incapable of putting the quality of the water either within or transferred from the Penderyn Reservoir system, at risk.

A number of species were however, potentially more significant than others, and these were Nitrite, Benzene, Fluoride, Mercury, and Antimony. Changes to the available Environmental Quality Standards would now incorporate Chloride into this list, based on a 750 µg/m^3 hourly limit of HCl (assumed as an annual contribution). Hence by further modelling the releases anticipated from the plant, which are substantially less than those required for compliance with the Air Quality Standards or Environmental Quality Standards, each of these substances is seen to present no substantive risk to the reservoir and its systems (see Table 19). Annual contributions of Nitrite, Benzene, Chloride, Fluoride, Mercury and Antimony to the Penderyn Reservoir and in each volume of the Dwr Cymru service reservoir are calculated, and for all species except Nitrite are calculated to contribute less than 1 % of the Water Quality Standard[(11)]. The contribution of Nitrite is a little over 4 % when modelling the Enviroparks facility in isolation, and approximately 7.33 % of the Water Quality Standard when considering the cumulative contributions of other local sources. This assumes that all of the deposited NO_x is Nitric Oxide, and suggests a higher level of Nitrite than if all of the NO_x were modelled as Nitrogen dioxide. However, as noted previously, Nitric Oxide does not deposit in significant quantities, and at least a small portion of the NO_x will comprise Nitrogen Dioxide. Hence this can be considered a robust assessment, which takes a worst-case approach. It is also noted that, although other heavy metals have limits within the Drinking Water Quality Standards, Antimony has the lowest limit of those combined metals which may be discharged and deposited, and hence has been applied in this assessment.

With a contribution of approximately 4 % of the Water Quality Standard for Nitrite, contributions from the Enviroparks facility would equate to less than 20.5 % of the Water Quality Standard over five years, should the water not be used or should drought conditions result in a concentration of pollutants in the reservoir. This is significantly less than the potential contribution from air which is at the Air Quality Standard for Nitrogen Dioxide, which would equate to a contribution of more than 50 % of the Water Quality Standard per year (as per the 2009 assessment). As such, the predicted emissions from the proposed Enviroparks facility are much less significant for the Dwr Cymru infrastructure than the potential impact of the nationally accepted Air Quality Standard for Nitrogen Dioxide.

5. Conclusions

Enviroparks Wales Limited holds planning consent for their proposed eco-park facility to treat waste using a number of different technologies, in order to recover and recycle wastes where possible, and to create energy from the remaining Refuse Derived Fuel. Since receiving their original planning consent, various changes have been made to the plans for the facility, and these include changes to layout and the technologies to be applied. As such, a revision to the current planning consent is required, and this is to be accompanied by an Addendum to the original Environmental Statement. This modelling report, which considers the discharges to atmosphere from the proposed site technologies, has been prepared in support of the ES Addendum.

The process contribution of all pollutants, and the predicted environmental concentrations of the pollutants across the area remain within the Air Quality Standards or Environmental Assessment Levels. This is true whether considering the impact on individual receptors, or the maximum calculated concentration across the modelled grid.

In addition, the impact of a number of pollutants is reduced when considering the current proposal from the original Enviroparks scheme. Process contributions of Oxides of Nitrogen, Sulphur Dioxide, PM_{10}, Carbon Monoxide and Volatile Organic Compounds all reduce from the 2008 / 2009 studies, in part due to reduced emissions, but also due to the proposal to increase the stack height to 45 m.

Not all of the process contributions of emissions from the Enviroparks facility can immediately be screened as insignificant, however the predicted environmental concentration of all species consistently remains within 70 % of the Standards. Although the process contribution of NO_2 cannot be screened as insignificant at either the primary or secondary stage, the contributions proposed by the revised Enviroparks scheme result in a lower process contribution of Nitrogen Dioxide than the scheme already consented.

Consideration has also been given to the potential failure of abatement systems, and the cumulative impact of third-party new, or proposed developments within the Hirwaun Industrial Estate. Although in both of these scenarios the process contributions increase and could not be screened as insignificant, all of the predicted environmental concentrations continue to remain within 70 % of the Environmental Quality Standards, with the exception of predicted environmental concentrations of Nitrogen Dioxide, when applying a worst-case combination of releases from Enviroparks and from the third-party releases. In this case the predicted environmental concentration remains below 72 % of the EQS and it is noted that the calculation method applied is likely to result in an overly negative assessment of the likely impacts.

Detailed assessments have also been undertaken on the key sensitive receptors in the area, including the three local Special Areas of Conservation, and the Penderyn Reservoir, including the Dwr Cymru service reservoir. Deposition of nutrient Nitrogen from deposited concentrations of Oxides of Nitrogen and Ammonia can be screened as insignificant at both Cwm Cadlan and Coed Nedd a Mellte. The Nitrogen deposition at Blaen Cynon from the Enviroparks facility is calculated to represent 4.58 % of the lower critical load for nutrient Nitrogen (8.4 % when combined with other sources), which is a fraction of the current background levels of nutrient Nitrogen, and is significantly less than the potential impact of the nationally accepted Air Quality Objective for the protection of vegetation.

Contributions of total Acid deposition also exceed 1 % of the EQS at both Blaen Cynon and Cwm Cadlan when modelling Enviroparks alone or in combination with other new or proposed facilities in the area, however again, the predicted impact of the Enviroparks facility represents a fraction of the current background levels of Acid deposition, and are significantly less than the potential impact of nationally accepted Air Quality Objectives for the protection of vegetation.

Finally, the assessment of the potential impact on the Dwr Cymru infrastructure in the locality resulted only in contributions of Nitrite potentially exceeding 1 % of the Water Quality Standards. However, this assumed that all of the Oxides of Nitrogen deposited at the reservoir from the Enviroparks facility were available as Nitric Oxide and convert to Nitrite, and resulted in a significantly lower contribution than could be expected from air which is at the Air Quality Standard for Nitrogen Dioxide, which would equate to a contribution of more than 50 % of the Water Quality Standard per year. As such, the predicted emissions from the proposed Enviroparks facility are much less significant for the Dwr Cymru infrastructure than the potential impact of the nationally accepted Air Quality Standard for Nitrogen Dioxide.

The results of the modelling exercise have demonstrated that, with often reduced emissions, and an increased stack height from 40 m to 45 m, the potential impact of the emissions from the plant now proposed for the Enviroparks facility are acceptable. The process contributions of several species reduce from the original scheme and earlier modelling, and while some do increase, these are generally screened as insignificant at the primary or secondary screening stage. Where this is not the case, that is for emissions of Nitrogen Dioxide, contributions are in fact lower than those currently consented and hence, in this case, the revised scheme can be seen as having a beneficial effect.

The results from this modelling report have been used to produce both an Addendum to the Ecology Chapter of the Environmental Statement, and a Health Impact Assessment which provides a detailed assessment of the potential for any risk to health from the Enviroparks releases to air.

6. References

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APPENDIX A
MODELLING RESULTS TABLES

Notes:

Within the tables the concentration units vary by pollutant. Please refer to each individual table for details.

Grid references specified in the tables denote the location on the modelled grid which predicted the maximum concentration of each pollutant.

Highlighted cells denote the maximum reported value.

The insignificance test tables compare all relevant concentrations to an assessment level, however the reporting period of the pollutant and limit concentrations may not be directly comparable.

Table 1 Range of Maximum Process Contributions When Modelling Maximum Emissions and Five Years of Meteorological Data (2011 - 2015)

MODELLING AT IED LIMITS	2011	2012	2013	2014	2015
Annual Average NOx as NO2 (ug/m3)	5.13	4.21	3.37	3.89	5.13
Maximum Hourly NOx as NO2 (ug/m3)	145.53	139.34	156.38	142.74	138.33
99.79 Percentile Hourly NOx as NO2 (ug/m3)	95.44	81.18	85.17	85.69	73.99
Dry Deposition NOx as NO2 (ug/m2/s)	0.0103	0.0084	0.0067	0.0078	0.0103
Annual Average 15 Minute SO2 (ug/m3)	1.25	1.02	0.82	0.94	1.25
Maximum 15 Minute SO2 (ug/m3)	31.61	26.741	35.61	31.98	30.80
99.9 Percentile 15 Minute SO2 (ug/m3)	24.48	23.73	22.13	23.95	22.02
Dry Deposition 15 Minute SO2 (ug/m2/s)	0.0200	0.0163	0.0131	0.0151	0.0199
Annual Average SO2 (ug/m3)	1.2350	1.0107	0.8096	0.9360	1.2368
Maximum Hourly SO2 (ug/m3)	31.02	25.94	34.96	31.07	29.73
99.73 Percentile Hourly SO2 (ug/m3)	21.64	18.56	18.89	18.73	16.66
Dry Deposition SO2 (ug/m2/s)	0.0198	0.0162	0.0130	0.0150	0.0198
Annual Average 24 Hour SO2 (ug/m3)	1.17	0.96	0.78	0.90	1.17
Maximum 24 Hour SO2 (ug/m3)	7.34	5.87	7.47	6.96	6.93
99.18 Percentile 24 Hour SO2 (ug/m3)	6.51	4.92	5.24	5.86	6.25
Dry Deposition 24 Hour SO2 (ug/m2/s)	0.0187	0.0154	0.0125	0.0144	0.0188
Annual Average 24 Hour PM10 (ug/m3)	0.1780	0.1485	0.1185	0.1363	0.1727
Maximum 24 Hour PM10 (ug/m3)	1.11	1.10	1.37	1.00	0.96
90.41 Percentile 24 Hour PM10 (ug/m3)	0.5075	0.4505	0.3867	0.4041	0.4924
Dry Deposition 24 Hour PM10 (ug/m2/s)	0.0294	0.0211	0.0196	0.0232	0.0348
Annual Average PM10 (ug/m3)	0.1865	0.1546	0.1207	0.1412	0.1809
Maximum Hourly PM10 (ug/m3)	5.30	4.69	6.23	5.38	5.10
Dry Deposition PM10 (ug/m2/s)	0.0318	0.0226	0.0211	0.0247	0.0372
Annual Average PM2.5 (ug/m3)	0.2440	0.2008	0.1601	0.1850	0.2428
Maximum Hourly PM2.5 (ug/m3)	6.83	5.52	7.50	6.78	6.53
Dry Deposition PM2.5 (ug/m2/s)	0.0059	0.0041	0.0040	0.0047	0.0072
8 Hour Rolling Average CO (mg/m3)	0.0012	0.0010	0.0008	0.0009	0.0012
Maximum 8 Hour Rolling Average CO (mg/m3)	0.0252	0.0240	0.0201	0.0123	0.0346
Dry Deposition 8 Hour Rolling CO (ug/m2/s)	0.0023	0.0019	0.0015	0.0018	0.0023
Annual Average VOC (ug/m3)	0.2565	0.2105	0.1687	0.1944	0.2563
Maximum Hourly VOC (ug/m3)	7.29	7.01	7.83	7.15	6.93
Dry Deposition VOC (ug/m2/s)	5.00E-04	4.10E-04	3.29E-04	3.79E-04	5.02E-04
Annual Average Hg (ug/m3)	1.37E-03	1.13E-03	9.03E-04	1.04E-03	1.37E-03
Maximum Hourly Hg (ug/m3)	0.0390	0.0375	0.0419	0.0383	0.0371
Dry Deposition Hg (ug/m2/s)	2.68E-06	2.19E-06	1.76E-06	2.03E-06	2.68E-06
Annual Average Cd / Tl as Cd (ng/m3)	1.37	1.13	0.90	1.04	1.37
Maximum Hourly Cd / Tl as Cd (ng/m3)	39.00	37.52	41.90	38.26	37.09
Dry Deposition Cd / Tl as Cd (ng/m2/s)	2.68E-06	2.19E-06	1.76E-06	2.03E-06	2.68E-06
Annual Average Heavy Metals as Pb (ug/m3)	0.0127	0.0105	0.0084	0.0097	0.0127
Maximum Hourly Heavy Metals as Pb (ug/m3)	0.3622	0.3484	0.3891	0.3553	0.3444
Dry Deposition Heavy Metals as Pb (ug/m2/s)	2.49E-05	2.04E-05	1.64E-05	1.88E-05	2.49E-05
Annual Average HCl (ug/m3)	0.2349	0.1914	0.1534	0.1780	0.2356
Maximum Hourly HCl (ug/m3)	5.91	5.06	6.82	5.98	5.71
Dry Deposition HCl (ug/m2/s)	0.0087	0.0071	0.0057	0.0066	0.0087
Annual Average HF (ug/m3)	0.0243	0.0199	0.0159	0.0184	0.0243
Maximum Hourly HF (ug/m3)	0.6321	0.5086	0.7153	0.6400	0.6142
Dry Deposition HF (ug/m2/s)	5.82E-04	4.67E-04	3.83E-04	4.41E-04	6.04E-04
Annual Average Dioxins (ug/m3)	2.57E-09	2.11E-09	1.69E-09	1.95E-09	2.57E-09
Maximum Hourly Dioxins (ug/m3)	7.30E-08	7.02E-08	7.84E-08	7.16E-08	6.94E-08
Dry Deposition Dioxins (ug/m2/s)	5.01E-12	4.11E-12	3.30E-12	3.80E-12	5.02E-12
Annual Average 24 Hour Dioxins (ug/m3)	2.44E-09	2.01E-09	1.63E-09	1.87E-09	2.44E-09
Maximum 24 Hour Dioxins (ug/m3)	1.50E-08	1.22E-08	1.59E-08	1.43E-08	1.42E-08
Dry Deposition 24 Hour Dioxins (ug/m2/s)	4.75E-12	3.92E-12	3.18E-12	3.64E-12	4.77E-12
Annual Average PAH (ng/m3)	0.0255	0.0209	0.0168	0.0193	0.0255
Maximum Hourly PAH (ng/m3)	0.7244	0.6969	0.7782	0.7106	0.6888
Dry Deposition PAH (ng/m2/s)	4.97E-08	4.07E-08	3.27E-08	3.77E-08	4.99E-08
Annual Average PCB (ug/m3)	1.27E-04	1.05E-04	8.38E-05	9.66E-05	1.27E-04
Maximum Hourly PCB (ug/m3)	0.0036	0.0035	0.0039	0.0036	0.0034
Dry Deposition PCB (ug/m2/s)	2.49E-07	2.04E-07	1.64E-07	1.88E-07	2.49E-07
Annual Average NH3 (ug/m3)	0.239	0.195	0.156	0.181	0.239
Maximum Hourly NH3 (ug/m3)	5.941	5.083	6.829	6.014	5.749
Dry Deposition NH3 (ug/m2/s)	0.0072	0.0058	0.0047	0.0054	0.0072

Note: NO_x is modelled as 100 % NO_2.

Table 2 Range of Maximum Process Contributions When Modelling Expected Emissions and Five Years of Meteorological Data (2011 - 2015)

LONG TERM REALISTIC LEVELS	2011	2012	2013	2014	2015
Annual Average NOx as NO2 (ug/m3)	3.85	3.16	2.53	2.92	3.84
Maximum Hourly NOx as NO2 (ug/m3)	109.15	104.51	117.29	107.06	103.75
99.79 Percentile Hourly NOx as NO2 (ug/m3)	71.58	60.89	63.88	64.27	55.50
Dry Deposition NOx as NO2 (ug/m2/s)	0.0077	0.0063	0.0051	0.0058	0.0077
Annual Average 15 Minute SO2 (ug/m3)	0.2494	0.2038	0.1632	0.1885	0.2493
Maximum 15 Minute SO2 (ug/m3)	6.32	5.35	7.12	6.40	6.16
99.9 Percentile 15 Minute SO2 (ug/m3)	4.90	4.75	4.42	4.79	4.40
Dry Deposition 15 Minute SO2 (ug/m2/s)	0.0040	0.0033	0.0026	0.0030	0.0040
Annual Average SO2 (ug/m3)	0.2470	0.2021	0.1619	0.1872	0.2473
Maximum Hourly SO2 (ug/m3)	6.20	5.19	6.99	6.21	5.95
99.73 Percentile Hourly SO2 (ug/m3)	4.33	3.71	3.78	3.75	3.33
Dry Deposition SO2 (ug/m2/s)	0.0040	0.0032	0.0026	0.0030	0.0040
Annual Average 24 Hour SO2 (ug/m3)	0.2341	0.1929	0.1560	0.1793	0.2349
Maximum 24 Hour SO2 (ug/m3)	1.47	1.17	1.49	1.39	1.39
99.18 Percentile 24 Hour SO2 (ug/m3)	1.30	0.98	1.05	1.17	1.25
Dry Deposition 24 Hour SO2 (ug/m2/s)	0.0037	0.0031	0.0025	0.0029	0.0038
Annual Average 24 Hour PM10 (ug/m3)	0.0533	0.0445	0.0355	0.0408	0.0517
Maximum 24 Hour PM10 (ug/m3)	0.3340	0.3292	0.4120	0.2984	0.2885
90.41 Percentile 24 Hour PM10 (ug/m3)	0.1521	0.1350	0.1159	0.1211	0.1476
Dry Deposition 24 Hour PM10 (ug/m2/s)	0.0088	0.0063	0.0059	0.0069	0.0104
Annual Average PM10 (ug/m3)	0.0559	0.0463	0.0362	0.0423	0.0542
Maximum Hourly PM10 (ug/m3)	1.59	1.40	1.87	1.61	1.53
Dry Deposition PM10 (ug/m2/s)	0.0095	0.0068	0.0063	0.0074	0.0111
Annual Average PM2.5 (ug/m3)	0.0731	0.0602	0.0480	0.0554	0.0728
Maximum Hourly PM2.5 (ug/m3)	2.05	1.65	2.25	2.03	1.96
Dry Deposition PM2.5 (ug/m2/s)	0.0018	0.0012	0.0012	0.0014	0.0021
8 Hour Rolling Average CO (mg/m3)	0.00012	0.00010	0.00008	0.00009	0.00012
Maximum 8 Hour Rolling Average CO (mg/m3)	0.0025	0.0024	0.0020	0.0012	0.0035
Dry Deposition 8 Hour Rolling CO (ug/m2/s)	0.00023	0.00019	0.00015	0.00018	0.00023
Annual Average VOC (ug/m3)	0.0514	0.0422	0.0338	0.0389	0.0513
Maximum Hourly VOC (ug/m3)	1.46	1.40	1.57	1.43	1.39
Dry Deposition VOC (ug/m2/s)	1.00E-04	8.21E-05	6.59E-05	7.60E-05	1.00E-04
Annual Average Hg (ug/m3)	1.96E-04	1.61E-04	1.29E-04	1.49E-04	1.96E-04
Maximum Hourly Hg (ug/m3)	0.0056	0.0054	0.0060	0.0055	0.0053
Dry Deposition Hg (ug/m2/s)	3.82E-07	3.13E-07	2.52E-07	2.90E-07	3.83E-07
Annual Average Cd / Tl as Cd (ng/m3)	0.20	0.16	0.13	0.15	0.20
Maximum Hourly Cd / Tl as Cd (ng/m3)	5.57	5.36	5.99	5.47	5.30
Dry Deposition Cd / Tl as Cd (ng/m2/s)	3.82E-07	3.13E-07	2.52E-07	2.90E-07	3.83E-07
Annual Average Heavy Metals as Pb (ug/m3)	0.0014	0.0011	0.0009	0.0010	0.0014
Maximum Hourly Heavy Metals as Pb (ug/m3)	0.0390	0.0375	0.0419	0.0383	0.0371
Dry Deposition Heavy Metals as Pb (ug/m2/s)	2.68E-06	2.19E-06	1.76E-06	2.03E-06	2.68E-06
Annual Average HCl (ug/m3)	0.1645	0.1341	0.1074	0.1246	0.1650
Maximum Hourly HCl (ug/m3)	4.14	3.54	4.77	4.19	4.00
Dry Deposition HCl (ug/m2/s)	0.0061	0.0050	0.0040	0.0046	0.0061
Annual Average HF (ug/m3)	0.0096	0.0079	0.0063	0.0073	0.0096
Maximum Hourly HF (ug/m3)	0.2509	0.202	0.2839	0.2540	0.2438
Dry Deposition HF (ug/m2/s)	2.31E-04	1.85E-04	1.52E-04	1.75E-04	2.40E-04
Annual Average Dioxins (ug/m3)	2.57E-10	2.11E-10	1.69E-10	1.95E-10	2.57E-10
Maximum Hourly Dioxins (ug/m3)	7.30E-09	7.02E-09	7.84E-09	7.16E-09	6.94E-09
Dry Deposition Dioxins (ug/m2/s)	5.01E-13	4.11E-13	3.30E-13	3.80E-13	5.02E-13
Annual Average 24 Hour Dioxins (ug/m3)	2.44E-10	2.01E-10	1.63E-10	1.87E-10	2.44E-10
Maximum 24 Hour Dioxins (ug/m3)	1.50E-09	1.22E-09	1.59E-09	1.43E-09	1.42E-09
Dry Deposition 24 Hour Dioxins (ug/m2/s)	4.75E-13	3.92E-13	3.18E-13	3.64E-13	4.77E-13
Annual Average PAH (ng/m3)	0.0255	0.0209	0.0168	0.0193	0.0255
Maximum Hourly PAH (ng/m3)	0.7244	0.6969	0.7782	0.7106	0.6888
Dry Deposition PAH (ng/m2/s)	4.97E-08	4.07E-08	3.27E-08	3.77E-08	4.99E-08
Annual Average PCB (ug/m3)	1.27E-04	1.05E-04	8.38E-05	9.66E-05	1.27E-04
Maximum Hourly PCB (ug/m3)	0.0036	0.0035	0.0039	0.0036	0.0034
Dry Deposition PCB (ug/m2/s)	2.49E-07	2.04E-07	1.64E-07	1.88E-07	2.49E-07
Annual Average NH3 (ug/m3)	0.239	0.195	0.156	0.181	0.239
Maximum Hourly NH3 (ug/m3)	5.941	5.083	6.829	6.014	5.749
Dry Deposition NH3 (ug/m2/s)	0.0072	0.0058	0.0047	0.0054	0.0072

Note: NO_x is modelled as 100 % NO_2.

Table 3 Consideration of the Likely Contribution of Nitrogen Dioxide to Oxides of Nitrogen. 2011 Meteorological Data

Averaging Period	Modelling at IED Limits			Long Term Realistic Emission Levels		
	NO_2 70 % NO_x	NO_2 50 % NO_x	NO_2 35 % NO_x	NO_2 70 % NO_x	NO_2 50 % NO_x	NO_2 35 % NO_x
Annual Average NO_x as NO_2 (ug/m^3)	3.59	2.56	-	2.69	1.92	-
Maximum Hourly NO_x as NO_2 (ug/m^3)	-	72.76	50.94	-	54.57	38.20
99.79 Percentile Hourly NO_x as NO_2 (ug/m^3)	-	46.47	32.53	-	34.86	24.40
Dry Deposition NO_x as NO_2 (ug/m^2/s)	0.0072	0.0051	-	0.0054	0.0038	-

Table 4 Assessment of the Potential for Contributions to be Insignificant

Pollutant (Units are specific to pollutants - see below)	Environmental Quality Standard	Background Concentration	Maximum Concentration	Predicted Environmental Concentration	Assessment of Significance		Maximum Concentration	Predicted Environmental Concentration	Assessment of Significance		Secondary Assessment of Significance			
			Long Term		LT PC % of EQS	< 1 %?	Short Term		ST PC % of EQS	< 10 %?	ST PC % of EQS - LT Background x 2	< 20 %?	LT PEC % of EQS	< 70 %?
NO2 (ug/m3) Annual Hourly Average	40	8.69	5.13	13.82	**12.82%**	No							34.55%	Yes
NO2 (ug/m3) Annual Hourly Average (Vegetation)	30	8.69	5.13	13.82	**17.09%**	No							46.07%	Yes
NO2 99.79%ile (ug/m3) Hourly Average	200	8.69					46.47	63.85	**23.24%**	No	25.45%	No		
SO2 (ug/m3) Annual Hourly Average	350	2.79	1.24	4.03	0.35%	Yes							1.15%	Yes
SO2 (ug/m3) Annual Hourly Average (Vegetation)	20	2.79	1.24	4.03	**6.18%**	No							20.13%	Yes
SO2 99.73%ile (ug/m3) Hourly Average	350	2.79					21.64	27.22	6.18%	Yes	6.28%	Yes		
SO2 99.18%ile (ug/m3) 24 Hr Average	125	2.79					6.51	12.09	5.20%	Yes	5.45%	Yes		
SO2 99.90%ile (ug/m3) 15 Minute Average	266	2.79					24.48	30.06	9.20%	Yes	9.40%	Yes		
PM10 90.41%ile (ug/m3) 24 Hr Average	50	13.16					0.51	26.82	1.01%	Yes	2.14%	Yes		
PM10 (ug/m3) Annual Hourly Average	40	13.16	0.19	13.34	0.47%	Yes							33.36%	Yes
PM2.5 (ug/m3) Annual Hourly Average	25	9.33	0.24	9.58	0.98%	Yes							38.32%	Yes
CO (mg/m3) maximum daily running 8 hour mean	10	0.0953					0.03	0.23	0.35%	Yes	0.35%	Yes		
Benzene (ug/m3) Annual Hourly Average	5	0.2070	0.26	0.46	**5.13%**	No							9.27%	Yes
Heavy Metals as Lead (ug/m3) Annual Hourly Av	0.25	0.0064	0.01	0.02	**5.10%**	No							7.67%	Yes
Cadmium (ng/m3) Annual Hourly Average	5	0.155	1.37	1.53	**27.44%**	No							30.54%	Yes
Mercury (ug/m3) Annual Hourly Average	0.25	0.000022	1.37E-03	0.00139	0.55%	Yes							0.56%	Yes
HCl (ug/m3) Hourly Average	750	0.262					6.82	7.34	0.91%	Yes	0.91%	Yes		
HF (ug/m3) Hourly Average	160						0.7153	0.72	0.45%	Yes	0.45%	Yes		
PAH (ng/m3) Annual Average	1	0.188	0.0255	0.21	**2.55%**	No							21.35%	Yes
Ammonia (ug/m3) Annual Average	180	0.64	0.2393	0.88	0.13%	Yes								

Note: Maximum concentrations of pollutants are generally taken from Table 1, with the exception of the short-term NO_2 concentration, drawn from Table 3 above. All emissions are assumed to be discharged at the maximum rate.

Results in bold cannot be screened as insignificant.

Table 5 Assessment of Individual Species from Combined Results

METALS BREAKDOWN	PC Per Species	Background Concentration	PEC Per Species	Environmental Quality Standard	LT PC % of EQS	LT PEC % of EQS
Cadmium (ng/m3)	0.686	0.155	0.841	5	**14%**	16.82%
Thallium (ng/m3)	0.686		0.686			
Antimony (ug/m3)	0.00142		0.00142	5	0.03%	0.03%
Arsenic (ug/m3)	0.00142	0.00104	0.00245	0.006	**24%**	40.88%
Lead (ug/m3)	0.00142	0.00643	0.00785	0.25	0.57%	3.14%
Chromium (ug/m3)	0.00142	0.0199	0.0213	5	0.03%	0.43%
Cobalt (ug/m3)	0.00142	0.000241	0.00166			
Copper (ug/m3)	0.00142	0.00500	0.00642	10	0.01%	0.06%
Manganese (ug/m3)	0.00142	0.00357	0.00499	0.15	0.94%	3.32%
Nickel (ug/m3)	0.00142	0.00923	0.0106	0.02	**7%**	53.22%
Vanadium (ug/m3)	0.00142	0.000654	0.00207	5	0.03%	0.04%

Results in bold cannot be screened as insignificant.

Table 6 Assessment of the Impact of Abatement System Failures

ABATEMENT FAILURES	2015	Background Concentration	PEC	EQS	ST PC % of EQS - LT Background x 2	< 20 %?	PEC < 70 % EQS?
Maximum Hourly NOx as NO2 (ug/m3)	210.95	8.69	228.34				
99.79 Percentile Hourly NOx as NO2 (ug/m3)	109.02	8.69	126.40	200	59.70%	No	Yes
Maximum 15 Minute SO2 (ug/m3)	48.65	2.79	54.23				
99.9 Percentile 15 Minute SO2 (ug/m3)	34.79	2.79	40.37	266	13.36%	Yes	Yes
Maximum Hourly SO2 (ug/m3)	46.98	2.79	52.56				
99.73 Percentile Hourly SO2 (ug/m3)	26.32	2.79	31.90	350	7.64%	Yes	Yes
Maximum Hourly PM10 (ug/m3)	77.31	13.16	103.62				
Maximum Hourly PM2.5 (ug/m3)	97.90	9.33	116.57				
Maximum Hourly HCl (ug/m3)	91.41	0.2617	91.94	750	12.20%	Yes	Yes
Maximum Hourly Heavy Metals as Pb (ug/m3)	0.39	0.0064	0.40				
Maximum Hourly Dioxins (ug/m3)	2.08E-07	2.76E-15	2.08E-07				

Table 7 Assessment of Cumulative Effects of Enviroparks and New or Committed Developments Within the Hirwaun Industrial Estate

CUMULATIVE EFFECTS	Third Party PC 2011 Met Data	NO2 as a Fraction of NOx	Total PC	Background Concentration	PEC	EQS	PEC < 70 % EQS?	Third Party PC 2015 Met Data	NO2 as a Fraction of NOx	Total PC	Background Concentration	PEC	EQS	PEC < 70 % EQS?
Annual Average NOx as NO2 (ug/m3)	9.28		14.41	8.69	23.10	40	Yes	11.05		16.17	8.69	24.86	40	Yes
99.79 Percentile Hourly NOx as NO2 (ug/m3)	157.49	78.74	126.46	8.69	143.84	200	No	163.09	81.54	118.54	8.69	135.92	200	Yes
99.9 Percentile 15 Minute SO2 (ug/m3)	15.46		39.94	2.79	45.52	266	Yes	14.76		36.78	2.79	42.36	266	Yes
Annual Average SO2 (ug/m3)	1.28		2.52	2.79	5.31	350	Yes	1.23		2.46	2.79	5.25	350	Yes
99.73 Percentile Hourly SO2 (ug/m3)	12.57		34.21	2.79	39.79	350	Yes	11.49		28.14	2.79	33.72	350	Yes
99.18 Percentile 24 Hour SO2 (ug/m3)	5.77		12.27	2.79	17.85	125	Yes	6.44		12.69	2.79	18.27	125	Yes
90.41 Percentile 24 Hour PM10 (ug/m3)	0.47		0.98	13.16	27.29	50	Yes	0.59		1.09	13.16	27.40	50	Yes
Annual Average PM10 (ug/m3)	0.16		0.34	13.16	13.50	40	Yes	0.19		0.37	13.16	13.53	40	Yes
8 Hour Rolling Average CO (mg/m3)	0.012		0.013	0.0953	0.20	10	Yes	0.014		0.015	0.0953	0.21	10	Yes
Maximum 8 Hour Rolling Average CO (mg/m3)	0.88		0.91	0.0953	1.10	10	Yes	0.28		0.32	0.0953	0.51	10	Yes

Table 8 Process Contributions of Oxides of Nitrogen and Sulphur Dioxide to Sensitive Receptors

Receptor Name	Annual Average NOx as NO2 (ug/m3)	99.79 Percentile Hourly NOx as NO2 (ug/m3)	99.9 Percentile 15 Minute SO2 (ug/m3)	99.73 Percentile Hourly SO2 (ug/m3)	99.18 Percentile 24 Hour SO2 (ug/m3)
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	0.8434	16.41	4.6472	3.8767	1.5107
Cwm Cadlan SAC	0.2585	3.88	1.1083	0.7514	0.2378
Coedydd Nedd a Mellte SAC	0.0836	3.92	1.2471	0.7879	0.1997
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	0.0874	3.94	1.3748	0.8151	0.2098
Cwm Gwrelych and Nant Llynfach Streams SSSI	0.1135	3.03	1.0546	0.5844	0.3037
Craig-y-Llyn	0.0697	2.65	0.8686	0.5153	0.1784
Bryn Bwch SSSI	0.0791	3.25	1.1613	0.5832	0.1885
Caeau Nant-y-Llechau SSSI	0.0347	2.16	0.7026	0.4039	0.1169
Gweunedd Dyffern Nedd SSSI	0.0577	2.91	0.9565	0.4992	0.1360
Bryncarnau Grasslands Llwyncoed SSSI	0.1010	3.91	1.3123	0.6409	0.1577
Blaenrhondda Road Cutting SSSI	0.0481	2.35	0.7223	0.4535	0.1932
Blaen Nedd SSSI	0.0360	1.58	0.5275	0.2689	0.0838
Ogof Ffynnon Ddu Pant Mawr SSSI	0.0134	0.81	0.2467	0.1416	0.0321
Caeau Ton-y-Fildre SSSI	0.0305	1.56	0.4159	0.2647	0.0779
Penmoelallt SSSI	0.0669	1.92	0.6257	0.3228	0.0876
Mynydd Ty-Isaf Rhondda SSSI	0.0199	1.44	0.4239	0.2396	0.0582
Plas-y-Gors SSSI	0.0264	1.13	0.3764	0.1896	0.0602
Daren Fach SSSI	0.0662	1.67	0.6043	0.2824	0.0708
Cwm Glo a Glyndyrys SSSI	0.0743	2.45	0.6707	0.4004	0.1124
Waun Ton-y-Spyddaden SSSI	0.0144	0.82	0.2608	0.1508	0.0415
Gorsllwyn Onllwyn SSSI	0.0315	1.68	0.5205	0.2666	0.0826
Cwm Taf Fechan Woodlands SSSI	0.0528	2.01	0.6883	0.3026	0.0794
Nant Llech SSSI	0.0212	1.31	0.3382	0.1981	0.0524
Caeau Nant Y Groes SSSI	0.0394	2.28	0.8294	0.3614	0.0975
Tir Mawr A Dderi Hir, Llwydcoed SSSI	0.1745	7.26	2.5696	1.2469	0.3046
Penderyn Reservoir	1.5842	34.60	8.8854	8.2783	3.4522
Eden Trading	0.9366	43.27	11.2367	10.1844	3.0182
House at Penderyn Reservoir	2.6184	24.42	6.4280	5.8124	4.0217
Ty Newydd Hotel	1.5865	20.92	5.5187	4.7110	1.8976
Caer Llwyn Cottage	0.6627	19.63	5.3580	4.6278	2.2924
Rhombic Farm	0.6290	14.91	3.9575	3.4677	1.6182
Castell Farm	0.5076	13.50	3.8194	3.1677	1.6306
TY Newydd Cottage	2.2312	21.18	5.4901	4.9475	2.3684
Residence Woodland Park	1.4684	11.47	3.2594	2.5894	1.5116
Pontbren Llwyd School	0.7594	7.49	2.0349	1.6114	0.7246
Ffynnon Ddu (spring)	0.1274	5.25	1.5436	1.1288	0.3656
Ton-Y-Gilfach	0.0792	3.58	1.0397	0.6543	0.2156
Rose Cottage	0.1370	4.99	1.4893	0.9974	0.3801
The Don Bungalow	0.1502	5.95	1.7794	1.2351	0.4811
Werfa Farm	0.2134	6.60	1.9699	1.4342	0.6977
Willows Farm	0.3990	23.96	6.9452	4.8713	1.0505
Trebanog Uchaf Farm	1.5861	20.55	5.3801	4.8028	3.1516
Tai-Cwpla Farm	0.7843	30.62	8.1319	7.1793	2.7009
Neuadd Farm	1.3609	12.88	3.8808	2.8694	1.4953
John Street Allotments, Hirwaun	0.2382	9.26	3.8931	1.7834	0.5132
Dwr Cymru Service Reservoir	3.8096	39.44	10.5956	9.3677	5.8315

Table 9 Process Contributions of Particulates and Carbon Monoxide to Sensitive Receptors

Receptor Name	90.41 Percentile 24 Hour PM10 (ug/m3)	Annual Average PM10 (ug/m3)	Annual Average PM2.5 (ug/m3)	8 Hour Rolling Average CO (mg/m3)	Maximum 8 Hour Rolling Average CO (mg/m3)
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	0.1425	0.0359	0.0414	2.14E-04	0.0055
Cwm Cadlan SAC	0.0180	0.0068	0.0115	6.08E-05	0.0017
Coedydd Nedd a Mellte SAC	0.0095	0.0023	0.0038	2.06E-05	0.0023
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	0.0096	0.0025	0.0039	2.16E-05	0.0023
Cwm Gwrelych and Nant Llynfach Streams SSSI	0.0109	0.0031	0.0051	2.67E-05	0.0010
Craig-y-Llyn	0.0084	0.0021	0.0033	1.75E-05	0.0015
Bryn Bwch SSSI	0.0078	0.0020	0.0034	1.89E-05	0.0019
Caeau Nant-y-Llechau SSSI	0.0038	0.0009	0.0017	8.25E-06	0.0019
Gweunedd Dyffern Nedd SSSI	0.0051	0.0014	0.0025	1.38E-05	0.0012
Bryncarnau Grasslands Llwyncoed SSSI	0.0095	0.0026	0.0040	2.61E-05	0.0013
Blaenrhondda Road Cutting SSSI	0.0052	0.0014	0.0022	1.37E-05	0.0040
Blaen Nedd SSSI	0.0033	0.0008	0.0016	8.62E-06	0.0006
Ogof Ffynnon Ddu Pant Mawr SSSI	0.0011	0.0003	0.0005	3.40E-06	0.0002
Caeau Ton-y-Fildre SSSI	0.0029	0.0007	0.0013	8.12E-06	0.0008
Penmoelallt SSSI	0.0048	0.0016	0.0028	1.67E-05	0.0006
Mynydd Ty-Isaf Rhondda SSSI	0.0024	0.0006	0.0010	5.60E-06	0.0015
Plas-y-Gors SSSI	0.0022	0.0006	0.0011	6.35E-06	0.0005
Daren Fach SSSI	0.0046	0.0016	0.0028	1.61E-05	0.0004
Cwm Glo a Glyndyrys SSSI	0.0057	0.0016	0.0024	2.01E-05	0.0008
Waun Ton-y-Spyddaden SSSI	0.0017	0.0004	0.0007	3.62E-06	0.0007
Gorsllwyn Onllwyn SSSI	0.0032	0.0007	0.0013	8.51E-06	0.0009
Cwm Taf Fechan Woodlands SSSI	0.0041	0.0012	0.0020	1.38E-05	0.0008
Nant Llech SSSI	0.0021	0.0005	0.0009	5.89E-06	0.0006
Caeau Nant Y Groes SSSI	0.0036	0.0009	0.0014	1.03E-05	0.0005
Tir Mawr A Dderi Hir, Llwydcoed SSSI	0.0181	0.0047	0.0069	4.45E-05	0.0023
Penderyn Reservoir	0.1975	0.0561	0.0750	3.67E-04	0.0120
Eden Trading	0.1762	0.0423	0.0461	2.43E-04	0.0110
House at Penderyn Reservoir	0.2660	0.0919	0.1236	6.10E-04	0.0060
Ty Newydd Hotel	0.1856	0.0604	0.0755	3.83E-04	0.0084
Caer Llwyn Cottage	0.0922	0.0244	0.0320	1.56E-04	0.0054
Rhombic Farm	0.0864	0.0230	0.0302	1.46E-04	0.0037
Castell Farm	0.0700	0.0184	0.0244	1.17E-04	0.0034
TY Newydd Cottage	0.2462	0.0831	0.1064	5.29E-04	0.0111
Residence Woodland Park	0.1382	0.0490	0.0685	3.44E-04	0.0056
Pontbren Llwyd School	0.0621	0.0231	0.0350	1.78E-04	0.0037
Ffynnon Ddu (spring)	0.0159	0.0040	0.0059	3.11E-05	0.0023
Ton-Y-Gilfach	0.0085	0.0021	0.0035	2.02E-05	0.0015
Rose Cottage	0.0163	0.0041	0.0063	3.38E-05	0.0035
The Don Bungalow	0.0174	0.0046	0.0069	3.59E-05	0.0031
Werfa Farm	0.0242	0.0070	0.0099	5.01E-05	0.0035
Willows Farm	0.0650	0.0138	0.0168	1.13E-04	0.0074
Trebanog Uchaf Farm	0.1722	0.0537	0.0743	3.69E-04	0.0055
Tai-Cwpla Farm	0.1146	0.0291	0.0374	1.84E-04	0.0069
Neuadd Farm	0.1348	0.0473	0.0639	3.21E-04	0.0062
John Street Allotments, Hirwaun	0.0330	0.0085	0.0110	6.37E-05	0.0047
Dwr Cymru Service Reservoir	0.3768	0.1403	0.1807	8.98E-04	0.0090

Table 10 Process Contributions of VOC, Metals, and Hydrogen Chloride to Sensitive Receptors

Receptor Name	Annual Average VOC (ug/m3)	Annual Average Hg (ug/m3)	Annual Average Cd / Tl as Cd (ng/m3)	Annual Average Heavy Metals as Pb (ug/m3)	Maximum Hourly HCl (ug/m3)
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	0.0422	2.26E-04	0.2259	0.0021	4.4595
Cwm Cadlan SAC	0.0129	6.93E-05	0.0692	0.0006	0.4359
Coedydd Nedd a Mellte SAC	0.0042	2.24E-05	0.0224	0.0002	0.5983
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	0.0044	2.34E-05	0.0234	0.0002	0.6103
Cwm Gwrelych and Nant Llynfach Streams SSSI	0.0057	3.04E-05	0.0304	0.0003	0.7105
Craig-y-Llyn	0.0035	1.87E-05	0.0187	0.0002	0.5552
Bryn Bwch SSSI	0.0040	2.12E-05	0.0212	0.0002	0.4338
Caeau Nant-y-Llechau SSSI	0.0017	9.32E-06	0.0093	0.0001	0.6026
Gweunedd Dyffern Nedd SSSI	0.0029	1.55E-05	0.0155	0.0001	0.4059
Bryncarnau Grasslands Llwyncoed SSSI	0.0052	2.76E-05	0.0276	0.0003	0.2693
Blaenrhondda Road Cutting SSSI	0.0025	1.32E-05	0.0132	0.0001	0.4641
Blaen Nedd SSSI	0.0018	9.66E-06	0.0097	0.0001	0.1435
Ogof Ffynnon Ddu Pant Mawr SSSI	0.0007	3.68E-06	0.0037	0.00003	0.0677
Caeau Ton-y-Fildre SSSI	0.0016	8.31E-06	0.0083	0.0001	0.0889
Penmoelallt SSSI	0.0034	1.80E-05	0.0180	0.0002	0.1099
Mynydd Ty-Isaf Rhondda SSSI	0.0010	5.38E-06	0.0054	0.00005	0.0993
Plas-y-Gors SSSI	0.0013	7.10E-06	0.0071	0.0001	0.0889
Daren Fach SSSI	0.0033	1.77E-05	0.0178	0.0002	0.1202
Cwm Glo a Glyndyrys SSSI	0.0040	2.15E-05	0.0215	0.0002	0.1401
Waun Ton-y-Spyddaden SSSI	0.0007	3.89E-06	0.0039	0.00004	0.0692
Gorsllwyn Onllwyn SSSI	0.0016	8.59E-06	0.0086	0.0001	0.0932
Cwm Taf Fechan Woodlands SSSI	0.0027	1.44E-05	0.0144	0.0001	0.1036
Nant Llech SSSI	0.0011	5.89E-06	0.0059	0.0001	0.0632
Caeau Nant Y Groes SSSI	0.0020	1.07E-05	0.0107	0.0001	0.1075
Tir Mawr A Dderi Hir, Llwydcoed SSSI	0.0088	4.74E-05	0.0474	0.0004	0.5278
Penderyn Reservoir	0.0792	4.24E-04	0.4240	0.0039	3.9692
Eden Trading	0.0468	2.50E-04	0.2507	0.0023	3.6241
House at Penderyn Reservoir	0.1310	7.01E-04	0.7008	0.0065	4.2269
Ty Newydd Hotel	0.0794	4.25E-04	0.4247	0.0039	3.3526
Caer Llwyn Cottage	0.0331	1.77E-04	0.1774	0.0016	2.2559
Rhombic Farm	0.0314	1.68E-04	0.1684	0.0016	2.1784
Castell Farm	0.0254	1.36E-04	0.1359	0.0013	1.9860
TY Newydd Cottage	0.1116	5.97E-04	0.5972	0.0055	3.6385
Residence Woodland Park	0.0736	3.94E-04	0.3931	0.0037	2.1411
Pontbren Llwyd School	0.0380	2.04E-04	0.2034	0.0019	1.0082
Ffynnon Ddu (spring)	0.0064	3.41E-05	0.0341	0.0003	0.8867
Ton-Y-Gilfach	0.0040	2.13E-05	0.0213	0.0002	0.3433
Rose Cottage	0.0069	3.67E-05	0.0367	0.0003	0.7171
The Don Bungalow	0.0075	4.02E-05	0.0402	0.0004	0.6356
Werfa Farm	0.0107	5.71E-05	0.0571	0.0005	1.3486
Willows Farm	0.0200	1.07E-04	0.1069	0.0010	2.3976
Trebanog Uchaf Farm	0.0793	4.25E-04	0.4246	0.0039	3.5984
Tai-Cwpla Farm	0.0392	2.10E-04	0.2099	0.0019	1.5680
Neuadd Farm	0.0681	3.64E-04	0.3643	0.0034	1.9664
John Street Allotments, Hirwaun	0.0119	6.38E-05	0.0639	0.0006	1.2432
Dwr Cymru Service Reservoir	0.1905	1.02E-03	1.0194	0.0095	2.8268

Table 11 Process Contributions of Hydrogen Fluoride, Dioxins, PAH, PCBs, and Ammonia to Sensitive Receptors

Receptor Name	Maximum Hourly HF (ug/m3)	Annual Average Dioxins (ug/m3)	Annual Average PAH (ng/m3)	Annual Average PCB (ug/m3)	Annual Average NH3 (ug/m3)
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	0.4767	4.23E-10	0.0042	2.10E-05	0.0380
Cwm Cadlan SAC	0.0525	1.30E-10	0.0013	6.43E-06	0.0104
Coedydd Nedd a Mellte SAC	0.0742	4.19E-11	0.0004	2.08E-06	0.0033
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	0.0757	4.39E-11	0.0004	2.18E-06	0.0035
Cwm Gwrelych and Nant Llynfach Streams SSSI	0.0925	5.69E-11	0.0006	2.82E-06	0.0043
Craig-y-Llyn	0.0716	3.50E-11	0.0003	1.73E-06	0.0026
Bryn Bwch SSSI	0.0593	3.97E-11	0.0004	1.97E-06	0.0029
Caeau Nant-y-Llechau SSSI	0.0838	1.74E-11	0.0002	8.65E-07	0.0013
Gweunedd Dyffern Nedd SSSI	0.0608	2.90E-11	0.0003	1.44E-06	0.0021
Bryncarnau Grasslands Llwyncoed SSSI	0.0329	5.17E-11	0.0005	2.57E-06	0.0034
Blaenrhondda Road Cutting SSSI	0.0827	2.48E-11	0.0002	1.23E-06	0.0015
Blaen Nedd SSSI	0.0181	1.81E-11	0.0002	8.97E-07	0.0013
Ogof Ffynnon Ddu Pant Mawr SSSI	0.0084	6.89E-12	0.0001	3.42E-07	0.0004
Caeau Ton-y-Fildre SSSI	0.0123	1.55E-11	0.0002	7.71E-07	0.0010
Penmoelallt SSSI	0.0230	3.37E-11	0.0003	1.67E-06	0.0023
Mynydd Ty-Isaf Rhondda SSSI	0.0271	1.01E-11	0.0001	5.00E-07	0.0006
Plas-y-Gors SSSI	0.0148	1.33E-11	0.0001	6.59E-07	0.0009
Daren Fach SSSI	0.0177	3.32E-11	0.0003	1.65E-06	0.0023
Cwm Glo a Glyndyrys SSSI	0.0186	4.03E-11	0.0004	2.00E-06	0.0022
Waun Ton-y-Spyddaden SSSI	0.0106	7.28E-12	0.0001	3.61E-07	0.0005
Gorsllwyn Onllwyn SSSI	0.0123	1.61E-11	0.0002	7.97E-07	0.0010
Cwm Taf Fechan Woodlands SSSI	0.0136	2.70E-11	0.0003	1.34E-06	0.0017
Nant Llech SSSI	0.0096	1.10E-11	0.0001	5.46E-07	0.0007
Caeau Nant Y Groes SSSI	0.0153	2.01E-11	0.0002	9.97E-07	0.0013
Tir Mawr A Dderi Hir, Llwydcoed SSSI	0.0638	8.86E-11	0.0009	4.40E-06	0.0060
Penderyn Reservoir	0.4422	7.93E-10	0.0079	3.94E-05	0.0727
Eden Trading	0.3735	4.69E-10	0.0047	2.33E-05	0.0440
House at Penderyn Reservoir	0.4763	1.31E-09	0.0130	6.51E-05	0.1202
Ty Newydd Hotel	0.3619	7.95E-10	0.0079	3.94E-05	0.0702
Caer Llwyn Cottage	0.2451	3.32E-10	0.0033	1.65E-05	0.0297
Rhombic Farm	0.2434	3.15E-10	0.0031	1.56E-05	0.0280
Castell Farm	0.2224	2.54E-10	0.0025	1.26E-05	0.0225
TY Newydd Cottage	0.4464	1.12E-09	0.0111	5.55E-05	0.1003
Residence Woodland Park	0.2547	7.37E-10	0.0073	3.65E-05	0.0657
Pontbren Llwyd School	0.1282	3.81E-10	0.0038	1.89E-05	0.0327
Ffynnon Ddu (spring)	0.1041	6.39E-11	0.0006	3.17E-06	0.0054
Ton-Y-Gilfach	0.0442	3.98E-11	0.0004	1.98E-06	0.0028
Rose Cottage	0.0826	6.87E-11	0.0007	3.41E-06	0.0054
The Don Bungalow	0.0704	7.53E-11	0.0007	3.74E-06	0.0061
Werfa Farm	0.1650	1.07E-10	0.0011	5.30E-06	0.0090
Willows Farm	0.3052	2.00E-10	0.0020	9.93E-06	0.0169
Trebanog Uchaf Farm	0.4103	7.95E-10	0.0079	3.94E-05	0.0720
Tai-Cwpla Farm	0.1622	3.93E-10	0.0039	1.95E-05	0.0359
Neuadd Farm	0.2401	6.82E-10	0.0068	3.38E-05	0.0600
John Street Allotments, Hirwaun	0.1537	1.20E-10	0.0012	5.93E-06	0.0098
Dwr Cymru Service Reservoir	0.2911	1.91E-09	0.0189	9.47E-05	0.1781

Table 12 Sensitive Receptors Where Process Contributions of Oxides of Nitrogen, Volatile Organic Compounds, Ammonia and Polycyclic Aromatic Hydrocarbons Cannot Immediately be Screened as Insignificant

Sensitive Receptor	X (m)	Y (m)	Environmental Quality Standard	Background Concentration	Annual Average NOx as NO2 (ug/m3)	Predicted Environmental Concentration	LT PC % of EQS	< 1 %?	LT PEC % of EQS	< 70 %?
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294600	206600	30	9.9805	0.8434	10.8239	**2.8%**	No	36.08%	Yes
Penderyn Reservoir	293839	207170	40	11.6180	1.5842	13.2022	**4.0%**	No	33.01%	Yes
Eden Trading	294020	206800	40	11.6180	0.9366	12.5546	**2.3%**	No	31.39%	Yes
House at Penderyn Reservoir	294100	207270	40	11.6180	2.6184	14.2364	**6.5%**	No	35.59%	Yes
Ty Newydd Hotel	294600	206940	40	9.9805	1.5865	11.5669	**4.0%**	No	28.92%	Yes
Caer Llwyn Cottage	293253	207151	40	9.0233	0.6627	9.6860	**1.7%**	No	24.22%	Yes
Rhombic Farm	292958	206712	40	9.0233	0.6290	9.6524	**1.6%**	No	24.13%	Yes
Castell Farm	292871	206783	40	9.0233	0.5076	9.5310	**1.3%**	No	23.83%	Yes
TY Newydd Cottage	294514	207025	40	9.9805	2.2312	12.2117	**5.6%**	No	30.53%	Yes
Residence Woodland Park	294824	207560	40	8.8283	1.4684	10.2967	**3.7%**	No	25.74%	Yes
Pontbren Llwyd School	295057	208264	40	8.8283	0.7594	9.5878	**1.9%**	No	23.97%	Yes
Trebanog Uchaf Farm	294063	207416	40	11.6180	1.5861	13.2041	**4.0%**	No	33.01%	Yes
Tai-Cwpla Farm	293519	207024	40	11.6180	0.7843	12.4022	**2.0%**	No	31.01%	Yes
Neuadd Farm	294906	207282	40	9.9805	1.3609	11.3414	**3.4%**	No	28.35%	Yes
Dwr Cymru Service Reservoir	294068	206939	40	11.6180	3.8096	15.4276	**9.5%**	No	38.57%	Yes
Sensitive Receptor	**X (m)**	**Y (m)**	**Environmental Quality Standard**	**Background Concentration**	**Annual Average VOC (ug/m3)**	**Predicted Environmental Concentration**	**PC as % EQS**	**< 1 %?**	**LT PEC % of EQS**	**< 70 %?**
Penderyn Reservoir	293839	207170	5	0.20704	0.0792	0.29	**1.6%**	No	5.73%	Yes
Ty Newydd Hotel	294600	206940	5	0.20448	0.0794	0.28	**1.6%**	No	5.68%	Yes
TY Newydd Cottage	294514	207025	5	0.20448	0.1116	0.32	**2.2%**	No	6.32%	Yes
Residence Woodland Park	294824	207560	5	0.20320	0.0736	0.28	**1.5%**	No	5.54%	Yes
Trebanog Uchaf Farm	294063	207416	5	0.20704	0.0793	0.29	**1.6%**	No	5.73%	Yes
Neuadd Farm	294906	207282	5	0.20448	0.0681	0.27	**1.4%**	No	5.45%	Yes
Dwr Cymru Service Reservoir	294068	206939	5	0.20704	0.1905	0.40	**3.8%**	No	7.95%	Yes
Sensitive Receptor	**X (m)**	**Y (m)**	**Environmental Quality Standard**	**Background Concentration**	**Annual Average PAH (ng/m3)**	**Predicted Environmental Concentration**	**PC as % EQS**	**< 1 %?**	**LT PEC % of EQS**	**< 70 %?**
TY Newydd Cottage	294514	207025	1	0.18833	0.0111	0.20	**1.1%**	No	19.94%	Yes
Dwr Cymru Service Reservoir	294068	206939	1	0.18833	0.0189	0.21	**1.9%**	No	20.73%	Yes
Sensitive Receptor	**X (m)**	**Y (m)**	**Environmental Quality Standard**	**Background Concentration**	**Annual Average Ammonia (ug/m3)**	**Predicted Environmental Concentration**	**PC as % EQS**	**< 1 %?**	**LT PEC % of EQS**	**< 70 %?**
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294600	206600	3	0.64	0.0380	0.68	**1.3%**	No	22.60%	Yes
Cwm Cadlan SAC	296100	209800	1	0.64	0.0104	0.65	**1.0%**	No	65.04%	Yes

Table 13 Sensitive Receptors Where Other Process Contributions of Combined Species Cannot Immediately be Screened as Insignificant

Sensitive Receptor	X (m)	Y (m)	Environmental Quality Standard	Background Concentration	Annual Average Cd / Tl as Cd (ng/m3)	Predicted Environmental Concentration	PC as % EQS	< 1 %?	PC of Single Species as % EQS	< 1 %?	LT PEC % of EQS	< 70 %?
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294600	206600	5	0.154934615	0.2259	0.38	**4.5%**	No	**2.3%**	No	7.62%	Yes
Cwm Cadlan SAC	296100	209800	5	0.154934615	0.0692	0.22	**1.4%**	No	0.7%	Yes	4.48%	Yes
Penderyn Reservoir	293839	207170	5	0.154934615	0.4240	0.58	**8.5%**	No	**4.2%**	No	11.58%	Yes
Eden Trading	294020	206800	5	0.154934615	0.2507	0.41	**5.0%**	No	**2.5%**	No	8.11%	Yes
House at Penderyn Reservoir	294100	207270	5	0.154934615	0.7008	0.86	**14.0%**	No	**7.0%**	No	17.11%	Yes
Ty Newydd Hotel	294600	206940	5	0.154934615	0.4247	0.58	**8.5%**	No	**4.2%**	No	11.59%	Yes
Caer Llwyn Cottage	293253	207151	5	0.154934615	0.1774	0.33	**3.5%**	No	**1.8%**	No	6.65%	Yes
Rhombic Farm	292958	206712	5	0.154934615	0.1684	0.32	**3.4%**	No	**1.7%**	No	6.47%	Yes
Castell Farm	292871	206783	5	0.154934615	0.1359	0.29	**2.7%**	No	**1.4%**	No	5.82%	Yes
TY Newydd Cottage	294514	207025	5	0.154934615	0.5972	0.75	**11.9%**	No	**6.0%**	No	15.04%	Yes
Residence Woodland Park	294824	207560	5	0.154934615	0.3931	0.55	**7.9%**	No	**3.9%**	No	10.96%	Yes
Pontbren Llwyd School	295057	208264	5	0.154934615	0.2034	0.36	**4.1%**	No	**2.0%**	No	7.17%	Yes
Werfa Farm	291944	206721	5	0.154934615	0.0571	0.21	**1.1%**	No	0.6%	Yes	4.24%	Yes
Willows Farm	294129	205879	5	0.154934615	0.1069	0.26	**2.1%**	No	**1.1%**	No	5.24%	Yes
Trebanog Uchaf Farm	294063	207416	5	0.154934615	0.4246	0.58	**8.5%**	No	**4.2%**	No	11.59%	Yes
Tai-Cwpla Farm	293519	207024	5	0.154934615	0.2099	0.36	**4.2%**	No	**2.1%**	No	7.30%	Yes
Neuadd Farm	294906	207282	5	0.154934615	0.3643	0.52	**7.3%**	No	**3.6%**	No	10.38%	Yes
John Street Allotments, Hirwaun	296180	205605	5	0.154934615	0.0639	0.22	**1.3%**	No	0.6%	Yes	4.38%	Yes
Dwr Cymru Service Reservoir	294068	206939	5	0.154934615	1.0194	1.17	**20.4%**	No	**10.2%**	No	23.49%	Yes
Sensitive Receptor	**X (m)**	**Y (m)**	**Environmental Quality Standard**	**Background Concentration**	**Annual Average Heavy Metals as Pb (ug/m3)**	**Predicted Environmental Concentration**	**PC as % EQS**	**< 1 %?**	**PC as a Single Species < 1 %?**	**Compared to EQS for As (0.006 ug/m3)**	**LT PEC % of EQS**	**< 70 %?**
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294600	206600	0.25	0.006434423	0.0021	0.009	0.8%	Yes	Yes	**3.9%**	3.41%	Yes
Cwm Cadlan SAC	296100	209800	0.25	0.006434423	0.0006	0.007	0.3%	Yes	Yes	**1.2%**	2.83%	Yes
Penderyn Reservoir	293839	207170	0.25	0.006434423	0.0039	0.010	**1.6%**	No	Yes	**7.3%**	4.15%	Yes
House at Penderyn Reservoir	294100	207270	0.25	0.006434423	0.0065	0.013	**2.6%**	No	Yes	**12.1%**	5.18%	Yes
Ty Newydd Hotel	294600	206940	0.25	0.006434423	0.0039	0.010	**1.6%**	No	Yes	**7.3%**	4.15%	Yes
TY Newydd Cottage	294514	207025	0.25	0.006434423	0.0055	0.012	**2.2%**	No	Yes	**10.3%**	4.79%	Yes
Residence Woodland Park	294824	207560	0.25	0.006434423	0.0037	0.010	**1.5%**	No	Yes	**6.8%**	4.03%	Yes
Trebanog Uchaf Farm	294063	207416	0.25	0.006434423	0.0039	0.010	**1.6%**	No	Yes	**7.3%**	4.15%	Yes
Neuadd Farm	294906	207282	0.25	0.006434423	0.0034	0.010	**1.4%**	No	Yes	**6.3%**	3.93%	Yes
Dwr Cymru Service Reservoir	294068	206939	0.25	0.006434423	0.0095	0.016	**3.8%**	No	Yes	**17.5%**	6.36%	Yes

Table 14 Secondary Assessment of Process Contributions of Oxides of Nitrogen

NOx = 100 % NO2 Sensitive Receptor	**X (m)**	**Y (m)**	**Environmental Quality Standard**	**Background Concentration**	**99.79 Percentile Hourly NOx as NO2 (ug/m3)**	**Predicted Environmental Concentration**	**ST PC % of EQS**	**< 10 %?**	**ST PC % of EQS - LT Background x 2**	**< 20 %?**
Penderyn Reservoir	293839	207170	200	11.62	34.60	46.22	**17.3%**	No	19.57%	Yes
Eden Trading	294020	206800	200	11.62	43.27	54.89	**21.6%**	No	**24.48%**	No
House at Penderyn Reservoir	294100	207270	200	11.62	24.42	36.04	**12.2%**	No	13.82%	Yes
Ty Newydd Hotel	294600	206940	200	9.98	20.92	30.90	**10.5%**	No	11.62%	Yes
TY Newydd Cottage	294514	207025	200	9.98	21.18	31.16	**10.6%**	No	11.76%	Yes
Willows Farm	294129	205879	200	8.68	23.96	32.64	**12.0%**	No	13.12%	Yes
Trebanog Uchaf Farm	294063	207416	200	11.62	20.55	32.17	**10.3%**	No	11.63%	Yes
Tai-Cwpla Farm	293519	207024	200	11.62	30.62	42.23	**15.3%**	No	17.32%	Yes
Dwr Cymru Service Reservoir	294068	206939	200	11.62	39.44	51.05	**19.7%**	No	**22.31%**	No
NOx = 50 % NO2 Sensitive Receptor	**X (m)**	**Y (m)**	**Environmental Quality Standard**	**Background Concentration**	**99.79 Percentile Hourly NO2; 50 % NOx (ug/m3)**	**Predicted Environmental Concentration**	**ST PC % of EQS**	**< 10 %?**	**ST PC % of EQS - LT Background x 2**	**< 20 %?**
Penderyn Reservoir	293839	207170	200	11.62	17.29995	28.92	8.6%	Yes	9.79%	Yes
Eden Trading	294020	206800	200	11.62	21.6364	33.25	**10.8%**	No	12.24%	Yes
House at Penderyn Reservoir	294100	207270	200	11.62	12.2118	23.83	6.1%	Yes	6.91%	Yes
Ty Newydd Hotel	294600	206940	200	9.98	10.4614	20.44	5.2%	Yes	5.81%	Yes
TY Newydd Cottage	294514	207025	200	9.98	10.58765	20.57	5.3%	Yes	5.88%	Yes
Willows Farm	294129	205879	200	8.68	11.9776	20.66	6.0%	Yes	6.56%	Yes
Trebanog Uchaf Farm	294063	207416	200	11.62	10.27715	21.90	5.1%	Yes	5.81%	Yes
Tai-Cwpla Farm	293519	207024	200	11.62	15.30815	26.93	7.7%	Yes	8.66%	Yes
Dwr Cymru Service Reservoir	294068	206939	200	11.62	19.71845	31.34	9.9%	Yes	11.16%	Yes

Table 15 Results of Modelling Cumulative Effects of Third Party Operations

CUMULATIVE EFFECTS Blaen Cynon	**Maximum Result from Third Party Emissions**	**Total PC (ug/m3) Including Enviroparks Maximum**	**EQS (ug/m3)**	**PC < 1 % EQS?**	**Background Concentration (ug/m3)**	**PEC (ug/m3)**	**PEC < 70 % EQS?**
Annual Average NOx as NO2 (ug/m3)	2.00	2.84	30	**No**	9.98	12.82	Yes
Annual Average SO2 (ug/m3)	0.28	0.47	20	**No**	2.58	3.05	Yes
Annual Average PM10 (ug/m3)	0.01	0.04	40	Yes	12.97	13.01	Yes
Maximum 8 Hour Rolling Average CO (mg/m3)	0.0452	0.0454	10	Yes	0.0965	0.14	Yes
CUMULATIVE EFFECTS Cwm Cadlan	**Maximum Result from Third Party Emissions**	**Total PC (ug/m3) Including Enviroparks Maximum**	**EQS (ug/m3)**	**PC < 1 % EQS?**	**Background Concentration (ug/m3)**	**PEC (ug/m3)**	**PEC < 70 % EQS?**
Annual Average NOx as NO2 (ug/m3)	0.49	0.75	30	**No**	7.88	8.63	Yes
Annual Average SO2 (ug/m3)	0.0105	0.07	20	Yes	2.41	2.48	Yes
Annual Average PM10 (ug/m3)	0.0004	0.01	40	Yes	12.42	12.43	Yes
Maximum 8 Hour Rolling Average CO (mg/m3)	0.00086	0.0009	10	Yes	0.0905	0.09	Yes
CUMULATIVE EFFECTS Coed Nedd a Mellte	**Maximum Result from Third Party Emissions**	**Total PC (ug/m3) Including Enviroparks Maximum**	**EQS (ug/m3)**	**PC < 1 % EQS?**	**Background Concentration (ug/m3)**	**PEC (ug/m3)**	**PEC < 70 % EQS?**
Annual Average NOx as NO2 (ug/m3)	0.18	0.26	30	Yes	7.50	7.76	Yes
Annual Average SO2 (ug/m3)	0.005	0.02	20	Yes	2.19	2.21	Yes
Annual Average PM10 (ug/m3)	0.0002	0.0025	40	Yes	11.32	11.32	Yes
Maximum 8 Hour Rolling Average CO (mg/m3)	0.0003	0.00032	10	Yes	0.0901	0.09	Yes

Table 16 Total Nitrogen Deposition to Special Areas of Conservation (Contributions from NO_x and NH_3)

Receptor Name	Rate of Total N Deposition from NOx (kg N/ha/yr)	Rate of Total N Deposition from NH3 (kg N/ha/yr)	Rate of Total Deposition as N (kg N/ha/yr)	Current Minimum Background (kg N/ha/yr)	Low End of Critical Load Range (kg N/ha/yr)	Deposition as % of Lower Critical Load
Blaen Cynon	0.16191	0.296314111	0.45822	21.98	10	**4.58%**
Cwm Cadlan	0.04962	0.081187132	0.13080	19.6	15	0.87%
Coed Nedd a Mellte	0.01605	0.025984848	0.04203	23.57	10	0.42%
Bryncarnau Grasslands Llwyncoed	0.01939	0.026140413	0.04553	25.34	15	0.3035%

Note: Bryncarnau Grasslands is also assessed as deposition values exceeded 1 % of the Critical Load when modelled in 2008 / 2009

Table 17 Total Acid Deposition to Special Areas of Conservation

Total Deposited Acid Contributions	NOx as NO2			50 % NOx as NO2		
	Blaen Cynon	Cwm Cadlan	Coed Nedd a Mellte	Blaen Cynon	Cwm Cadlan	Coed Nedd a Mellte
Rate of Total Dry Deposition as N (kg N/ha/yr)	0.458	0.131	0.042	0.377	0.106	0.034
Rate of Total Dry Deposition as N (kg eq/ha/yr)	0.033	0.009	0.003	0.027	0.008	0.002
Low End of Critical Load Range N (kg eq/ha/yr)	0.438	0.223	0.142	0.438	0.223	0.142
Deposition as % of Lower Critical Load	7.5%	4.2%	2.1%	6.2%	3.4%	1.7%
Current Minimum N Background (kg eq/ha/yr)	1.57	1.40	1.78	1.57	1.40	1.78
PEC N (kg eq/ha/yr)	1.6027	1.4093	1.7830	1.5969	1.4076	1.7824
Rate of Total Dry Deposition as S (kg S/ha/yr)	0.4981	0.1446	0.0464	0.4981	0.1446	0.0464
Rate of Total Dry Deposition as S (kg eq/ha/yr)	0.0311	0.0090	0.0029	0.0311	0.0090	0.0029
Rate of Total Deposition as HCl (kg H/ha/yr)	0.03615	0.00961	0.00310	0.03615	0.00961	0.00310
Rate of Total Deposition as S and H (kg eq/ha/yr)	0.06728	0.01865	0.00600	0.06728	0.01865	0.00600
Low End of Critical Load Range S (kg eq/ha/yr)	0.58	0.58	1.552	0.580	0.580	1.552
Deposition as % of Lower Critical Load	11.6%	3.2%	0.4%	11.6%	3.2%	0.4%
Current Minimum S Background (kg eq/ha/yr)	0.53	0.46	0.47	0.53	0.46	0.47
PEC S and H (kg eq/ha/yr)	0.59728	0.47865	0.47600	0.59728	0.47865	0.47600
PC Acid (kg eq/ha/yr)	0.10001	0.02799	0.00900	0.09423	0.02622	0.00843
% of Critical Load	**9.8%**	**3.5%**	0.53%	**9.3%**	**3.3%**	0.50%
PEC Acid (kg eq/ha/yr)	2.20	1.89	2.26	2.19	1.89	2.26
% of Critical Load	**216%**	**235%**	**133%**	**216%**	**235%**	**133%**

Note: Total HCl deposition is calculated as 3 x dry HCl deposition.

Table 18 Total Nitrogen and Acid Deposition to Special Areas of Conservation as Cumulative Effects

Total Deposited Nitrogen Contributions	**Blaen Cynon**	**Cwm Cadlan**	**Coed Nedd a Mellte**
Rate of Total N Deposition from NOx (kg N/ha/yr)	0.545	0.136	0.0349
Rate of Total N Deposition from NH3 (kg N/ha/yr)	0.296	0.081	0.026
Rate of Total Deposition as N (kg N/ha/yr)	0.841	0.217	0.061
Current Minimum Background (kg N/ha/yr)	21.98	19.6	23.57
Low End of Critical Load Range (kg N/ha/yr)	10	15	10
Deposition as % of Lower Critical Load	**8.4%**	**1.4%**	0.6%

Total Deposited Acid Contributions	**NOx as NO2**			**50 % NOx as NO2**		
	Blaen Cynon	**Cwm Cadlan**	**Coed Nedd a Mellte**	**Blaen Cynon**	**Cwm Cadlan**	**Coed Nedd a Mellte**
Rate of Total Dry Deposition as N (kg N/ha/yr)	0.84148	0.21749	0.06091	0.56890	0.14934	0.04345
Rate of Total Dry Deposition as N (kg eq/ha/yr)	0.06011	0.01554	0.00435	0.04064	0.01067	0.00310
Low End of Critical Load Range N (kg eq/ha/yr)	0.438	0.223	0.142	0.438	0.223	0.142
Deposition as % of Lower Critical Load	14%	7%	3%	9%	5%	2%
Current Minimum N Background (kg eq/ha/yr)	1.57	1.4	1.78	1.57	1.4	1.78
PEC N (kg eq/ha/yr)	1.63011	1.41554	1.78435	1.61064	1.41067	1.78310
Rate of Total Dry Deposition as S (kg S/ha/yr)	1.15791	0.16015	0.04044	1.15791	0.16015	0.04044
Rate of Total Dry Deposition as S (kg eq/ha/yr)	0.0724	0.0100	0.0025	0.0724	0.0100	0.0025
Rate of Total Deposition as HCl (kg H/ha/yr)	0.03615	0.00961	0.00310	0.03615	0.00961	0.00310
Rate of Total Deposition as S and H (kg eq/ha/yr)	0.10852	0.01962	0.00563	0.10852	0.01962	0.00563
Low End of Critical Load Range S (kg eq/ha/yr)	0.58	0.58	1.552	0.58	0.58	1.552
Deposition as % of Lower Critical Load	18.7%	3.4%	0.4%	18.7%	3.4%	0.4%
Current Minimum S Background (kg eq/ha/yr)	0.53	0.46	0.47	0.53	0.46	0.47
PEC S and H (kg eq/ha/yr)	0.63852	0.47962	0.47563	0.63852	0.47962	0.47563
PC Acid (kg eq/ha/yr)	0.16862	0.03516	0.00998	0.14915	0.03029	0.00873
% of Critical Load	**16.6%**	**4.4%**	0.59%	**14.7%**	**3.8%**	0.52%
PEC Acid (kg eq/ha/yr)	2.26862	1.89516	2.25998	2.24915	1.89029	2.25873
% of Critical Load	**223%**	**236%**	**133%**	**221%**	**235%**	**133%**

Note: Total HCl deposition is calculated as 3 x dry HCl deposition.

Table 19 Consideration of Deposition to Drinking Water; Penderyn Reservoir and Dwr Cymru Service Reservoir

Pollutant	WQ Standard (mg/l)	Contribution to Penderyn Reservoir Per Year (mg/l)	Contribution to Service Reservoir Per Fill (mg/l)	Total Contribution (mg/l)	Contribution as a % of Water Quality Standard
Nitrite	0.5	2.04E-02	5.84E-06	2.04E-02	4.087%
Nitrite (Cumulative)	0.5	3.66E-02	1.24E-05	3.66E-02	7.327%
Benzene	0.001	6.49E-06	1.91E-09	6.49E-06	0.649%
Chloride	250	1.08E-02	1.71E-07	1.08E-02	0.004%
Fluoride	1.5	7.03E-04	1.72E-08	7.03E-04	0.047%
Mercury	0.001	3.47E-06	1.02E-09	3.47E-06	0.347%
Antimony	0.005	3.58E-06	1.06E-09	3.58E-06	0.072%

Notes:
Nitrite (Cumulative) considers the total exposure of the water storage infrastructure when considering the Enviroparks emissions in combination with other third party sources proposed or recently built.
Benzene is assumed to comprise 1 % of the total VOC deposition, and Antimony is assumed to comprise 1/9th of the combined total of Heavy Metal deposition.

FIGURES

All figures include results for discharges from three gasification lines firing simultaneously and discharging through a 45 m high stack.

Base maps are taken from Ordnance Survey OS Select Explorer Map OL12, Brecon Beacon National Park, Western Area. 2016; 1:25,000 Scale, and OS Explorer Map 166 Rhondda and Merthyr Tydfil. 2015; 1:25,000 Scale.

Figure 1 Maximum Annual Average Process Contribution of NOx (ug/m3)
With all NOx Modelled as NO2; 2011 Meteorological Data

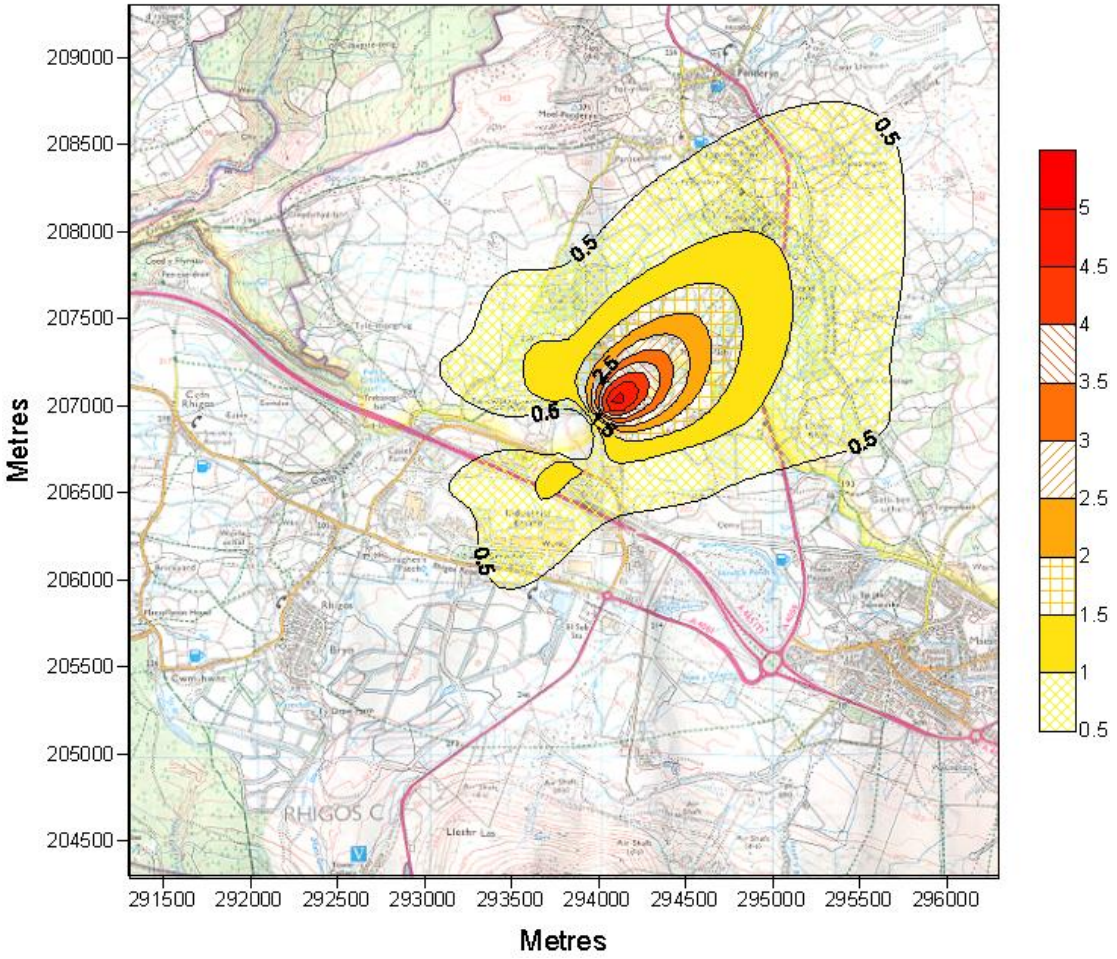

Figure 2 Maximum 99.97th Percentile Hourly Average Process Contribution of NOx (ug/m3) With all NOx Modelled as NO2; 2011 Meteorological Data

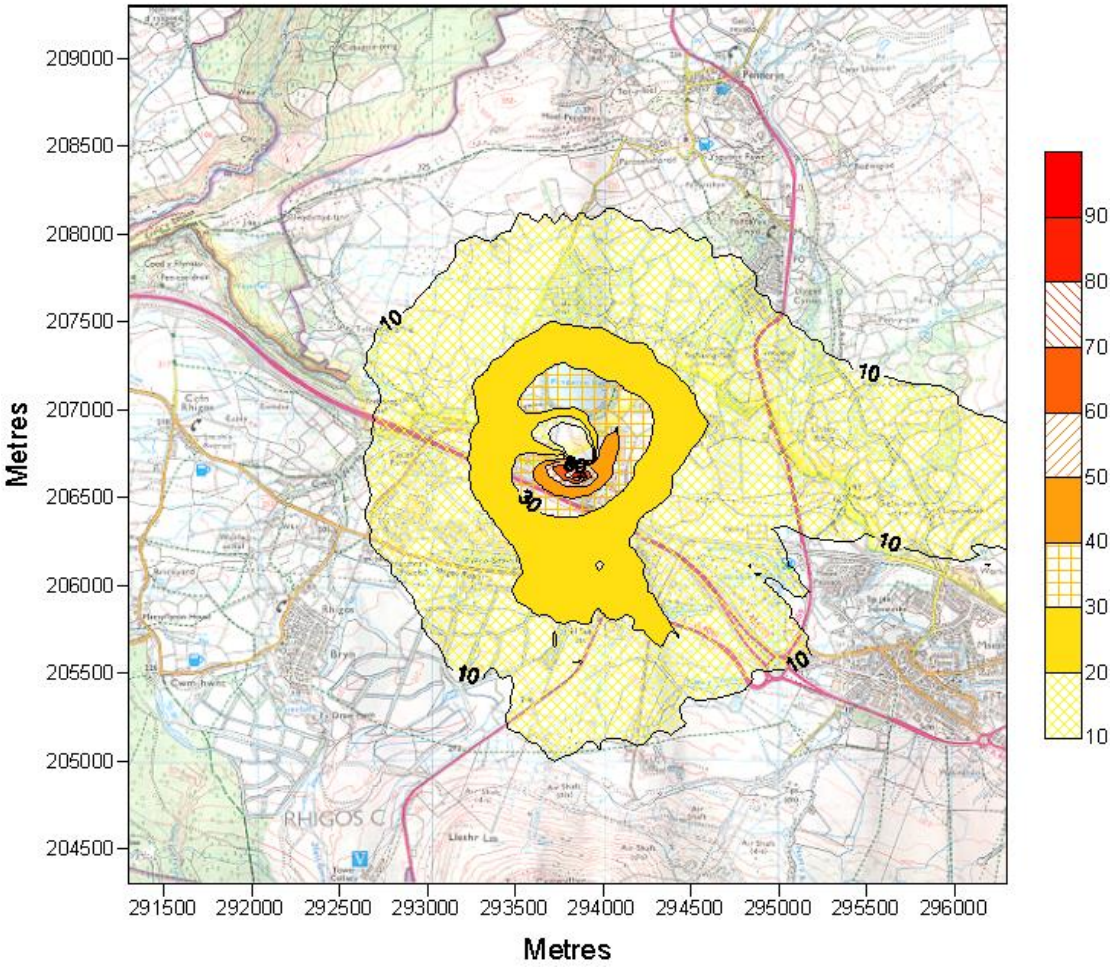

Figure 3 Maximum 99.9th Percentile 15 Minute Average Process Contribution of SO2 (ug/m3) 2011 Meteorological Data

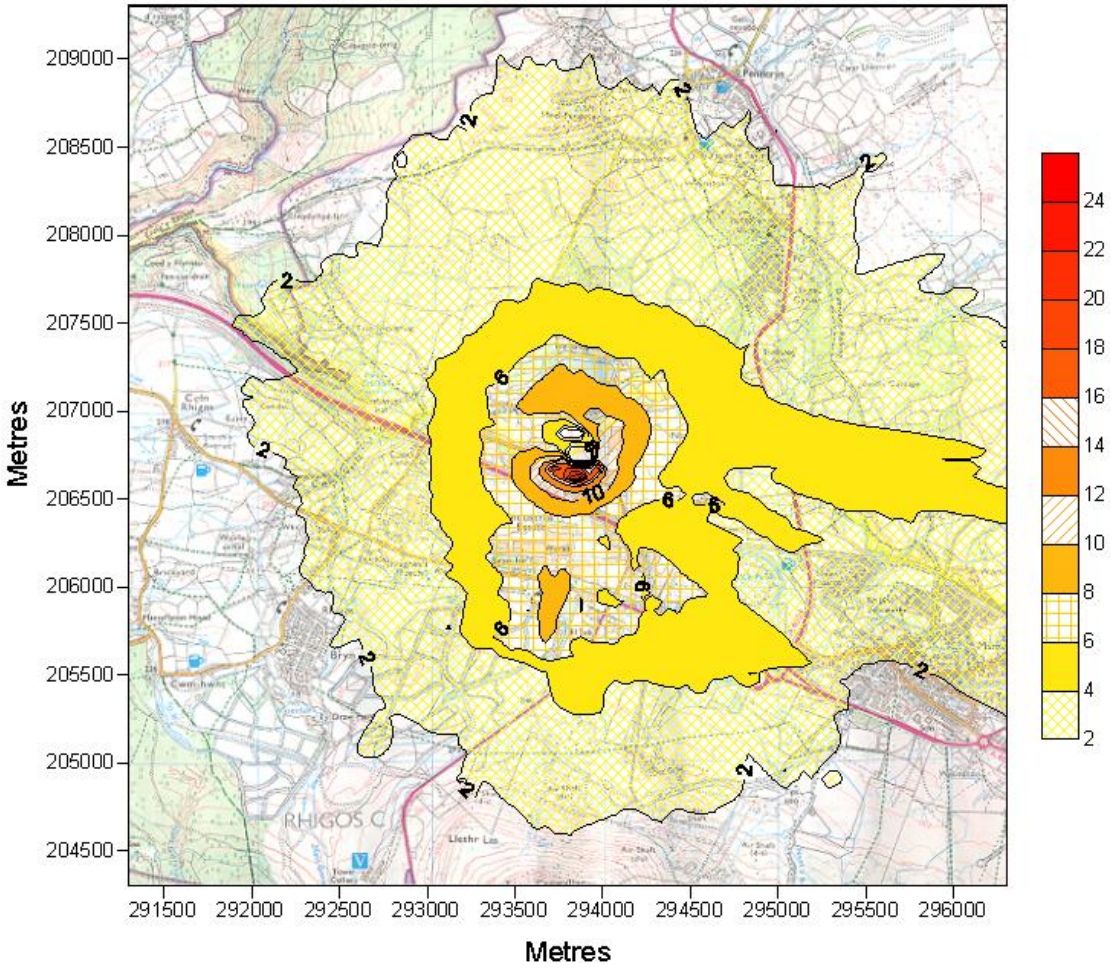

Figure 4 Maximum 99.73rd Percentile Hourly Average Process Contribution of SO2 (ug/m3) 2011 Meteorological Data

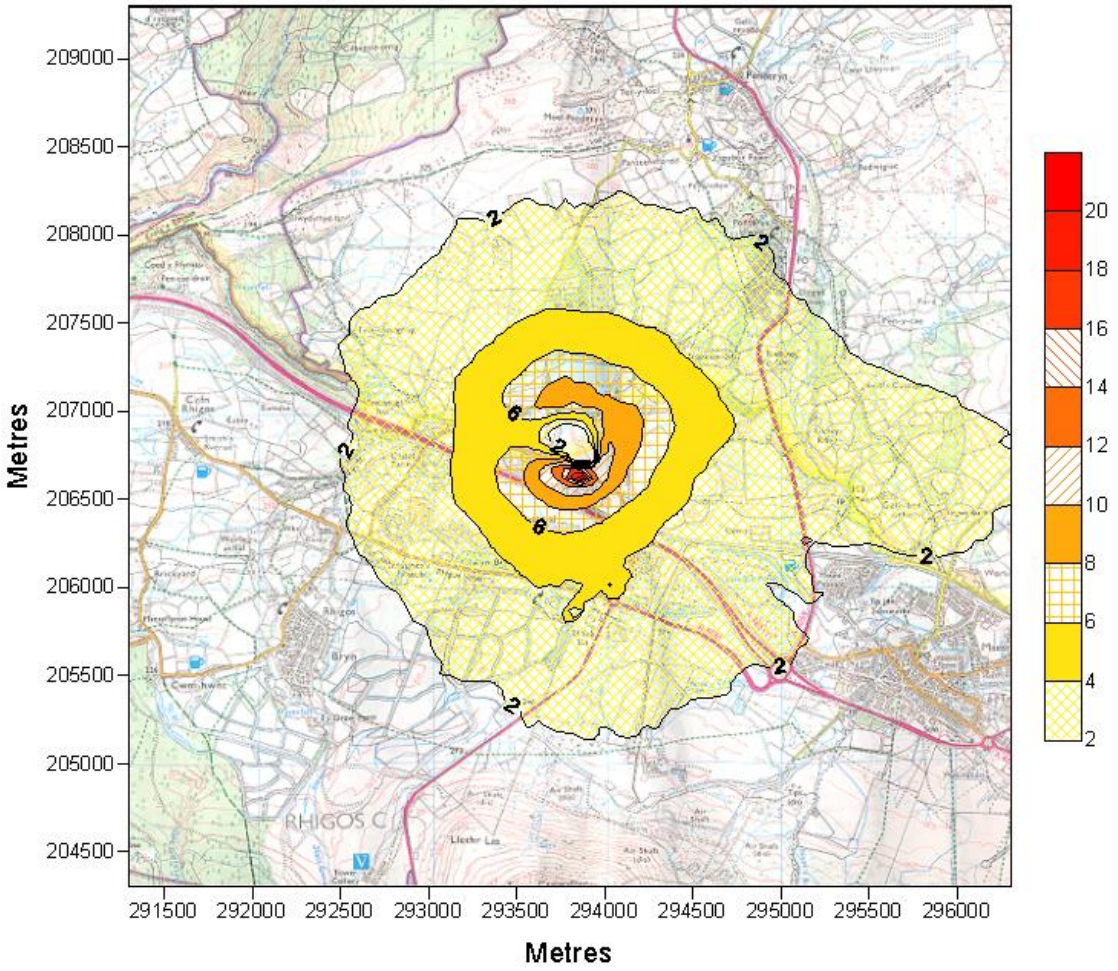

Figure 5 Maximum 99.18th Percentile 24 Hourly Average Process Contribution of SO2 (ug/m3) 2011 Meteorological Data

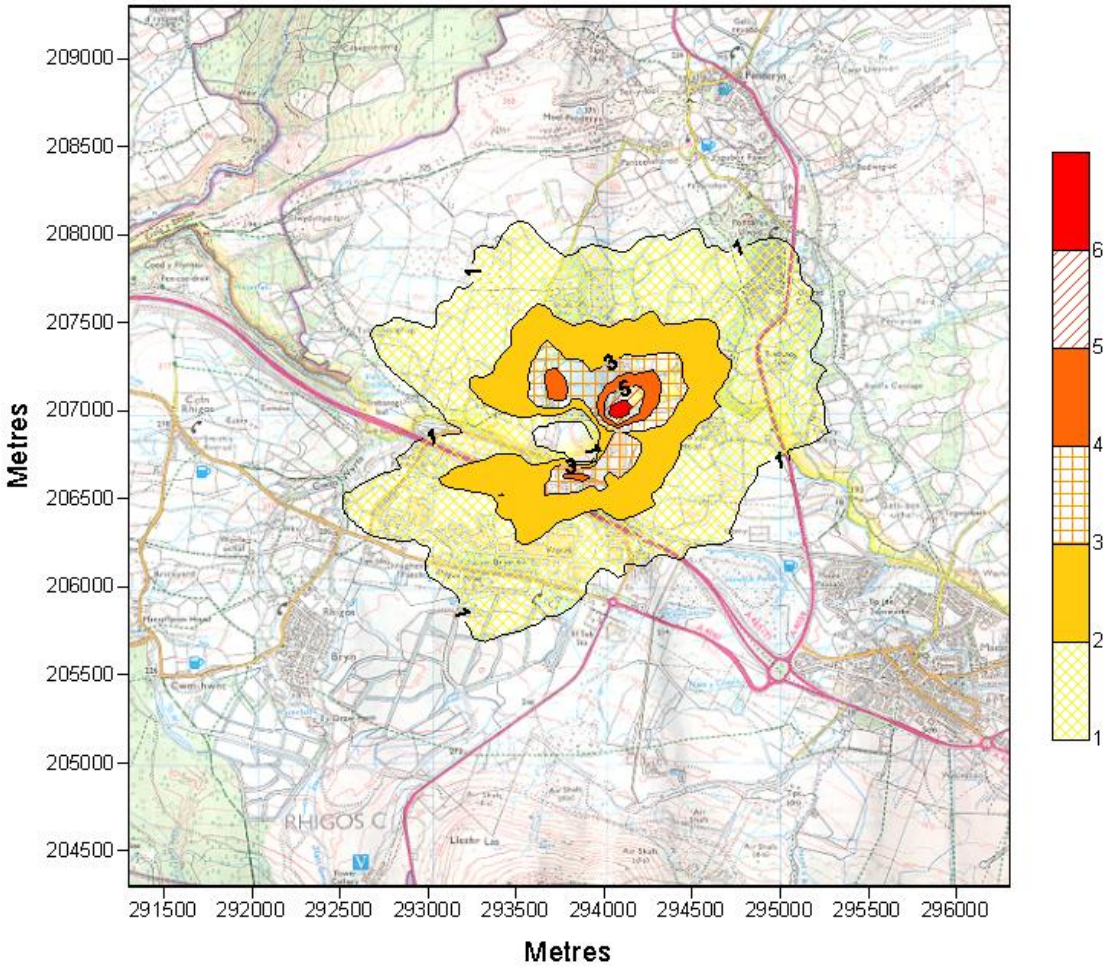

Figure 6 Maximum 99.41st Percentile 24 Hourly Average Process Contribution of PM10 (ug/m3) 2011 Meteorological Data

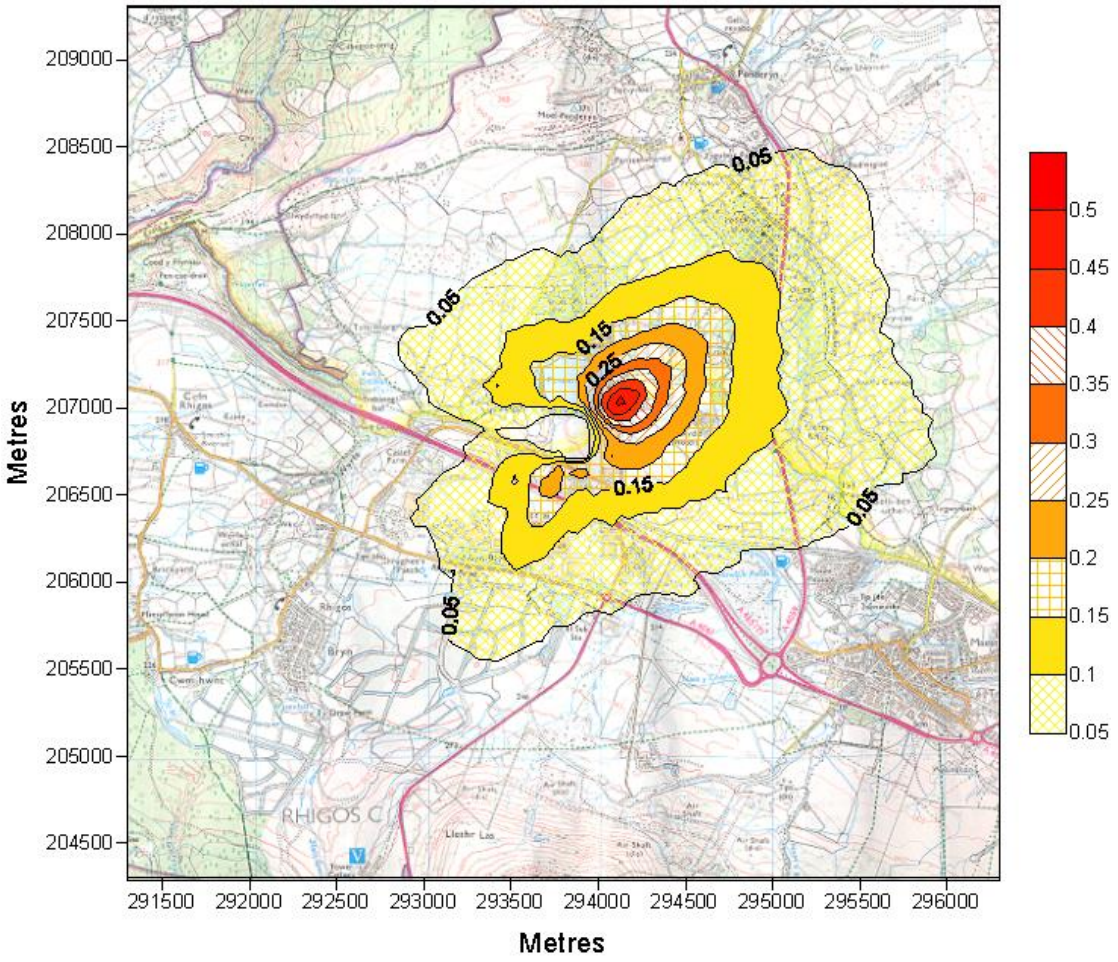

Figure 7 Maximum Annual Average Process Contribution of PM10 (ug/m3) 2011 Meteorological Data

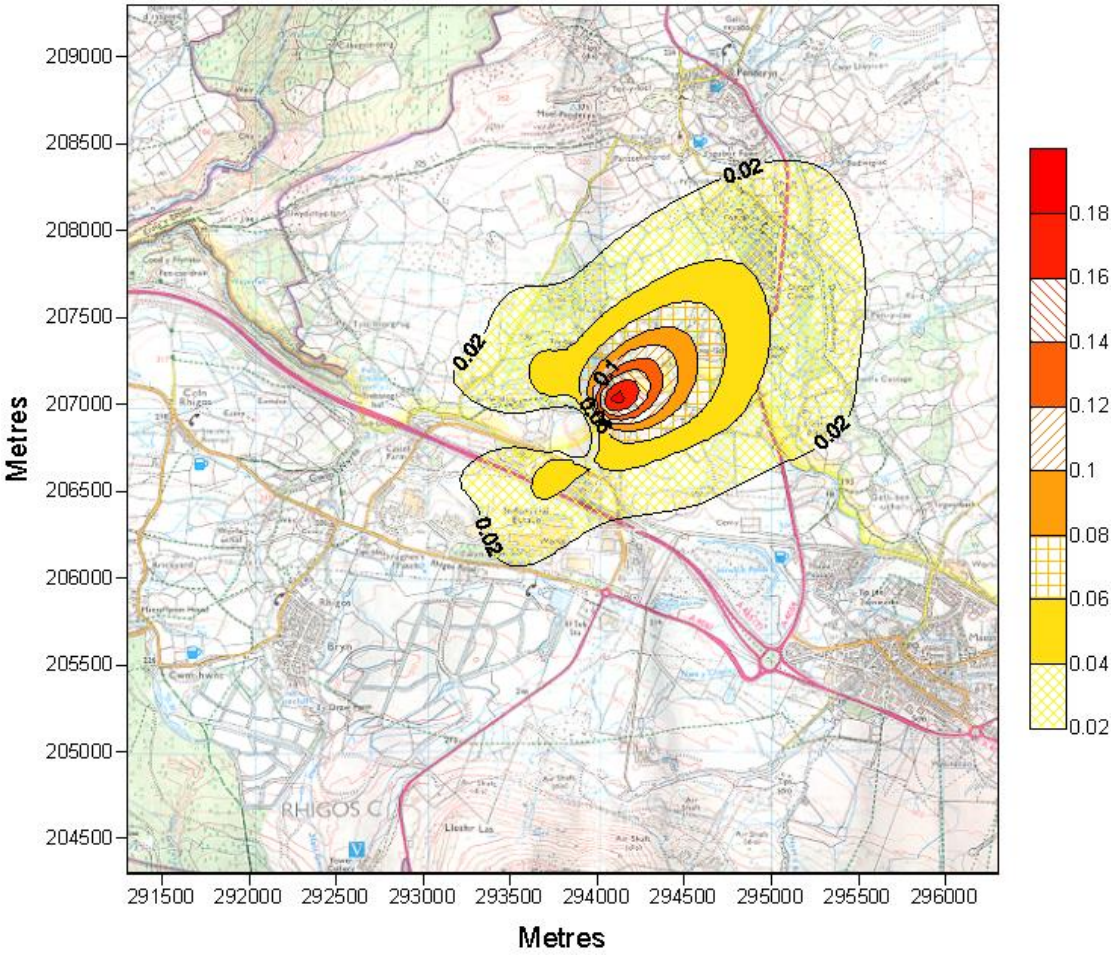

Figure 8 Maximum Annual Average Process Contribution of PM2.5 (ug/m3) 2011 Meteorological Data

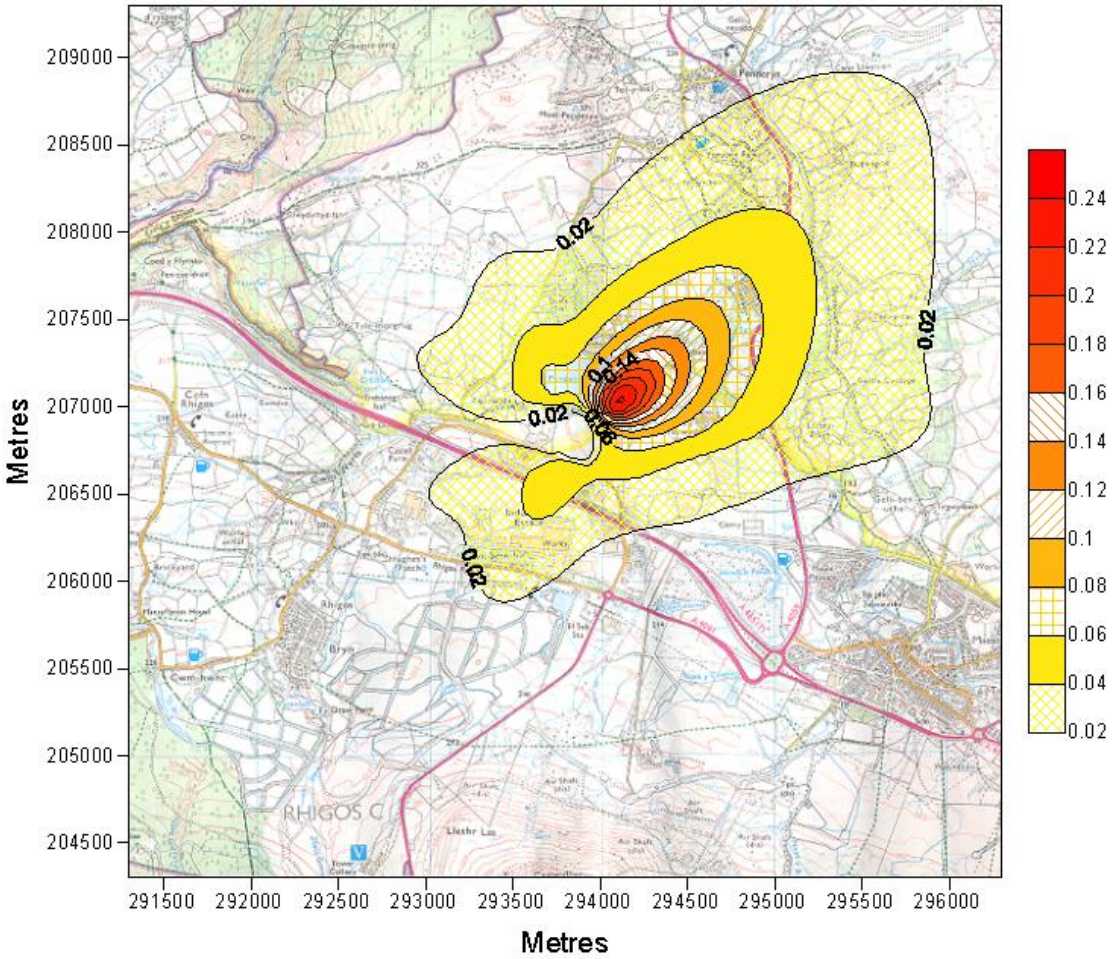

Figure 9 8 Hour Rolling Average Process Contribution of Carbon Monoxide (ug/m3) 2015 Meteorological Data

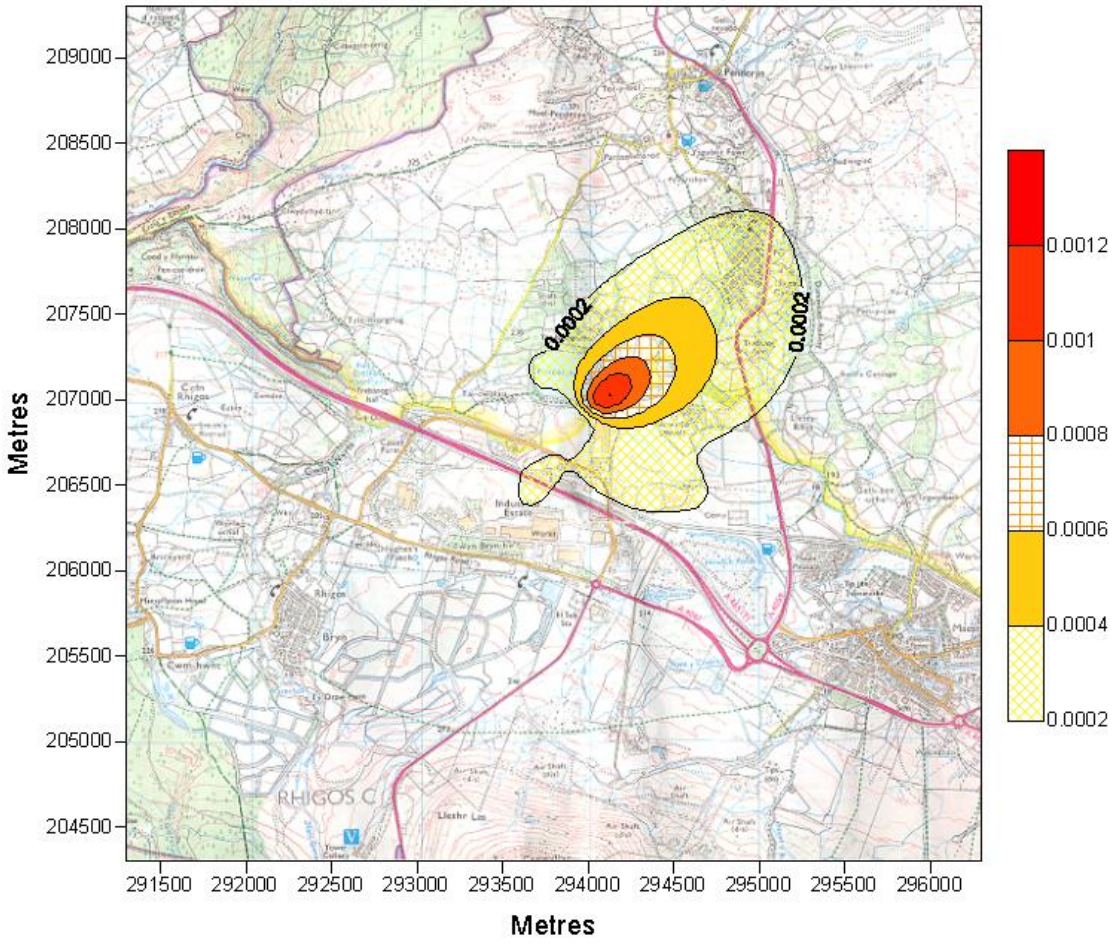

Figure 10 Maximum Annual Average Process Contribution of VOC (ug/m3) 2011 Meteorological Data

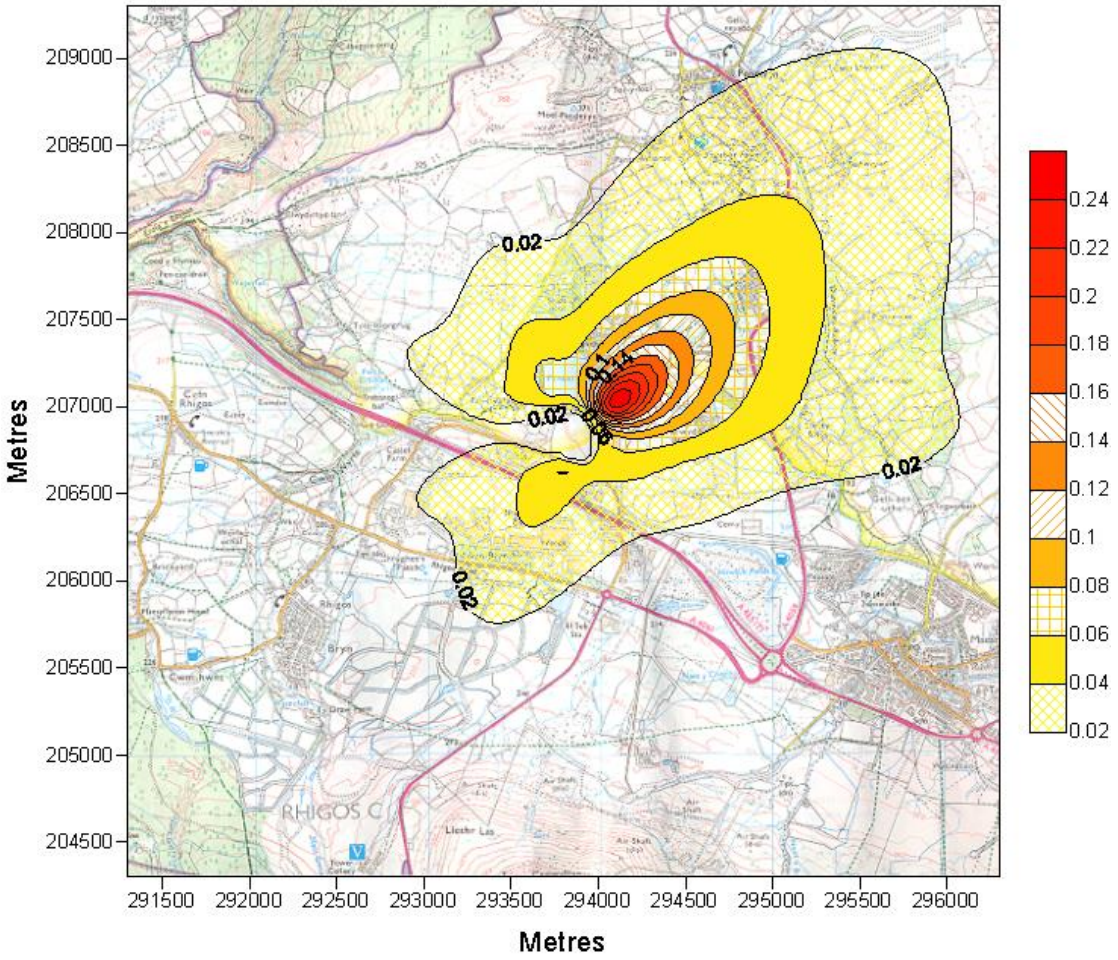

Figure 11 Maximum Annual Average Process Contribution of Mercury (ug/m3) 2011 Meteorological Data

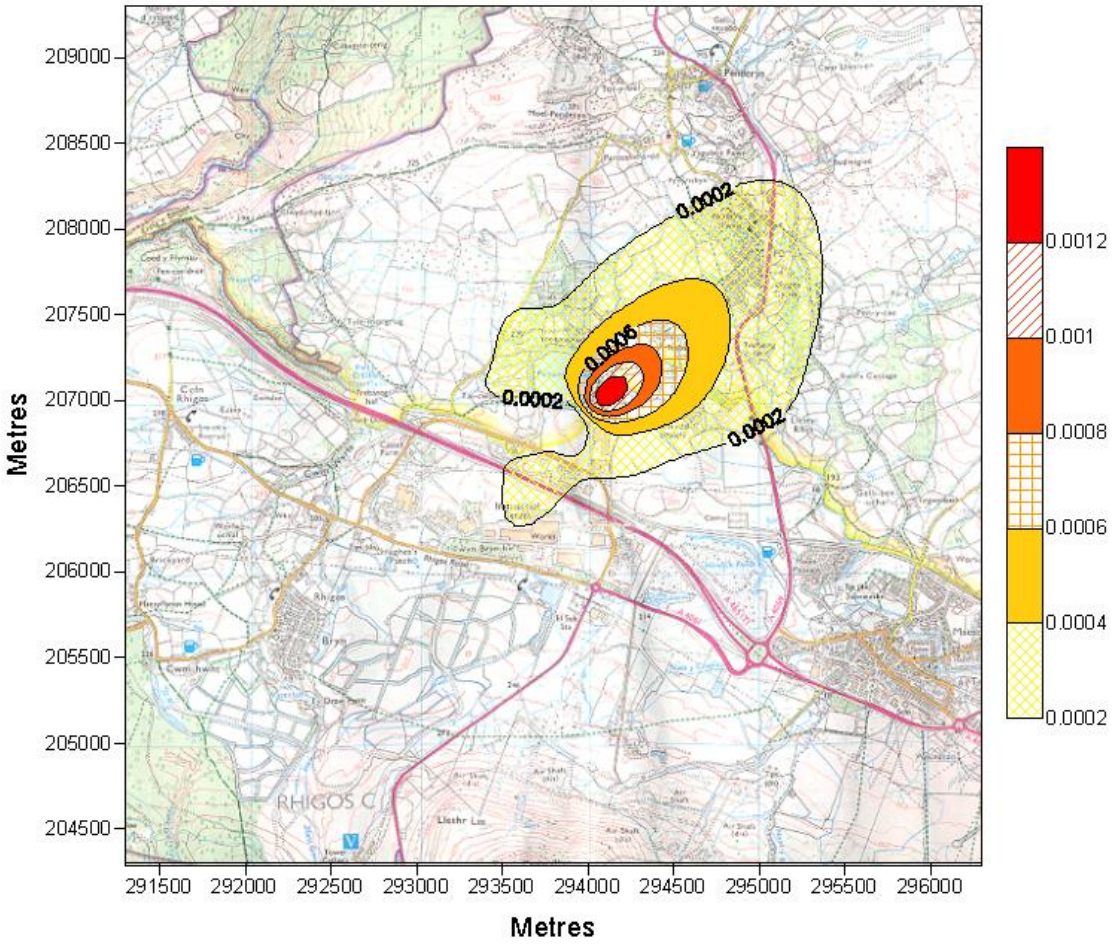

Figure 12 Maximum Annual Average Process Contribution of Cadmium (ng/m3) 2011 Meteorological Data

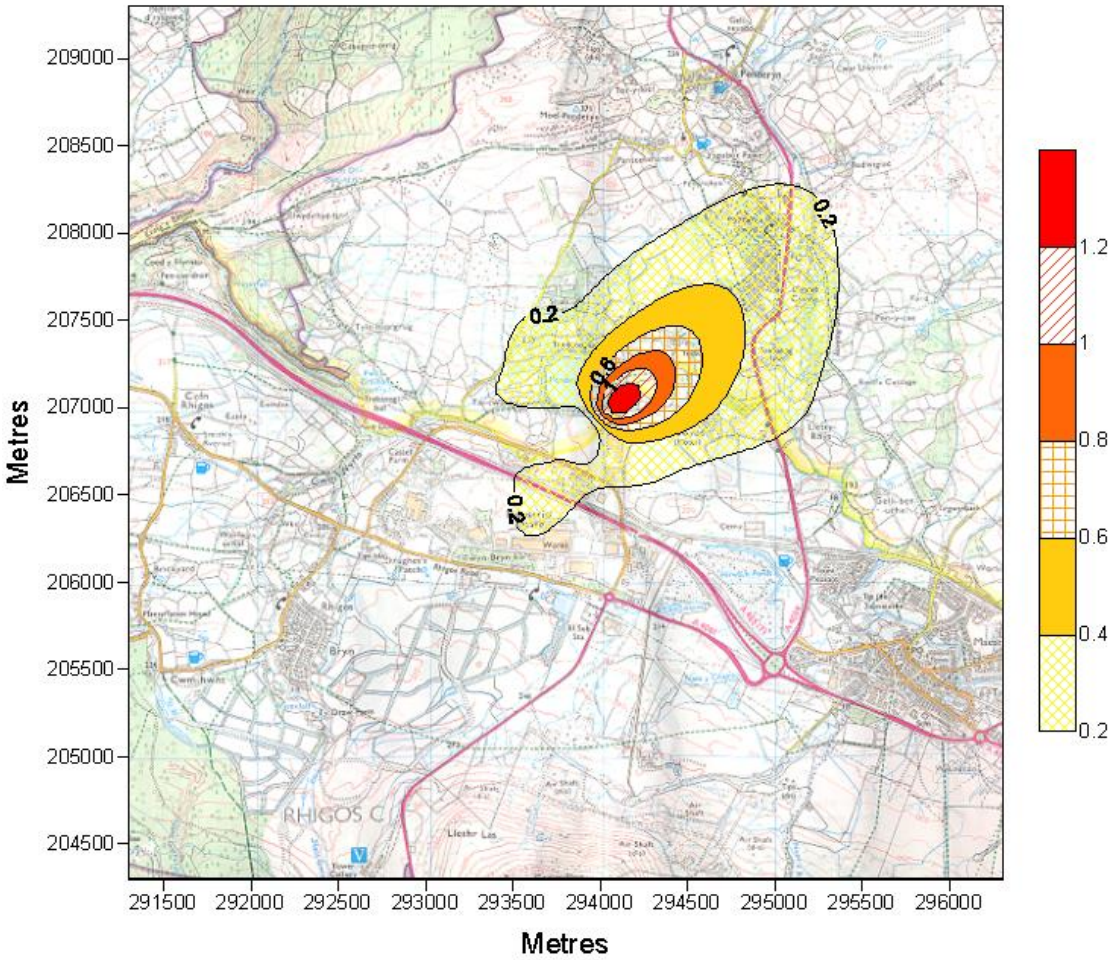

Figure 13 Maximum Annual Average Process Contribution of Heavy Metals as Lead (ug/m3) 2011 Meteorological Data

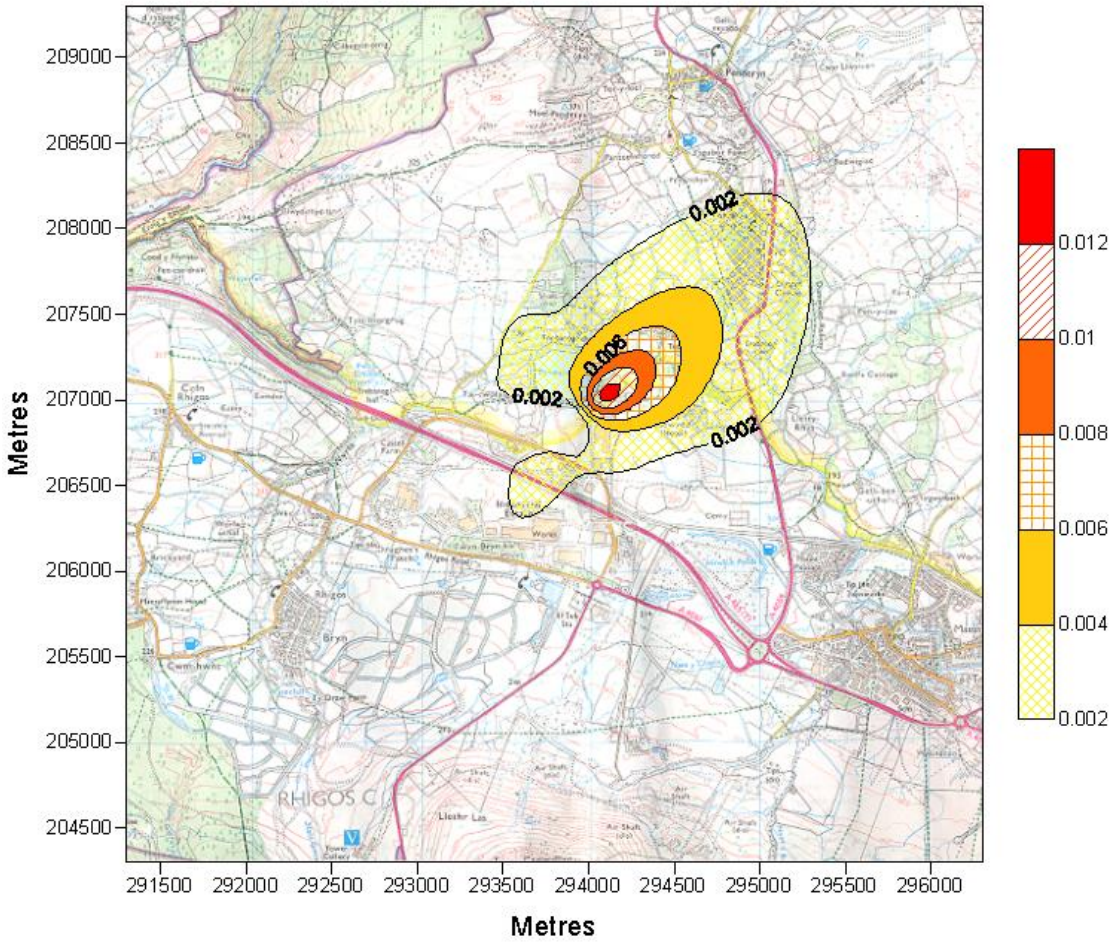

Figure 14 Maximum Annual Average Process Contribution of Hydrogen Chloride (ug/m3) 2013 Meteorological Data

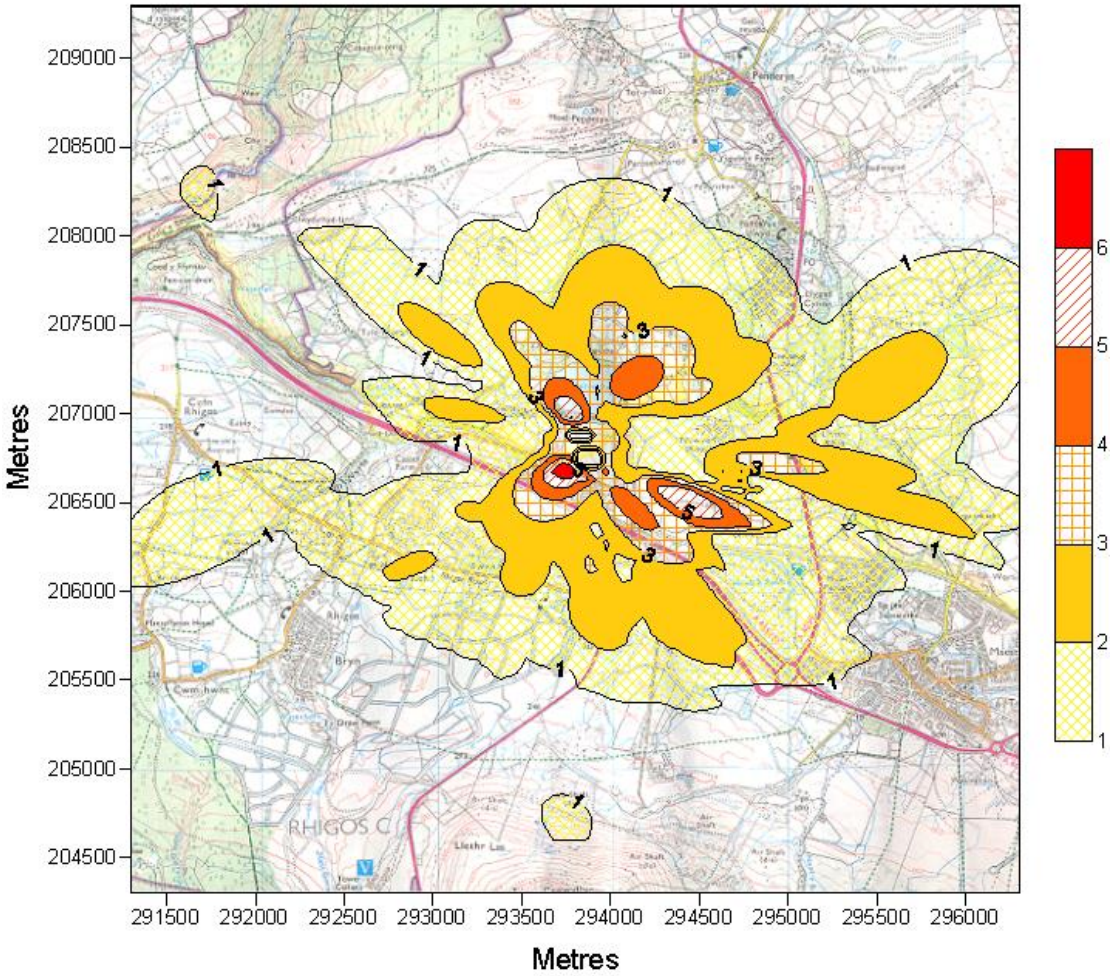

Figure 15 Maximum Annual Average Process Contribution of Hydrogen Fluoride (ug/m3) 2013 Meteorological Data

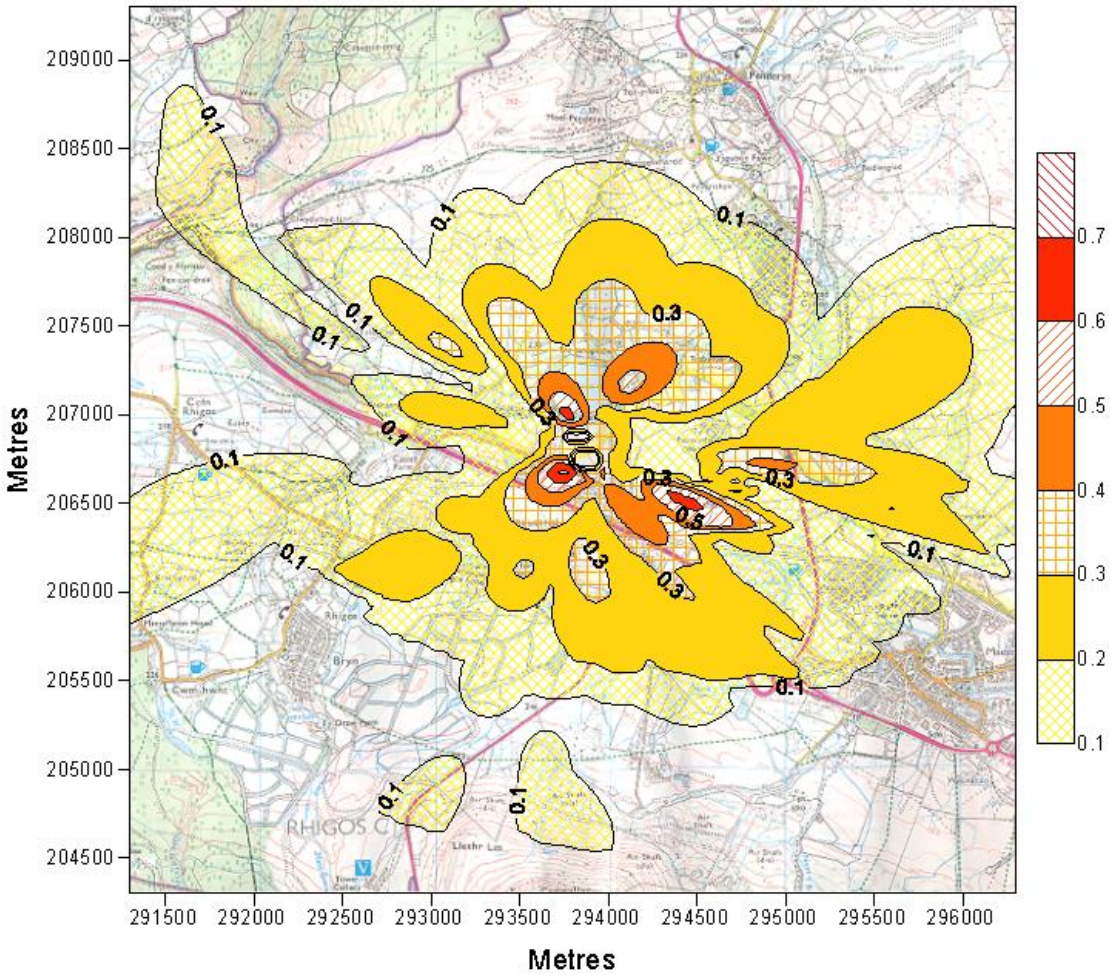

Figure 16 Maximum Annual Average Process Contribution of PAH (ng/m3) 2011 Meteorological Data

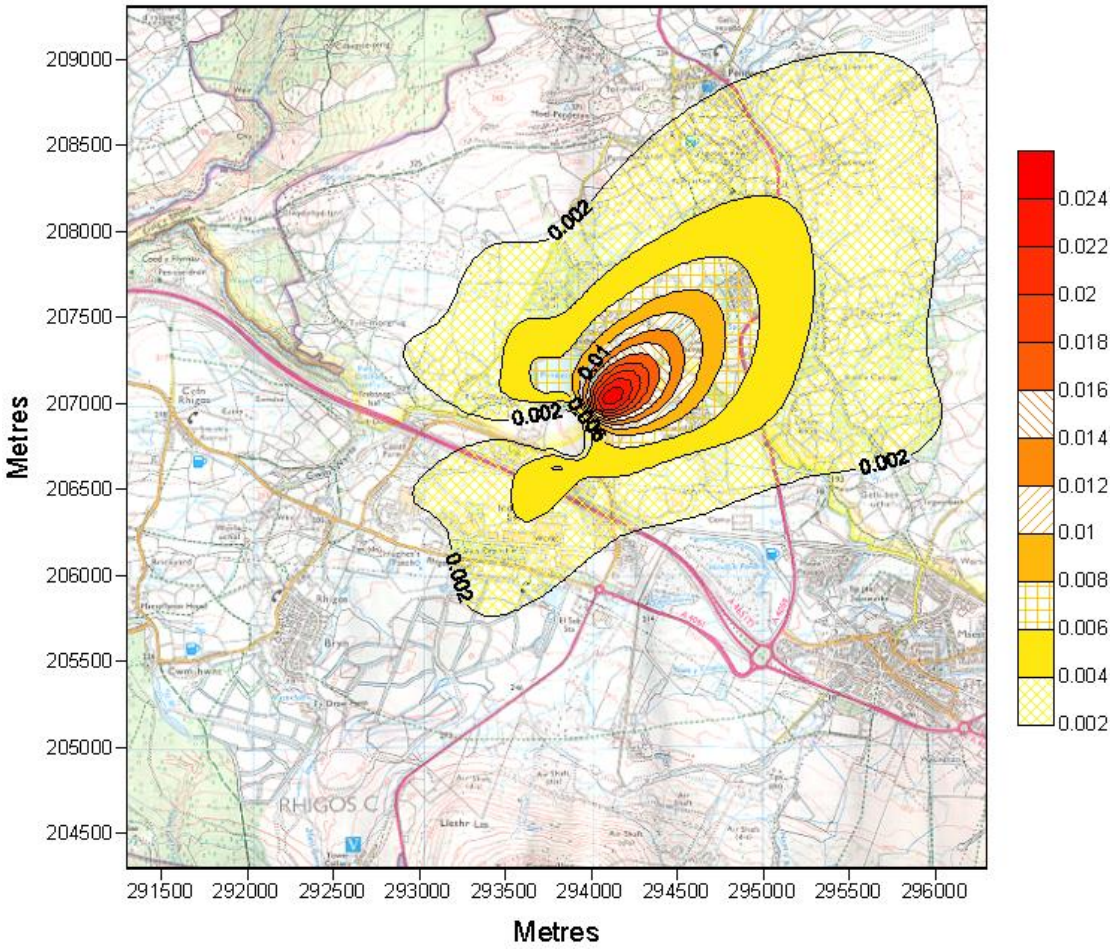

Figure 17 Maximum Annual Average Process Contribution of PCBs (ug/m3) 2011 Meteorological Data

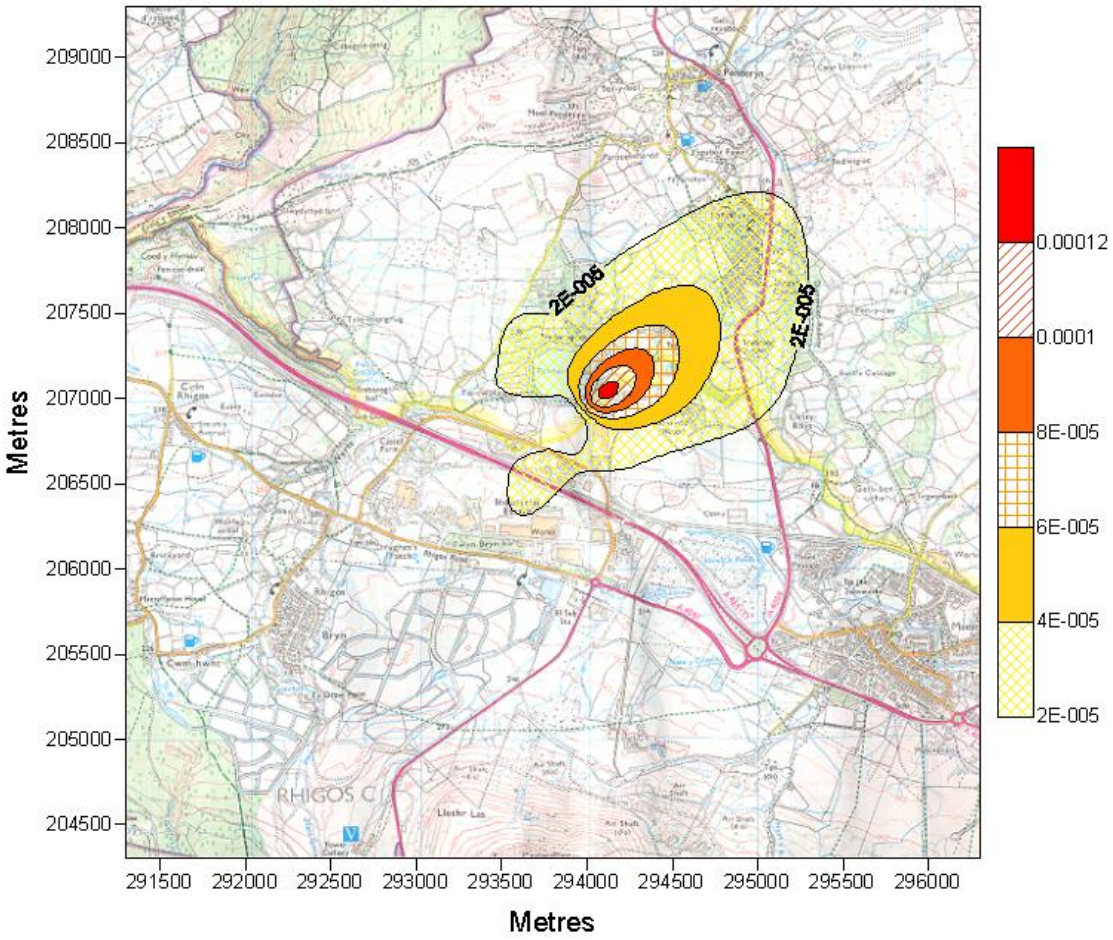

Figure 18 Maximum Annual Average Process Contribution of Ammonia (ug/m3) 2015 Meteorological Data

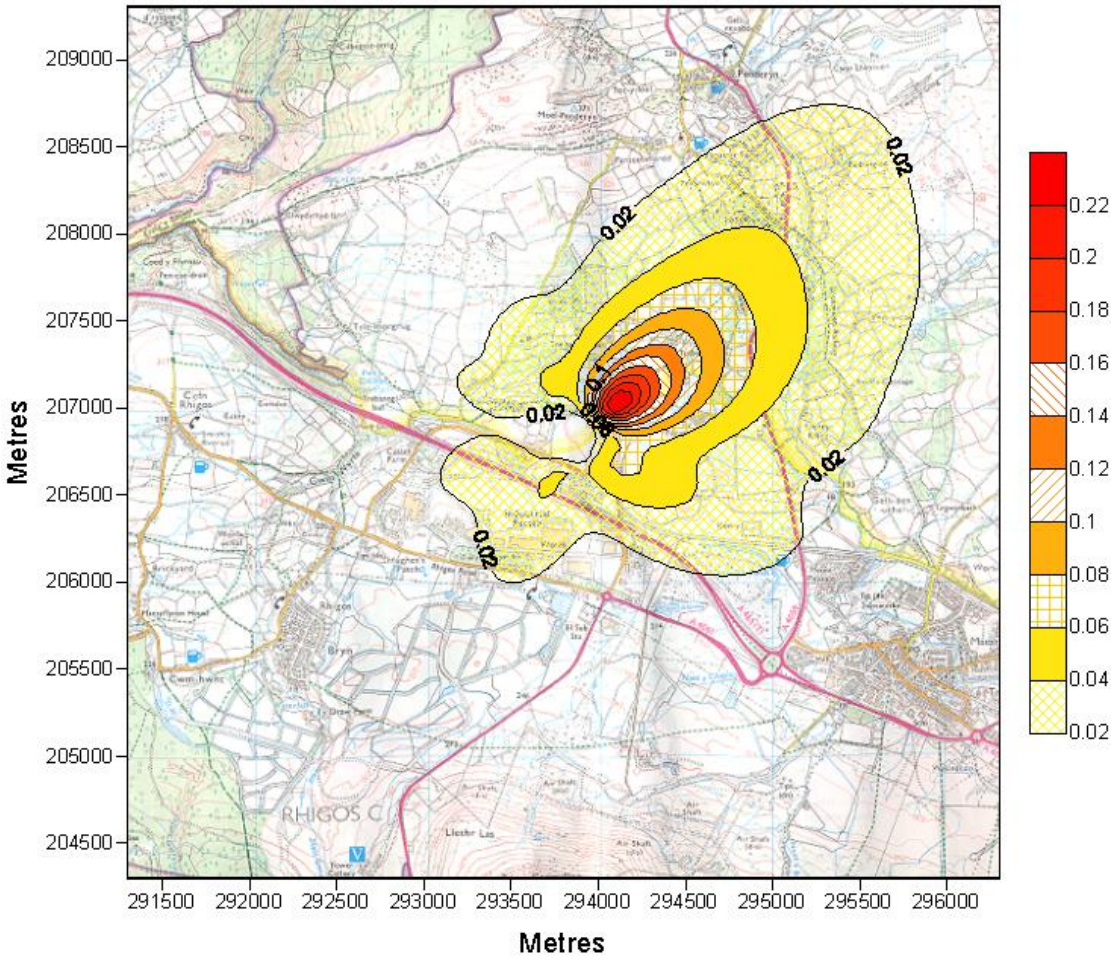

Figure 19 99.97th Percentile Process Contributions to NOx with all NOx Modelled as NO2 During Abatement Failure; 2015 Meteorological Data

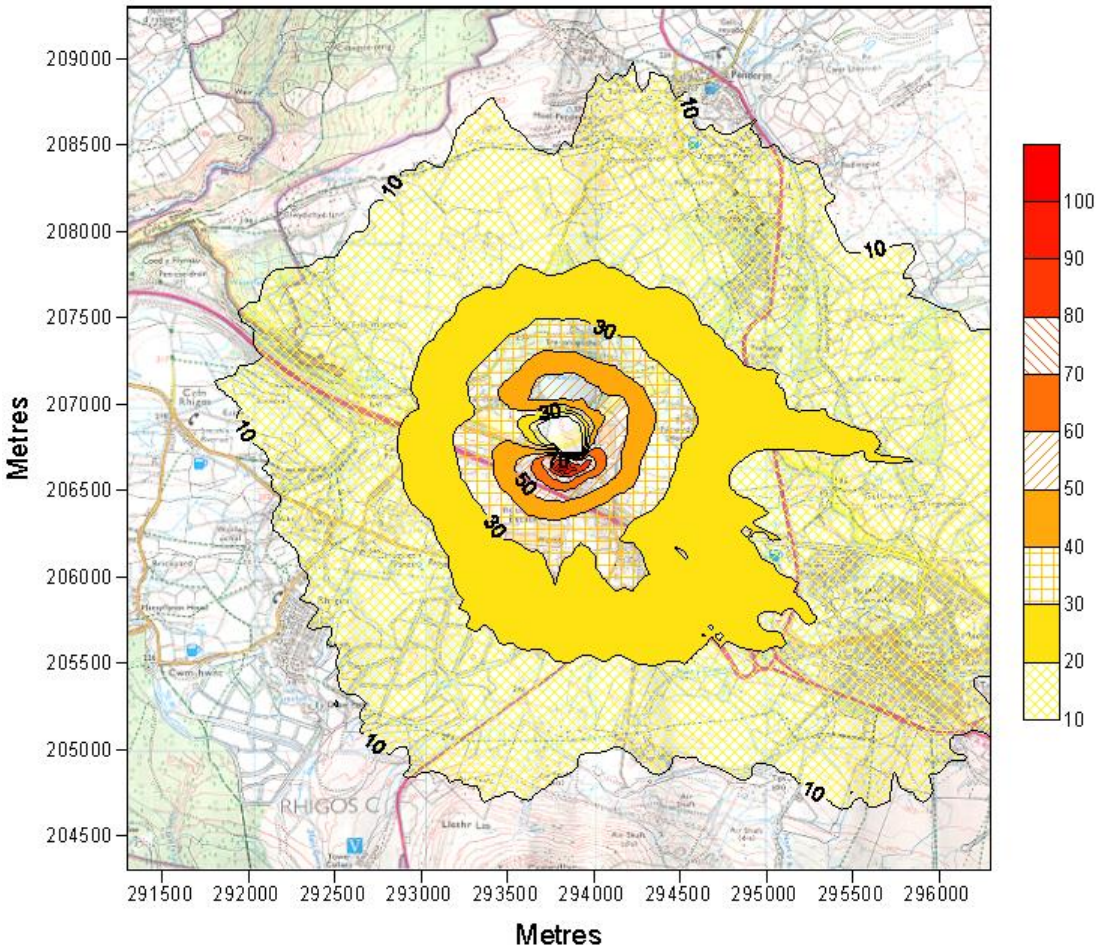

Figure 20 99.97th Percentile of Third-Party Contributions to NOx with all NOx Modelled as NO2 2015 Meteorological Data Applied with No Contribution from Enviroparks Shown

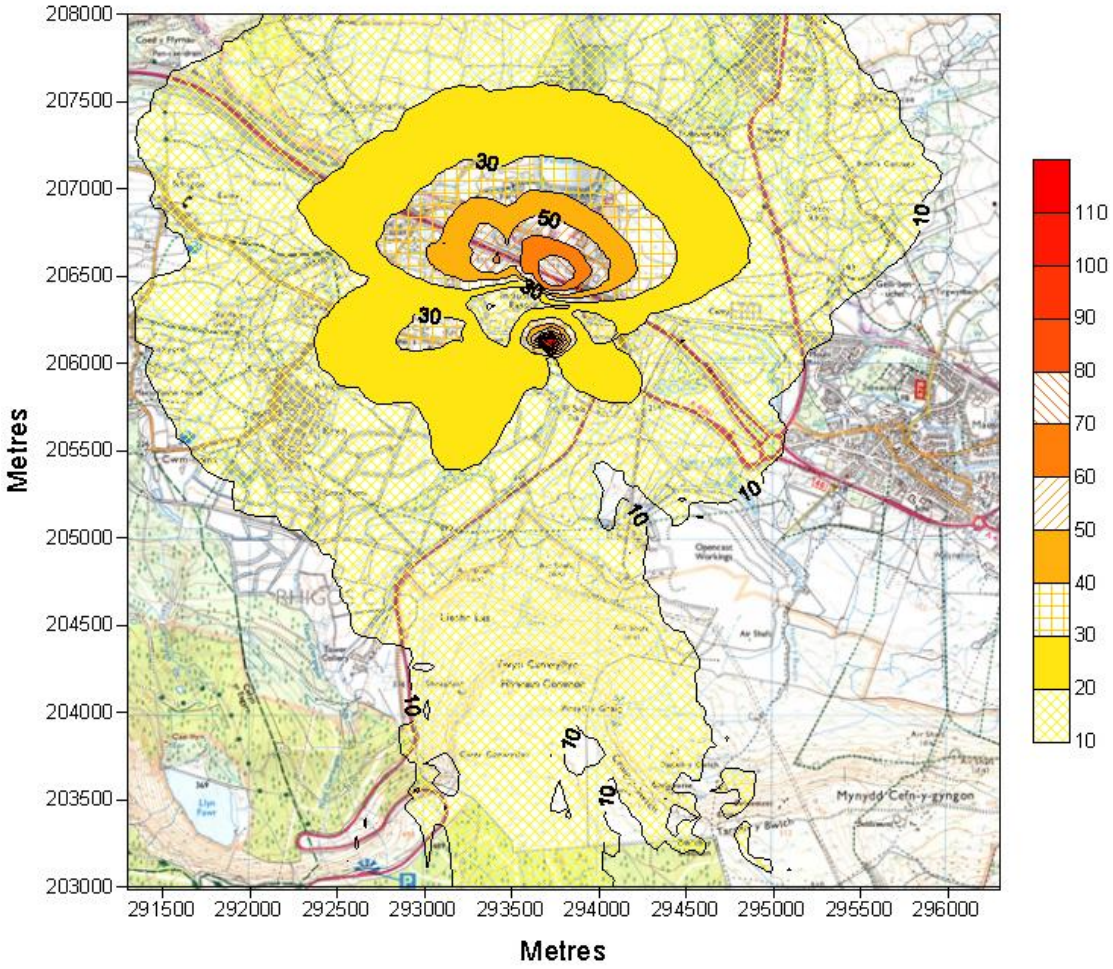

Figure 21 99.97th Percentile of Cumulative Contributions to NOx with all NOx Modelled as NO2 2015 Meteorological Data Applied with Added Contribution from Enviroparks Shown

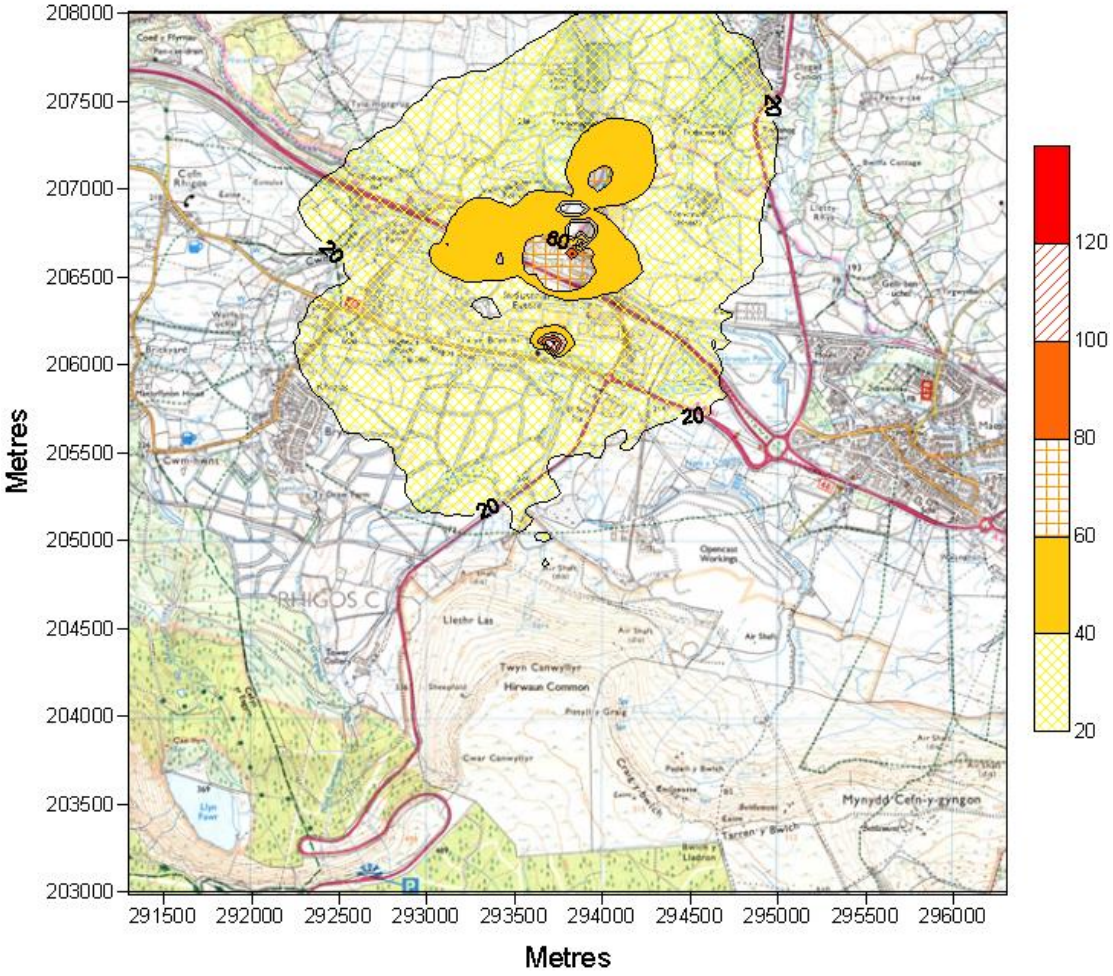

Figure 22 Critical Load Charts for Blaen Cynon; Cumulative Deposition

Critical Load Function

CLmaxS:	0.58
CLminN:	0.438
CLmaxN:	1.161

Deposition data

Source	keq/ha/yr		
	Sulphur Deposition	Nitrogen Deposition	Total Acid Deposition (S+N)
Process Contribution (PC)	0.109	0.060	0.17
Background	0.53	1.57	2.1
Predicted Environmental Concentration (PEC)	0.64	1.63	2.27

Results - exceedance and deposition as a proportion of the CL function

Source	Exceedance (keq/ha/yr)	% of CL function*
Process Contribution (PC)	no exceedance of CL function	14.6
Background	0.94	180.9
Predicted Environmental Concentration (PEC)	1.11	195.5

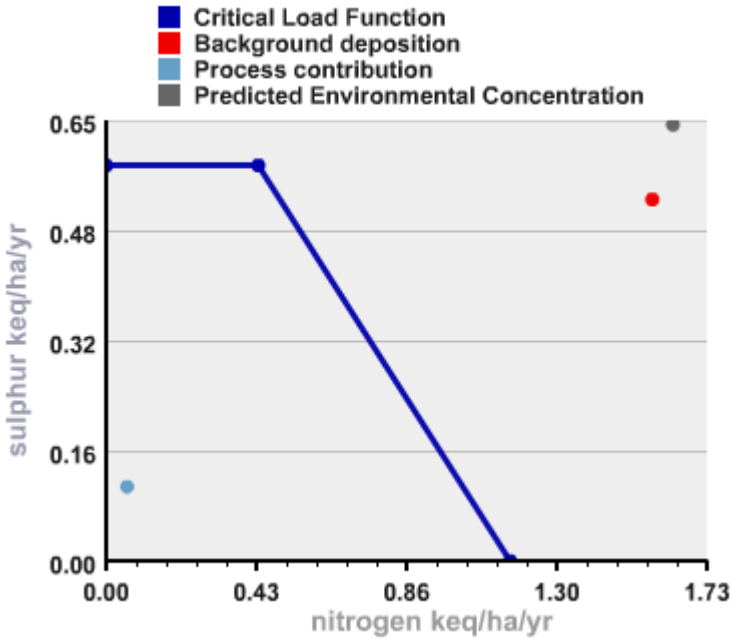

Figure 23 Critical Load Charts for Cwm Cadlan; Cumulative Deposition

Critical Load Function

CLmaxS:	0.58
CLminN:	0.223
CLmaxN:	1.161

Deposition data

Source	keq/ha/yr		
	Sulphur Deposition	Nitrogen Deposition	Total Acid Deposition (S+N)
Process Contribution (PC)	0.0196	0.0155	0.04
Background	0.46	1.4	1.86
Predicted Environmental Concentration (PEC)	0.48	1.42	1.9

Results - exceedance and deposition as a proportion of the CL function

Source	Exceedance (keq/ha/yr)	% of CL function*
Process Contribution (PC)	no exceedance of CL function	3.4
Background	0.7	160.2
Predicted Environmental Concentration (PEC)	0.74	163.7

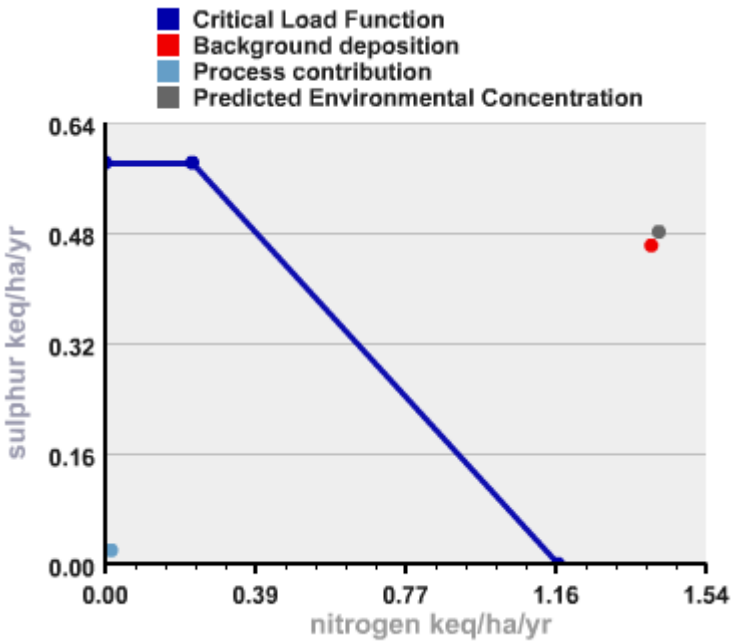

Figure 23 Critical Load Charts for Coed Nedd a Mellte; Cumulative Deposition

Critical Load Function

CLmaxS:	1.552
CLminN:	0.142
CLmaxN:	1.837

Deposition data

Source	keq/ha/yr		
	Sulphur Deposition	Nitrogen Deposition	Total Acid Deposition (S+N)
Process Contribution (PC)	0.0056	0.0044	0.01
Background	0.47	1.78	2.25
Predicted Environmental Concentration (PEC)	0.48	1.78	2.26

Results - exceedance and deposition as a proportion of the CL function

Source	Exceedance (keq/ha/yr)	% of CL function*
Process Contribution (PC)	no exceedance of CL function	0.5
Background	0.41	122.5
Predicted Environmental Concentration (PEC)	0.42	123