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Environmental Visage Ltd
Stroud House
Russell Street, Stroud
Gloucestershire GL5 3AN
Tel/Fax: 01453 752731

Atmospheric Dispersion Modelling Assessment of Proposed Emissions from

Enviroparks Wales Ltd Hirwaun Industrial Estate Aberdare

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Report Author: Amanda Owen

Registered in England and Wales no. 4907297
Registered office:
c/o Gerard & Co, 10A John Street, Stroud GL5 2HA

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 requested an amendment to their current planning consent, and an Addendum to the original Environmental Statement (ES Addendum) accompanied the revised planning application. A dispersion modelling assessment report(1) and an addendum to that report(2) were submitted in support of the ES Addendum and a Shadow Habitat Regulations Assessment Stage 1: Screening report. However, as the predicted contributions to, and possible impact on the nearby Special Areas of Conservation (SACs) could not necessarily be screened as insignificant for either contributions of nutrient Nitrogen or acid deposition, further efforts have been made to reduce the emissions from the site, and their potential impact.

This assessment report therefore presents the results of further atmospheric dispersion modelling which demonstrates that the potential impact on the local SACs can be screened as insignificant. The emissions data applied are in line with proposals from a credible technology provider, which has confirmed that they can meet the proposed discharge rate releases of the three gasification units proposed for the site, using available technologies.

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).

The results of the modelling exercise have demonstrated that, when applying specialist but available technologies within the proposed eco-park scheme, and discharging the resultant emissions through 45 m high flues, the potential impact of the emissions from the plant now proposed for the Enviroparks facility are acceptable. Emissions to atmosphere from the plant, which have been considered against assessment levels both for the protection of human health and sensitive ecological receptors can be screened as insignificant.

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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, discharging at 45 m high. Other releases of warm air will occur across the site, including from air cooled condensers, and building ventilation. Consideration was given to all release points across the site in earlier modelling studies and demonstrated no impact from releases of warm air and ventilation sources, and as pollutant emissions are only associated with the gasification line releases, these are the only site points which have been modelled during this study. However similarly to previous modelling reports, consideration has been given in this study 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. The site already holds planning consent for operations originally proposed by the Company, however changes to the technologies now planned for the site, and the need to install significant abatement measures to ensure minimal impact on the local sensitive ecological features, will modify the pollutant releases somewhat. As such, the key concern of this study is to detail the likely impact of discharges to atmosphere from the site, and to demonstrate an insignificant impact on the closest European designated sites. The local area includes a number of sensitive receptors including Blaen Cynon, Coedydd Nedd a Mellte, and Cwm Cadlan which are all Special Areas of Conservation (SACs); a number of Sites of Special Scientific Interest (SSSI), and the Penderyn Reservoir; 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.

Each of the SAC sites is located within 3 km of the Enviroparks site, with Blaen Cynon located less than 300 m from the discharge stack at the SACs nearest point. Coedydd Nedd a Mellte is located approximately 1.37 km from the discharge stack at its nearest point, and Cwm Cadlan is approximately 2.56 km distant.

The sensitive ecological status of these sites results in the designation of stringent Critical Loads. A Critical Load is defined as "a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge". A Shadow Habitat Regulations Assessment Stage 1: Screening report has been developed by Middlemarch Environmental Limited, which considers these three sensitive sites, and data from the modelling work reported here has been used to inform an update to that assessment.

It is recognised that there will always be a level of emission from an installation which is so small such that the resultant impact would constitute an 'inconsequential effect', and this is deemed to be 1% of the long-term Critical Level or Critical Load, or 10 % of any short-term level. Hence, in order to present a precautionary approach to the consideration of impacts on the SAC's, the ability of the discharges from the installation to result in an inconsequential effect, is considered.

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. These largely have their base in the maximum allowable emission limits which will be imposed on the site operations, 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)). It is recognised here that the Best Available Techniques guidance note for waste incineration plant (WI BREF) is currently in the process of review, and when issued, will essentially specify new binding requirements for site emissions. It is anticipated that, as per the draft version of the revised WI BREF, future emissions will be more stringent than currently, and Enviroparks is committed to operate within the emission limit values placed upon them. Whilst recognising that these may be more stringent than the current limits specified in the Industrial Emissions Directive, it is these currently obligatory emission limit values which have been applied to this study, except for pollutant species with no set limit, or those pollutants from the site which will be lower than the limits currently set. This ensures a robust approach as firstly, the draft WI BREF currently has no legal status, and additionally, should more stringent requirements be specified in future, Enviroparks is committed to meeting these and the potential impact on the local environment will therefore be further reduced.

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. Some of the characteristics of the individual release points have changed since the original modelling exercises, and these 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)	0.9
Stack Height (m)	45
Temperature of Release (K)	573
Actual Flow Rate (Am^3/s at 6 % Oxygen)	15.9
Emission Velocity at Stack Exit (m/s)	25.0

Table 3 Modelled Emissions to Atmosphere, Enviroparks Wales Limited

Emission Concentration (Daily Average)	Maximum Emissions (IED Limit)		
	At 11 % O_2 (mg/Nm^3)	Emissions at stack Conditions	A1, A2, and A3 Release Rate (g/s)
PM_{10}	10	6.15	9.77E-02
$PM_{2.5}$ (assumed to be the same as PM_{10})	10	6.15	9.77E-02
VOC	10	6.15	9.77E-02
HCl	0	0.00	0.00
HF	1	0.61	9.77E-03
CO	50	30.73	4.89E-01
SO_2	1	0.61	9.77E-03
NO_x (total NO_x as NO_2)	40	24.58	3.91E-01
Group I (Cd, Tl)	0.05	0.03	4.89E-04
Group II (Hg)	0.05	0.03	4.89E-04
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.5	0.31	4.89E-03
Dioxins and Furans (2,3,7,8 TCDD TEQ)	1 x 10-7	6.15E-08	9.77E-10
Ammonia (NH3 slip)	0.1	0.061	9.77E-04
PAHs (as B[a]P)	0.001	0.0006	9.77E-06
PCB	0.005	0.0031	4.89E-05

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_{10} and $PM_{2.5}$ have both been modelled at the limit value for total particulate, although this will result in an over-estimate.

Emissions concentration data was largely 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, specifically as measured temperature and pressure, 14.3 % 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 differ from the Industrial Emissions Directive requirements for Oxides of Nitrogen (NO_x), Sulphur Dioxide (SO_2), Ammonia (NH_3), and Hydrogen Chloride (HCl) as well as additional contributions being specified for Polycyclic Aromatic Hydrocarbons (PAH), and Poly Chlorinated Biphenyls (PCBs). PAH and PCBs are specified as per the technology providers assessment of emissions, despite not having limits specified in the Industrial Emissions Directive presently. Emissions of NO_x, SO_2, NH_3, and HCl have been reduced or removed by the use of comprehensive abatement measures, in order to ensure that the resultant impact on the local environment is not only acceptable from a human health perspective, but can also be screened as insignificant at the very local sensitive ecological receptors.

Details of the technologies to be applied are not detailed within this report, but will be included as part of a wider submission to the Local Planning Authority in due course. However, the ability of the abatement systems to meet the specified pollutant discharge concentrations is assured.

NO_x or NO_2

Emissions of 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, although assessments for the impact on vegetation are made against the concentrations of NO_x. 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.

A phased approach to NO_x conversion is recommended by Natural Resources Wales as follows:

1. Screening / worst-case scenario:
50 % and 100 % of the modelled values should be used for short-term and long-term average concentration respectively. If the predicted environmental concentration (equating to the process contribution plus the "relevant background concentration") exceeds the relevant air quality objective, then proceed to step 2.
Long-term: "relevant background concentration" = background annual mean.
Short-term: "relevant background concentration" = 2 x background annual mean.

2. Worse-case scenario:
35 % for short-term and 70 % for long-term average concentration should be considered. If the predicted environmental concentration exceeds the relevant air quality objective, then proceed to case specific scenarios.

Deposition Factors

Rates of dry deposition were included and were based on the following parameters, specified by the Regulator for habitat Appropriate Assessment modelling(3).

Table 4 Recommended Deposition Factors

Pollutant	Recommended Deposition Velocity (m s^{-1})	
Nitrogen Dioxide	Grassland	0.0015
	Forest	0.003
Sulphur Dioxide	Grassland	0.012
	Forest	0.024
Ammonia	Grassland	0.020
	Forest	0.030

The sensitive ecological receptors in the local area comprise both grassland and wood or forest receptors, and as such, models have been run twice, applying grassland and forest deposition factors respectively, to ensure that appropriate consideration is given to the potential impact on each sensitive ecological receptor.

Where a dry deposition velocity cannot 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 generally be considered to be reactive, Benzene, which is the specific pollutant referred to by the Air Quality Standard, has a low solubility and hence was assumed to be a less reactive compound.

Information from Cambridge Environmental Research Consultants (CERC), the company which developed the ADMS model, specifies 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. This is supported by the Regulators guidance(3) which states that “It is considered that the wet deposition of SO_2, NO_2 and NH_3 is not significant within a short range. However, wet deposition for HCl and HNO_3 should be considered where a process emits these species.” In the absence of any additional data, it is generally considered acceptable that total deposition (wet and dry) comprises 3 x dry deposition, where it is required to be considered.

Pollutant Combinations

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 the gasifiers are combined, not 0.000677 g s^{-1} Cadmium and 0.000677 g s^{-1} 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.

3.2 Background

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)[4], 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 5.

Table 5 Background Pollutant Concentrations Applied in the Enviroparks Study

Pollutant	Pollution Maps Data	Measured Network Data
NO_x as NO_2 ($\mu g\ m^{-3}$) 2016	8.692	
PM_{10} ($\mu g\ m^{-3}$) 2016	13.157	
$PM_{2.5}$ ($\mu g\ m^{-3}$) 2016	9.335	
SO_2 ($\mu g\ m^{-3}$) 2001	2.79	
CO (mg m^{-3}) 2016	0.095	
Benzene ($\mu g\ m^{-3}$) 2016	0.207	
Mercury (ng m^{-3}) - 2013		0.0217 (Mercury in PM10)
Cadmium (ng m^{-3}) – 2015		0.155 (Heavy Metals)
Arsenic ($\mu g\ m^{-3}$) – 2015		0.00104 (Heavy Metals)
Chromium ($\mu g\ m^{-3}$) – 2015		0.0199 (Heavy Metals)
Cobalt ($\mu g\ m^{-3}$) – 2015		0.00024 (Heavy Metals)
Copper ($\mu g\ m^{-3}$) – 2015		0.0050 (Heavy Metals)
Lead ($\mu g\ m^{-3}$) – 2015		0.00643 (Heavy Metals)
Manganese ($\mu g\ m^{-3}$) – 2015		0.00357 (Heavy Metals)
Nickel ($\mu g\ m^{-3}$) – 2015		0.00923 (Heavy Metals)
Vanadium ($\mu g\ m^{-3}$) – 2015		0.000654 (Heavy Metals)
Ammonia ($\mu g\ m^{-3}$) 2015	0.64*	0.299 (National Ammonia)
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 5 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.
- 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[4]. 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.

Where detailed assessment is made within this study to the contributions to Critical Levels and Critical Loads, background data specific to the sensitive ecological receptor is drawn from the Air Pollution Information System website (http://www.apis.ac.uk/)[5].

3.3 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 6.

Table 6 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

3.4 Meteorological Data

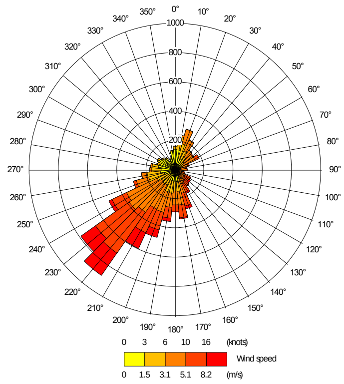
One of the key factors affecting the dispersion characteristics of a plume is the height it can gain above the release point, as a result of momentum and buoyancy. The higher the plume rises, the greater the volume of the atmosphere in which it can disperse, and the lower the potential contribution to 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.

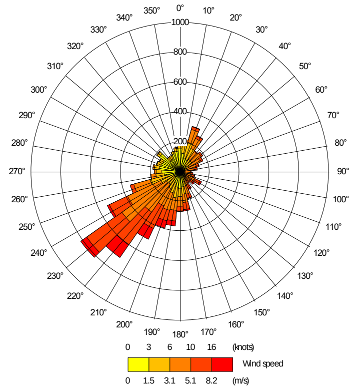
During the preparation of the modelling exercises for the original Environmental Statement, a sensitivity analysis was run on the meteorological data used, which also came from Sennybridge. Whilst a prevailing wind from the North or North East was suggested as possibly giving rise to higher pollutant 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 %).

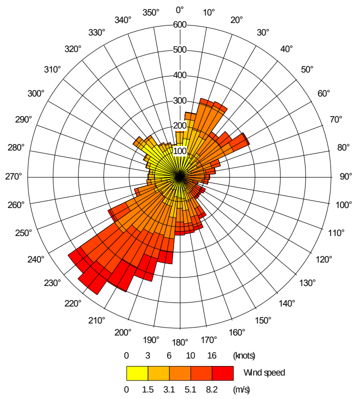
The wind-roses of the meteorological conditions reported at Sennybridge and therefore applied to the modelling study are presented below, and demonstrate that the wind does predominate from the South West quarter, and hence the use of Sennybridge data to support modelling at the Enviroparks site is considered to be acceptable.



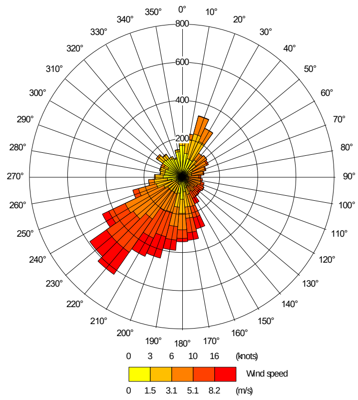
Sennybridge Wind-Rose 2011



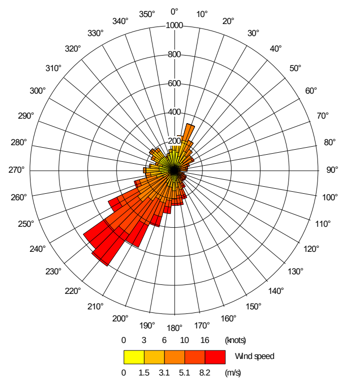
Sennybridge Wind-Rose 2012



Sennybridge Wind-Rose 2013



Sennybridge Wind-Rose 2014



Sennybridge Wind-Rose 2015

3.5 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 which have previously been screened as inconsequential for the modelling exercise, 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. The same surface roughness was applied to the area surrounding the meteorological station at Sennybridge, which is located at a site with an open aspect, although with some buildings and woodland nearby.

3.6 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.

3.7 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)[(6)], 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 section 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.

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 100^{th} 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 1^{st} 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[(7)] 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	294099	206960	290	E
2	Cwm Cadlan SAC	294970	209125	2,560	NNE
3	Coedydd Nedd a Mellte SAC	292525	207199	1,370	N
4	Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	293790	208448	1,630	NW
5	Cwm Gwrelych and Nant Llynfach Streams SSSI	289980	206868	3,865	W
6	Craig-y-Llyn SSSI	291083	203873	4,038	SSW
7	Bryn Bwch SSSI	291990	210505	4,126	NNW
8	Caeau Nant-y-Llechau SSSI	290235	210177	4,930	NW
9	Gweunedd Dyffern Nedd SSSI	291341	210980	4,856	NNW
10	Bryncarnau Grasslands Llwyncoed SSSI	299424	206366	5,597	E
11	Blaenrhondda Road Cutting SSSI	292768	201528	5,400	S
12	Blaen Nedd SSSI	291234	212551	6,299	NNW
13	Ogof Ffynnon Ddu Pant Mawr SSSI	290258	213083	7,218	NNW
14	Caeau Ton-y-Fildre SSSI	286882	210448	7,852	WNW
15	Penmoelallt SSSI	301892	209166	8,382	NE
16	Mynydd Ty-Isaf Rhondda SSSI	292688	198555	8,345	S
17	Plas-y-Gors SSSI	292223	215231	8,567	NNW
18	Daren Fach SSSI	301984	210048	8,756	NE
19	Cwm Glo a Glyndyrys SSSI	302548	205327	8,830	E
20	Waun Ton-y-Spyddaden SSSI	286406	211980	9,054	NW
21	Gorsllwyn Onllwyn SSSI	285547	210323	9,007	W
22	Cwm Taf Fechan Woodlands SSSI	303358	208182	9,610	NE
23	Nant Llech SSSI	285246	211804	9,939	NW
24	Caeau Nant Y Groes SSSI	302672	202490	9,831	SE
25	Tir Mawr A Dderi Hir, Llwydcoed SSSI	297977	206236	4,173	E
26	Penderyn Reservoir	293890	207015	201	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

3.8 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 will be used to control emissions of Oxides of Nitrogen, acid gases, metals, Dioxins, and particulate matter from the gasification process, and the technology provider has identified that system failures could result in the short-term release of the following levels of pollution. 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	92.18	1.47
NO_x	305	187.43	2.98
HCl	160	98.32	1.56
SO_2	79	48.55	0.772
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	5	3.07	0.0489
Dioxins	3 x 10-7	1.84E-07	2.93E-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 Operating 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[(8)], 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 two year's-worth of meteorological conditions have generally been applied to these further assessments. The meteorological conditions experienced in 2011 and 2015 resulted in the majority of the highest process contribution results from the basic models, and hence these was the meteorological files 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)	NO_x Emission Rate (g/s)	CO Emission Rate (g/s)	SO_2 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	0.3935	0.114	0.0399

3.9 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. Emissions of NO_x, SO_2, and Ammonia are significantly lower than those specified in the Industrial Emissions Directive, and emissions of HCl have been removed from the discharges completely. These significant reductions have been made in order to ensure that the impact of the site can be screened as having an insignificant impact on the sensitive ecological receptors in the immediate vicinity of the Enviroparks site, with extensive abatement techniques employed to ensure acceptable levels of discharge. Details of the specific abatement measures to be employed will be provided separately to this report.

- 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 included within the model. 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(9), 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(10), 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 Table 1 presents the maximum process contribution of each pollutant for each year of meteorological data studied, with the maximum value of each species highlighted. 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.

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 2 demonstrates that 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.

Many of the un-screened emissions actually comprise combinations of species, including total VOC, heavy metals, Cadmium and Thallium, and total PAH, and thus assessing against a level for a single species represents an over-estimate. There are also no short-term environmental standards for some of these emissions to compare against. However, the screening methodology is applied and the results in Table 2 demonstrate that all pollutants pass the second stage of the screening, and can therefore be considered as insignificant.

Appendix A Table 3 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, and thus the potential impact of these emissions is considered to be insignificant.

Appendix A Table 4 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 9 % 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 over 69 % for the hourly average of NO_x (assuming all NO_x is NO_2). However, with the exception of NO_x, which is compared to the Air Quality Standard for Nitrogen Dioxide in Table 4, 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. The secondary assessment of Nitrogen Dioxide specifically against the Air Quality Standard, presented at the end of Table 4, demonstrates that the short-term predicted environmental concentration of Nitrogen Dioxide would remain within 70 % of the Air Quality Standard and hence, the impact of all short-term elevated emissions in the event of an abatement systems failure, can be screened as insignificant.

Table 5 in Appendix A summarises the results of models assessing the cumulative effects of other local third-party emissions. The process contributions from the Enviroparks facility when modelled in combination with emissions from Hirwaun Power, Hirwaun Energy, and Green Frog STOR are presented.

The results of the cumulative discharge modelling confirm that, with the exception of the maximum short-term (24-Hour) contribution of Oxides of Nitrogen which is compared to the short-term standard for impacts on vegetation, predicted environmental concentrations of all pollutants remain below 70 % of their relevant Environmental Quality Standard. The Environmental Quality Standards for the protection of vegetation will only be relevant at sensitive ecological receptors, and hence are considered in detail later in this section, when the results of modelling at the specified receptor locations are detailed. It should 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 has been modelled at its maximum capacity when in reality, it operates for a fraction of this period. As such, the assessment of the contributions from the Green Frog STOR can be considered to be a significant over-estimate.

Tables 6 – 10 in Appendix A present the process contribution results at sensitive receptors, and are highlighted to show pollutants which represent more than 1 % of the long-term, or more than 10 % of the short-term assessment level and which therefore cannot immediately be screened as insignificant. The data comprises the maximum result at each receptor, for each pollutant and reference period, assessing results from five years-worth of meteorological conditions. From this data, Table 11 in Appendix A details the sensitive receptors where process contributions of Oxides of Nitrogen, Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons are not immediately screened. As previously, the long-term predicted environmental concentrations of all species remain within 70 % of the Environmental Quality Standards, and represent between 5 and 35 % of the relevant EQS. Similarly, Table 12 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 the these pollutants at all receptors remain within 25 % of the Environmental Quality Standards.

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 cumulative impact of Enviroparks when modelled with other local developments, for impacts on the SACs. Appendix A Table 13 considers the maximum likely process contributions of the combined local releases, to the Blaen Cynon, Cwm Cadlan, and Coedydd Nedd a Mellte SACs. The results demonstrate that the annual average process contributions of total NO_x are above 1 % of the Environmental Quality Standards for vegetation at each of the three SACs local to the Hirwaun Industrial Estate, and therefore cannot immediately be screened as insignificant. However, as demonstrated in Tables 6 and 11, the contribution of the Enviroparks facility to the total is small ($1/6^{th}$ of the in-combination contribution at Blaen Cynon), and all can be screened at the secondary assessment stage for long-term concentrations, with the maximum predicted environmental concentration remaining within 15 % of the assessment level for vegetation. All other pollutants from the cumulative assessment are less than 1 % of the vegetation or air quality standards at the three SACs.

An assessment of the short term, daily process contribution of Nitrogen Dioxide can also be made against the daily target for Oxides of Nitrogen at Conservation sites, which is set at 75 $\mu g/m^3$. As shown in Appendix A, Table 6, the process contribution from the Enviroparks development in isolation represents 6.25 % of the short-term assessment level and hence is screened as insignificant. When considering the combined effects of Enviroparks and other local sites however in Appendix A, Table 13, the cumulative contribution to ground level concentrations is predicted to exceed 10 % at both Blaen Cynon and Coedydd Nedd a Mellte, equating to 36.6 % of the short-term Critical Level at Blaen Cynon, and 16.4 % of the short-term Critical Level at Coedydd Nedd a Mellte.

Appendix A Tables 14 and 15 consider the potential for nutrient Nitrogen and acid deposition to the SACs. Assessment has consistently been made against the lower end of any identified Critical Loads and, includes discharge rates which have been confirmed in line with proposals from a credible technology provider. These are the emission levels against which the Enviroparks scheme will be limited within their Environmental Permit in due course, and hence can be considered to represent a worst-case assessment. Table 14 sets out the calculations which determine the quantities of nutrient Nitrogen (kg/ha/year) and levels of acid deposition which comprise keq/ha/year emissions taking contributions from emissions of Nitrogen Dioxide, Ammonia, and Sulphur Dioxide. It is noted that as the technologies now proposed, remove any contribution from Hydrogen Chloride, only contributions from NO_2, Ammonia and SO_2 are considered.

Table 15 demonstrates that deposition of nutrient Nitrogen and acid deposition is screened at all three receptors, when considering the Enviroparks scheme in isolation, and at Cwm Cadlan and Coedydd Nedd a Mellte when considering in-combination effects. However, the in-combination effects cannot be screened as insignificant at Blaen Cynon, representing 4.5 % of the Critical Load for acid deposition, and 5.1 % of the Critical Load for nutrient Nitrogen deposition.

It is important to note here that, by definition, a Critical Load is "a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge". It is not a quantitative estimate of damage to a particular habitat, but represents the potential for damage to occur. There appears to be no evidence in the available literature to indicate that the sensitive ecological habitats at Blaen Cynon are suffering as a consequence of nitrogen deposition from nearby sources, although air pollution is identified as a 'threat' to the SAC in the Natura 2000 Standard Data Forms from 2015.

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/)[5] is 23.8 kg N/ha/year, which represents 238 % of the lower Critical Load. Additionally, if the National Objective for the protection of vegetation for Oxides of Nitrogen in air (30 $\mu g/m^3$) were experienced at the Blaen Cynon site, the applied deposition rate would result in approximately 4.32 kg N/ha/year being deposited (assuming a deposition velocity of 0.0015 m/s for grassland). This represents approximately 43 % of the lower Critical Load at Blaen Cynon from air quality which could reasonably be experienced anywhere in the UK as an annual mean with no question as to the impact on human health or vegetation. The predicted cumulative emissions from Enviroparks and other local developments constitute less than 12 % of the nationally accepted Objective for the protection of vegetation, and will therefore be much less significant at the Blaen Cynon site than any impact being caused by the current background levels.

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. Hence, further modelling of the releases anticipated from the plant, which are substantially less than those required for compliance with the Air Quality Standards or Environmental Quality Standards, demonstrated that each of these substances presents no substantive risk to the reservoir and its systems (see Appendix A, Table 16). Annual contributions of Nitrite, Benzene, 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 0.5 % when modelling the Enviroparks facility in isolation, and approximately 5.5 % of the Water Quality Standard when considering the cumulative contributions of other local sources.

The assessment of the effects on the Dwr Cymru Welsh Water infrastructure 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 0.5 % of the Water Quality Standard for Nitrite, contributions from the Enviroparks facility would equate to approximately 2.6 % 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 existing planning consent is currently being considered and, various iterations of modelling works have been provided as the scheme has developed through discussion with consultees to the process. Initial suggestions were that the predicted contributions to, and possible impact on the nearby Special Areas of Conservation (SACs) could not necessarily be screened as insignificant for either contributions of nutrient Nitrogen or acid deposition, and thus further efforts have been made, utilising technological solutions within the project design, to reduce the emissions from the site and their potential impact.

This assessment report therefore presents the results of further atmospheric dispersion modelling which demonstrates that the potential impact on the local SACs can be screened as insignificant. The emissions data applied are in line with proposals from a credible technology provider, which has confirmed that they can meet the proposed discharge rate releases of the three gasification units proposed for the site.

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.

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, and is therefore screened at the secondary stage.

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 immediately be screened as insignificant, all of the predicted environmental concentrations continue to remain within 70 % of the Environmental Quality Standards, where applicable.

The short-term (maximum 24-hourly average) process contribution of Oxides of Nitrogen, cannot be screened as insignificant at the Blaen Cynon or Coedydd Nedd a Mellte SACs when considering the in-combination releases against the short-term assessment level for vegetation. However, contributions equate to 36.6 % of the short-term Critical Level at Blaen Cynon, and 16.4 % of the short-term Critical Level at Coedydd Nedd a Mellte, and contributions from the Enviroparks facility in isolation represents only 6.25 % of the assessment level at Blaen Cynon and hence is screened as insignificant. Assessment of the long-term contributions of Oxides of Nitrogen to the Critical Level are screened at the second stage, that is, predicted environmental concentrations remain within 70 % of the Critical Level.

When considered in isolation, contributions to nutrient Nitrogen and acid deposition from the Enviroparks facility are predicted to be less than 1 % of the Critical Loads for each of the three nearest SAC sites. In-combination contributions continue to be screened at Cwm Cadlan and Coedydd Nedd a Mellte, although are not screened at Blaen Cynon. The rate of nutrient Nitrogen deposition at Blaen Cynon when undertaking a cumulative assessment equates to 5.1 % of the Critical Load, with acid deposition equating to 4.5 % of the Critical Load for the site. A Critical Load sets the point below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge. However, it does not automatically follow that significant harmful effects will occur should the Critical Load be exceeded and the identified potential cumulative contribution remains very small despite not being screened as insignificant.

Finally, the assessment of the potential impact on the Dwr Cymru infrastructure in the locality screened most key species as contributing less than 1 % of the Water Quality Standard. The one exception to this was the cumulative contribution of Nitrite when Enviroparks was modelled in conjunction with other planned or new developments, which was predicted to potentially contribute approximately 5.5 % to the Nitrite level. However, this assumes that all of the Oxides of Nitrogen deposited at the reservoir from the local sources modelled are available as Nitric Oxide and convert to Nitrite, which is an over-estimate. It is also significantly lower than the contribution which could be expected from air which is at the Air Quality Standard for Nitrogen Dioxide, which would equate to contributions of more than 50 % of the Water Quality Standard per year. As such, the predicted emissions from the proposed Enviroparks facility in combination with other local schemes 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, when applying specialist but available technologies within the proposed eco-park scheme, and discharging the resultant emissions through 45 m high flues, the potential impact of the emissions from the plant now proposed for the Enviroparks facility are acceptable. Emissions to atmosphere from the plant, which have been considered against assessment levels both for the protection of human health and sensitive ecological receptors can be screened as insignificant.

The results from this modelling report have been used to produce both an updated Shadow Habitat Regulations Assessment and an updated Human Health Risk Assessment which provides a detailed assessment of the potential for any risk to health from the Enviroparks releases to air.

6. References

1. Atmospheric Dispersion Modelling Assessment of Proposed Emissions from Enviroparks Wales Ltd Hirwaun Industrial Estate Aberdare. Issue 2, February 2017. Environmental Visage Limited.

2. Addendum to an Atmospheric Dispersion Modelling Assessment of Proposed Emissions from Enviroparks Wales Ltd Hirwaun Industrial Estate Aberdare. Issue 1, May 2017. Environmental Visage Limited.

3. Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air Status: Updated version, (Approved March 2014). Environment Agency.

4. Air Quality Archive Estimated UK Background Air Pollution Concentrations (https://uk-air.defra.gov.uk/data/laqm-background-home).

5. Air Pollution Information System (http://www.apis.ac.uk/).

6. Local Air Quality Management. Technical Guidance LAQM.TG(16). April 2016. DEFRA. Crown Copyright 2016.

7. The Air Quality Standards (Wales) Regulations 2010, Statutory Instrument No. 1433 (W.126). 16 May 2010.

8. The Hirwaun Power (Gas Fired Power Station) Order. 6.1.0 Environmental Statement. PINS Reference Number: EN010059. Author: Parsons Brinckerhoff. Submission Version, March 2014.

9. Chamorro, L., Porté-Agel, F. (2009). A Wind-Tunnel Investigation of Wind-Turbine Wakes: Boundary-Layer Turbulence Effects. Boundary-Layer Meteorol 132(1): 129-149.

10. Meneveau, C., & Meyers, J. (2012). Optimal turbine spacing in fully developed wind-farm boundary layers. Wind Energy 15, 305-317. doi:10.1002/we.469

11. The Water Supply (Water Quality) Regulations 2010 Statutory Instrument No. 994 (W.99). 25 March 2010.

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)

POLLUTANT PARAMETER	2011	2012	2013	2014	2015
Annual Average NOx as NO2 (ug/m3)	0.887	0.748	0.593	0.675	0.875
Maximum Hourly NOx as NO2 (ug/m3)	27.68	22.88	29.44	23.67	24.36
99.79 Percentile Hourly NOx as NO2 (ug/m3)	16.59	14.95	14.89	15.29	13.23
Dry Deposition NOx as NO2 (ug/m2/s)	0.0013	0.0011	0.0009	0.0010	0.0013
Maximum 24 Hour NOx as NO2 (ug/m3)	4.72	4.32	5.69	4.61	4.60
Maximum 15 Minute SO2 (ug/m3)	0.6230	0.4668	0.6917	0.5466	0.5525
99.9 Percentile 15 Minute SO2 (ug/m3)	0.4402	0.4279	0.3888	0.4221	0.3874
Annual Average SO2 (ug/m3)	0.0215	0.0181	0.0144	0.0164	0.0213
Maximum Hourly SO2 (ug/m3)	0.6147	0.4569	0.6815	0.5325	0.5366
99.73 Percentile Hourly SO2 (ug/m3)	0.3891	0.3359	0.3388	0.3470	0.2994
Dry Deposition SO2 (ug/m2/s)	0.0003	0.0002	0.0002	0.0002	0.0003
Maximum 24 Hour SO2 (ug/m3)	0.1151	0.1051	0.1362	0.1127	0.1123
99.18 Percentile 24 Hour SO2 (ug/m3)	0.1055	0.0850	0.0890	0.0957	0.0982
Annual Average 24 Hour PM10 (ug/m3)	0.1542	0.1316	0.1037	0.1183	0.1479
Maximum 24 Hour PM10 (ug/m3)	0.9733	0.9652	1.2081	0.9076	0.8874
90.41 Percentile 24 Hour PM10 (ug/m3)	0.4388	0.3988	0.3343	0.3491	0.4134
Annual Average PM10 (ug/m3)	0.1613	0.1370	0.1065	0.1225	0.1547
Maximum Hourly PM10 (ug/m3)	4.8616	4.1186	5.9829	4.4517	4.5654
Dry Deposition PM10 (ug/m2/s)	0.0270	0.0196	0.0178	0.0209	0.0308
Annual Average PM2.5 (ug/m3)	0.2108	0.1781	0.1406	0.1602	0.2071
Maximum Hourly PM2.5 (ug/m3)	6.4645	4.6412	7.0576	5.5919	5.6891
Dry Deposition PM2.5 (ug/m2/s)	0.0050	0.0036	0.0033	0.0039	0.0059
8 Hour Rolling Average CO (mg/m3)	0.0010	0.0009	0.0007	0.0008	0.0010
Maximum 8 Hour Rolling Average CO (mg/m3)	0.0226	0.0230	0.0186	0.0107	0.0275
Dry Deposition 8 Hour Rolling CO (ug/m2/s)	0.0020	0.0017	0.0013	0.0015	0.0020
Annual Average VOC (ug/m3)	0.2214	0.1867	0.1480	0.1684	0.2184
Maximum Hourly VOC (ug/m3)	6.8864	5.6345	7.3373	5.8948	6.0632
Dry Deposition VOC (ug/m2/s)	0.0004	0.0004	0.0003	0.0003	0.0004
Annual Average Hg (ug/m3)	0.0011	0.0009	0.0007	0.0008	0.0011
Maximum Hourly Hg (ug/m3)	0.0345	0.0282	0.0367	0.0295	0.0303
Dry Deposition Hg (ug/m2/s)	2.16E-06	1.82E-06	1.45E-06	1.64E-06	2.14E-06
Annual Average Cd / Tl as Cd (ng/m3)	1.1082	0.9345	0.7406	0.8428	1.0933
Maximum Hourly Cd / Tl as Cd (ng/m3)	34.4671	28.2013	36.7239	29.5041	30.3469
Dry Deposition Cd / Tl as Cd (ng/m2/s)	2.16E-06	1.82E-06	1.45E-06	1.64E-06	2.14E-06
Annual Average Heavy Metals as Pb (ug/m3)	0.0111	0.0093	0.0074	0.0084	0.0109
Maximum Hourly Heavy Metals as Pb (ug/m3)	0.3447	0.2820	0.3672	0.2950	0.3035
Dry Deposition Heavy Metals as Pb (ug/m2/s)	2.16E-05	1.82E-05	1.45E-05	1.64E-05	2.14E-05
Annual Average HF (ug/m3)	0.0209	0.0176	0.0139	0.0159	0.0206
Maximum Hourly HF (ug/m3)	0.5950	0.4505	0.6755	0.5274	0.5365
Dry Deposition HF (ug/m2/s)	0.0005	0.0004	0.0003	0.0004	0.0005
Annual Average Dioxins (ug/m3)	2.21E-09	1.87E-09	1.48E-09	1.68E-09	2.18E-09
Maximum Hourly Dioxins (ug/m3)	6.89E-08	5.63E-08	7.34E-08	5.89E-08	6.06E-08
Dry Deposition Dioxins (ug/m2/s)	4.32E-12	3.64E-12	2.89E-12	3.28E-12	4.27E-12
Maximum 24 Hour Dioxins (ug/m3)	1.18E-08	1.08E-08	1.42E-08	1.15E-08	1.15E-08
Annual Average PAH (ng/m3)	0.0221	0.0187	0.0148	0.0168	0.0218
Maximum Hourly PAH (ng/m3)	0.6886	0.5634	0.7337	0.5895	0.6063
Dry Deposition PAH (ng/m2/s)	4.32E-08	3.63E-08	2.89E-08	3.28E-08	4.27E-08
Annual Average PCB (ug/m3)	1.11E-04	9.34E-05	7.41E-05	8.43E-05	1.09E-04
Maximum Hourly PCB (ug/m3)	0.0034	0.0028	0.0037	0.0030	0.0030
Dry Deposition PCB (ug/m2/s)	2.16E-07	1.82E-07	1.45E-07	1.64E-07	2.14E-07
Annual Average NH3 (ug/m3)	0.0021	0.0018	0.0014	0.0016	0.0021
Maximum Hourly NH3 (ug/m3)	0.0567	0.0445	0.0651	0.0501	0.0511
Dry Deposition NH3 (ug/m2/s)	4.22E-05	3.54E-05	2.81E-05	3.20E-05	4.17E-05

Note: Total NO_x is reported above.

Table 2 Assessment of the Potential for Contributions to be Insignificant

POLLUTANT	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 %?
NOx (ug/m3) Annual Hourly Average	40	8.69	0.887	9.58	**2.22%**	No							23.95%	Yes
NOx (ug/m3) Annual Hourly Average (Vegetation)	30	8.69	0.887	9.58	**2.96%**	No							31.93%	Yes
NOx 99.79%ile (ug/m3) Hourly Average	200	8.69					16.59	33.97	8.30%	Yes	9.08%	Yes		
NOx (ug/m3) Maximum 24 Hour Average (Vegetation)	75	8.69					4.72	22.10	6.29%	Yes	8.19%	Yes		
SO2 (ug/m3) Annual Hourly Average	350	2.79	0.022	2.81	0.01%	Yes							0.80%	Yes
SO2 (ug/m3) Annual Hourly Average (Vegetation)	20	2.79	0.022	2.81	0.11%	Yes							14.06%	Yes
SO2 99.73%ile (ug/m3) Hourly Average	350	2.79					0.39	5.97	0.11%	Yes	0.11%	Yes		
SO2 99.18%ile (ug/m3) 24 Hour Average	125	2.79					0.11	5.69	0.08%	Yes	0.09%	Yes		
SO2 99.90%ile (ug/m3) 15 Minute Average	266	2.79					0.44	6.02	0.17%	Yes	0.17%	Yes		
PM10 90.41%ile (ug/m3) 24 Hour Average	50	13.16					0.44	26.75	0.88%	Yes	1.85%	Yes		
PM10 (ug/m3) Annual Hourly Average	40	13.16	0.154	13.31	0.39%	Yes							33.28%	Yes
PM2.5 (ug/m3) Annual Hourly Average	25	9.33	0.211	9.55	0.84%	Yes							38.18%	Yes
Maximum 8 Hour Rolling Average CO (mg/m3)	10	0.0953					0.001	0.19	0.01%	Yes	0.01%	Yes		
Benzene (ug/m3) Annual Hourly Average	5	0.2070	0.22	0.43	**4.43%**	No							8.57%	Yes
Heavy Metals as Lead (ug/m3) Annual Hourly Average	0.25	0.0064	0.01	0.02	**4.43%**	No							7.01%	Yes
Cadmium (ng/m3) Annual Hourly Average	5	0.155	1.11	1.26	**22.16%**	No							25.26%	Yes
Mercury (ug/m3) Annual Hourly Average	0.25	0.000022	0.0011	0.00113	0.44%	Yes							0.45%	Yes
HF (ug/m3) Hourly Average	160						0.0003	0.0003	0.0002%	Yes	0.0002%	Yes		
PAH (ng/m3) Annual Average	1	0.188	0.0221	0.21	**2.21%**	No							21.01%	Yes
Ammonia (ug/m3) Annual Average	180	0.64	0.0021	0.64	0.0012%	Yes							0.36%	Yes
Ammonia (ug/m3) Annual Average (Vegetation)	1	0.64	0.0021	0.64	0.21%	Yes							64.21%	Yes

Note: Maximum concentrations of pollutants are taken from Table 1, and total NO_x is considered. All emissions are assumed to be discharged at the maximum rate. Results in bold cannot be screened as insignificant.

Table 3 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)	0.554	0.155	0.709	5	**11%**	14.18%
Thalium (ng/m3)	0.554		0.554			
Antimony (ug/m3)	0.00123		0.00123	5	0.02%	0.02%
Arsenic (ug/m3)	0.00123	0.00104	0.00227	0.006	**21%**	37.80%
Lead (ug/m3)	0.00123	0.00643	0.00767	0.25	0.49%	3.07%
Chromium (ug/m3)	0.00123	0.0199	0.0211	5	0.02%	0.42%
Cobalt (ug/m3)	0.00123	0.000241	0.00147			
Copper (ug/m3)	0.00123	0.00500	0.00623	10	0.01%	0.06%
Manganese (ug/m3)	0.00123	0.00357	0.00480	0.15	0.82%	3.20%
Nickel (ug/m3)	0.00123	0.00923	0.0105	0.02	**6%**	52.30%
Vanadium (ug/m3)	0.00123	0.000654	0.00189	5	0.02%	0.04%

Results in bold cannot be screened as insignificant.

Table 4 Assessment of the Impact of Abatement System Failures

ABATEMENT FAILURES	2011	Background Concentration	PEC	EQS	ST PC % of EQS - LT Background x 2	< 20 %?	PEC < 70 % EQS?
Maximum Hourly NOx as NO2 (ug/m3)	210.96	8.69	228.34				
99.79 Percentile Hourly NOx as NO2 (ug/m3)	126.44	8.69	143.83	200	69.24%	No	No
Maximum 15 Minute SO2 (ug/m3)	49.23	2.79	54.81				
99.9 Percentile 15 Minute SO2 (ug/m3)	34.79	2.79	40.37	266	13.36%	Yes	Yes
Maximum Hourly SO2 (ug/m3)	48.57	2.79	54.15				
99.73 Percentile Hourly SO2 (ug/m3)	30.75	2.79	36.33	350	8.93%	Yes	Yes
Maximum Hourly PM10 (ug/m3)	73.15	13.16	99.46				
Maximum Hourly PM2.5 (ug/m3)	97.26	9.33	115.93				
Maximum Hourly HCl (ug/m3)	87.45	0.2617	87.97	750	11.67%	Yes	Yes
Maximum Hourly Heavy Metals as Pb (ug/m3)	3.45	0.0064	3.46				
Maximum Hourly Dioxins (ug/m3)	2.07E-07	2.76E-15	2.07E-07				
Secondary Assessment of NO2 (as 50 % NOx)	**2011**	**Background Concentration**	**PEC**	**EQS**	**ST PC % of EQS - LT Background x 2**	**< 20 %?**	**PEC < 70 % EQS?**
Maximum Hourly NO2 as 50 % NOx (ug/m3)	105.48	8.69	122.86				
99.79 Percentile Hourly NO2 as 50 % NOx (ug/m3)	63.22	8.69	80.60	200	34.62%	No	Yes

Table 5 Assessment of Cumulative Effects of Enviroparks and New or Committed Developments Within the Hirwaun Industrial Estate

CUMULATIVE EFFECTS	Cumulative Process Contribution	NO2 as a Fraction of NOx (ST = 50 %)	Background Concentration	PEC	EQS	PEC < 70 % EQS?
Annual Average NOx as NO2 (ug/m3)	11.14		8.69	19.84	40	Yes
Annual Average NOx as NO2 (ug/m3) (Vegetation)	11.14		8.69	19.84	30	Yes
99.79 Percentile Hourly NOx as NO2 (ug/m3)	163.19	81.59	8.69	98.98	200	Yes
Maximum 24 Hour NOx as NO2 (ug/m3) (Vegetation)	113.07		8.69	130.46	75	No
99.9 Percentile 15 Minute SO2 (ug/m3)	15.46		2.79	21.04	266	Yes
Annual Average SO2 (ug/m3)	1.28		2.79	4.07	350	Yes
99.73 Percentile Hourly SO2 (ug/m3)	12.57		2.79	18.15	350	Yes
99.18 Percentile 24 Hour SO2 (ug/m3)	5.77		2.79	11.35	125	Yes
90.41 Percentile 24 Hour PM10 (ug/m3)	0.47		13.16	26.78	50	Yes
Annual Average PM10 (ug/m3)	0.16		13.16	13.31	40	Yes
8 Hour Rolling Average CO (mg/m3)	0.012		0.0953	0.20	10	Yes
Maximum 8 Hour Rolling Average CO (mg/m3)	0.88		0.0953	1.07	10	Yes

Table 6 Process Contributions of Oxides of Nitrogen to Sensitive Receptors

SENSITIVE RECEPTOR	X (m)	Y (m)	Annual Average Total NOx (ug/m3)	PC as % EQS	PC as % EQS (Vegetation)	99.79 Percentile Hourly Total NOx (ug/m3)	PC as % EQS	Maximum 24 Hour Total NOx (ug m-3)	PC as % EQS (Vegetation)
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294099	206960	0.801701	2.0%	2.7%	6.46479	3.2%	4.6851	6.25%
Cwm Cadlan SAC	294970	209125	0.0542607	0.1%	0.2%	0.961686	0.5%	0.341046	0.45%
Coedydd Nedd a Mellte SAC	292525	207199	0.0491468	0.1%	0.2%	1.45842	0.7%	0.822194	1.10%
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	293790	208448	0.0462193	0.1%	0.2%	1.29526	0.6%	0.561805	0.75%
Cwm Gwrelych and Nant Llynfach Streams SSSI	289980	206868	0.0129883	0.03%	0.04%	0.541599	0.3%	0.231358	0.31%
Craig-y-Llyn	291083	203873	0.00932858	0.02%	0.03%	0.412324	0.2%	0.169234	0.23%
Bryn Bwch SSSI	291990	210505	0.0134646	0.03%	0.04%	0.583723	0.3%	0.166688	0.22%
Caeau Nant-y-Llechau SSSI	290235	210177	0.00606024	0.02%	0.02%	0.359885	0.2%	0.138623	0.18%
Gweunedd Dyffern Nedd SSSI	291341	210980	0.00910121	0.02%	0.03%	0.455431	0.2%	0.171232	0.23%
Bryncarnau Grasslands Llwyncoed SSSI	299424	206366	0.0194186	0.05%	0.06%	0.689749	0.3%	0.228531	0.30%
Blaenrhondda Road Cutting SSSI	292768	201528	0.00830904	0.02%	0.03%	0.339788	0.2%	0.242816	0.32%
Blaen Nedd SSSI	291234	212551	0.0068259	0.02%	0.02%	0.310297	0.2%	0.105452	0.14%
Ogof Ffynnon Ddu Pant Mawr SSSI	290258	213083	0.00422848	0.01%	0.01%	0.236916	0.1%	0.0612528	0.08%
Caeau Ton-y-Fildre SSSI	286882	210448	0.00540909	0.01%	0.02%	0.270808	0.1%	0.0843367	0.11%
Penmoelallt SSSI	301892	209166	0.010139	0.03%	0.03%	0.294723	0.1%	0.0836802	0.11%
Mynydd Ty-Isaf Rhondda SSSI	292688	198555	0.0038014	0.01%	0.01%	0.204289	0.1%	0.0878992	0.12%
Plas-y-Gors SSSI	292223	215231	0.00448824	0.01%	0.01%	0.192582	0.1%	0.0528361	0.07%
Daren Fach SSSI	301984	210048	0.00997743	0.02%	0.03%	0.24908	0.1%	0.090175	0.12%
Cwm Glo a Glyndyrys SSSI	302548	205327	0.0123482	0.03%	0.04%	0.439017	0.2%	0.165203	0.22%
Waun Ton-y-Spyddaden SSSI	286406	211980	0.00247658	0.01%	0.01%	0.131743	0.1%	0.0429667	0.06%
Gorsllwyn Onllwyn SSSI	285547	210323	0.00565649	0.01%	0.02%	0.314739	0.2%	0.1077	0.14%
Cwm Taf Fechan Woodlands SSSI	303358	208182	0.00969796	0.02%	0.03%	0.393769	0.2%	0.0979228	0.13%
Nant Llech SSSI	285246	211804	0.00323141	0.01%	0.01%	0.183311	0.1%	0.0501617	0.07%
Caeau Nant Y Groes SSSI	302672	202490	0.0065971	0.02%	0.02%	0.340249	0.2%	0.0900023	0.12%
Tir Mawr A Dderi Hir, Llwydcoed SSSI	297977	206236	0.0311041	0.1%	0.1%	1.24335	0.6%	0.383383	0.51%
Penderyn Reservoir	293890	207015	0.271619	0.7%	0.9%	6.01734	3.0%	3.68145	4.91%
Eden Trading	294020	206800	0.186035	0.5%	0.6%	7.86697	3.9%	2.74461	3.66%
House at Penderyn Reservoir	294100	207270	0.430361	1.1%	1.4%	3.97673	2.0%	2.76271	3.68%
Ty Newydd Hotel	294600	206940	0.272053	0.7%	0.9%	3.59058	1.8%	1.7793	2.37%
Caer Llwyn Cottage	293253	207151	0.11075	0.3%	0.4%	3.20223	1.6%	1.8958	2.53%
Rhombic Farm	292958	206712	0.104532	0.3%	0.3%	2.38492	1.2%	1.23281	1.64%
Castell Farm	292871	206783	0.0839849	0.2%	0.3%	2.20551	1.1%	1.1684	1.56%
TY Newydd Cottage	294514	207025	0.373073	0.9%	1.2%	3.49194	1.7%	2.10978	2.81%
Residence Woodland Park	294824	207560	0.231589	0.6%	0.8%	1.85305	0.9%	1.50827	2.01%
Pontbren Llwyd School	295057	208264	0.119011	0.3%	0.4%	1.18127	0.6%	0.611715	0.82%
Ffynnon Ddu (spring)	292273	208364	0.0201556	0.1%	0.1%	0.83298	0.4%	0.335723	0.45%
Ton-Y-Gilfach	289565	208712	0.0127733	0.0%	0.0%	0.57789	0.3%	0.214982	0.29%
Rose Cottage	291284	208150	0.0222924	0.1%	0.1%	0.818795	0.4%	0.393576	0.52%
The Don Bungalow	291512	207044	0.0242062	0.1%	0.1%	1.00778	0.5%	0.460413	0.61%
Werfa Farm	291944	206721	0.0347123	0.1%	0.1%	1.0819	0.5%	0.497069	0.66%
Willows Farm	294129	205879	0.0638063	0.2%	0.2%	3.59035	1.8%	1.29255	1.72%
Trebanog Uchaf Farm	294063	207416	0.256951	0.6%	0.9%	3.31828	1.7%	2.3131	3.08%
Tai-Cwpla Farm	293519	207024	0.142023	0.4%	0.5%	5.04431	2.5%	2.97304	3.96%
Neuadd Farm	294906	207282	0.216621	0.5%	0.7%	2.04789	1.0%	1.21922	1.63%
John Street Allotments, Hirwaun	296180	205605	0.0382809	0.1%	0.1%	1.50785	0.8%	0.670038	0.89%
Dwr Cymru Service Reservoir	294068	206939	0.709137	1.8%	2.4%	6.76855	3.4%	4.24394	5.66%

Process contributions over 1 % of the long-term or 10 % of the short-term assessment level are highlighted in yellow, or green where the assessment level is specific to vegetation

Table 7 Process Contributions of Sulphur Dioxide to Sensitive Receptors

SENSITIVE RECEPTOR	X (m)	Y (m)	Annual Average SO2 (ug/m3)	PC as % EQS (Vegetation)	99.9 Percentile 15 Minute SO2 (ug/m3)	PC as % EQS	99.73 Percentile Hourly SO2 (ug/m3)	PC as % EQS	99.18 Percentile 24 Hour SO2 (ug/m3)	PC as % EQS
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294099	206960	0.0194878	0.10%	0.174162	0.07%	0.154863	0.0442%	0.0989738	0.079%
Cwm Cadlan SAC	294970	209125	0.00123763	0.01%	0.0293534	0.01%	0.0204048	0.0058%	0.00711458	0.006%
Coedydd Nedd a Mellte SAC	292525	207199	0.00114184	0.01%	0.0443247	0.02%	0.0334395	0.0096%	0.0167006	0.013%
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	293790	208448	0.00106131	0.01%	0.0391691	0.01%	0.0280008	0.0080%	0.00909431	0.007%
Cwm Gwrelych and Nant Llynfach Streams SSSI	289980	206868	0.000286626	0.0014%	0.0196429	0.01%	0.0107924	0.0031%	0.00432619	0.003%
Craig-y-Llyn	291083	203873	0.000200916	0.0010%	0.0136312	0.01%	0.00792598	0.0023%	0.00256388	0.002%
Bryn Bwch SSSI	291990	210505	0.000291682	0.0015%	0.0234489	0.01%	0.0107343	0.0031%	0.00311206	0.002%
Caeau Nant-y-Llechau SSSI	290235	210177	0.000130631	0.0007%	0.0111142	0.00%	0.00683917	0.0020%	0.00193906	0.002%
Gweunedd Dyffern Nedd SSSI	291341	210980	0.000197486	0.0010%	0.0156611	0.01%	0.00920792	0.0026%	0.00200169	0.002%
Bryncarnau Grasslands Llwyncoed SSSI	299424	206366	0.000379301	0.0019%	0.0283442	0.01%	0.0120682	0.0034%	0.0031991	0.003%
Blaenrhondda Road Cutting SSSI	292768	201528	0.000165207	0.0008%	0.0139036	0.01%	0.00680521	0.0019%	0.0031055	0.002%
Blaen Nedd SSSI	291234	212551	0.000144805	0.0007%	0.0110745	0.00%	0.00582455	0.0017%	0.00165789	0.001%
Ogof Ffynnon Ddu Pant Mawr SSSI	290258	213083	9.01868E-05	0.0005%	0.00727432	0.00%	0.00441124	0.0013%	0.000913566	0.001%
Caeau Ton-y-Fildre SSSI	286882	210448	0.000107402	0.0005%	0.00760429	0.00%	0.00467661	0.0013%	0.00145344	0.001%
Penmoelallt SSSI	301892	209166	0.000207579	0.0010%	0.0100586	0.00%	0.00523913	0.0015%	0.00138561	0.001%
Mynydd Ty-Isaf Rhondda SSSI	292688	198555	7.77049E-05	0.0004%	0.00698561	0.00%	0.00435119	0.0012%	0.000874407	0.001%
Plas-y-Gors SSSI	292223	215231	8.98384E-05	0.0004%	0.00597856	0.00%	0.00328099	0.0009%	0.000988453	0.001%
Daren Fach SSSI	301984	210048	0.000209495	0.0010%	0.0107505	0.00%	0.00483498	0.0014%	0.00116573	0.001%
Cwm Glo a Glyndyrys SSSI	302548	205327	0.000204505	0.0010%	0.0102446	0.00%	0.00614154	0.0018%	0.00190451	0.002%
Waun Ton-y-Spyddaden SSSI	286406	211980	5.18494E-05	0.0003%	0.00473613	0.00%	0.00256438	0.0007%	0.000747777	0.001%
Gorsllwyn Onllwyn SSSI	285547	210323	0.000108707	0.0005%	0.0114908	0.00%	0.0049254	0.0014%	0.00142447	0.001%
Cwm Taf Fechan Woodlands SSSI	303358	208182	0.000177908	0.0009%	0.012011	0.00%	0.00538187	0.0015%	0.00158151	0.001%
Nant Llech SSSI	285246	211804	6.28576E-05	0.0003%	0.00453748	0.00%	0.00268566	0.0008%	0.000928109	0.001%
Caeau Nant Y Groes SSSI	302672	202490	0.00013016	0.0007%	0.0152312	0.01%	0.00553803	0.0016%	0.00158017	0.001%
Tir Mawr A Dderi Hir, Llwydcoed SSSI	297977	206236	0.00062659	0.0031%	0.0405345	0.02%	0.0220903	0.0063%	0.00541797	0.004%
Penderyn Reservoir	293890	207015	0.00658343	0.03%	0.177538	0.07%	0.134126	0.0383%	0.0561977	0.045%
Eden Trading	294020	206800	0.00451689	0.02%	0.206317	0.08%	0.186584	0.0533%	0.0601736	0.048%
House at Penderyn Reservoir	294100	207270	0.0103791	0.05%	0.105853	0.04%	0.0945358	0.0270%	0.0660183	0.053%
Ty Newydd Hotel	294600	206940	0.00643566	0.03%	0.103114	0.04%	0.079752	0.0228%	0.0307254	0.025%
Caer Llwyn Cottage	293253	207151	0.00264023	0.01%	0.0878867	0.03%	0.0758308	0.0217%	0.0379999	0.030%
Rhombic Farm	292958	206712	0.00248444	0.01%	0.0661117	0.02%	0.0566956	0.0162%	0.0271597	0.022%
Castell Farm	292871	206783	0.00199374	0.01%	0.0632078	0.02%	0.0513132	0.0147%	0.0270357	0.022%
TY Newydd Cottage	294514	207025	0.00891033	0.04%	0.0982662	0.04%	0.0824474	0.0236%	0.0398629	0.032%
Residence Woodland Park	294824	207560	0.00551448	0.03%	0.0553454	0.02%	0.0423687	0.0121%	0.0232929	0.019%
Pontbren Llwyd School	295057	208264	0.00278444	0.01%	0.0334943	0.01%	0.0259424	0.0074%	0.0115822	0.009%
Ffynnon Ddu (spring)	292273	208364	0.000468392	0.00%	0.0249727	0.01%	0.0178132	0.0051%	0.00571219	0.005%
Ton-Y-Gilfach	289565	208712	0.000269513	0.00%	0.0177081	0.01%	0.0108627	0.0031%	0.00353819	0.003%
Rose Cottage	291284	208150	0.000496066	0.00%	0.0247876	0.01%	0.0171431	0.0049%	0.00618502	0.005%
The Don Bungalow	291512	207044	0.00055225	0.00%	0.0320526	0.01%	0.0209725	0.0060%	0.00774281	0.006%
Werfa Farm	291944	206721	0.00080363	0.00%	0.032695	0.01%	0.0230497	0.0066%	0.0112332	0.009%
Willows Farm	294129	205879	0.0014604	0.01%	0.108423	0.04%	0.0679828	0.0194%	0.0167063	0.013%
Trebanog Uchaf Farm	294063	207416	0.00615767	0.03%	0.0883139	0.03%	0.0786773	0.0225%	0.0503143	0.040%
Tai-Cwpla Farm	293519	207024	0.0034259	0.02%	0.135627	0.05%	0.119079	0.0340%	0.0479365	0.038%
Neuadd Farm	294906	207282	0.00513215	0.03%	0.0604532	0.02%	0.0467176	0.0133%	0.0237349	0.019%
John Street Allotments, Hirwaun	296180	205605	0.0008633	0.00%	0.0597967	0.02%	0.030773	0.0088%	0.00804926	0.006%
Dwr Cymru Service Reservoir	294068	206939	0.0172302	0.09%	0.182988	0.07%	0.162131	0.0463%	0.0946061	0.076%

Table 8 Process Contributions of Particulate Matter and Carbon Monoxide to Sensitive Receptors

SENSITIVE RECEPTOR	X (m)	Y (m)	90.41 Percentile 24 Hour PM10 (ug/m3)	PC as % EQS	Annual Average PM10 (ug/m3)	PC as % EQS	Annual Average PM2.5 (ug/m3)	PC as % EQS	8 Hour Rolling Average CO (mg/m3)	Maximum 8 Hour Rolling Average CO (mg/m3)	PC as % EQS
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294099	206960	0.406428	0.81%	0.149046	0.37%	0.191239	0.76%	0.000942092	0.0073519	0.074%
Cwm Cadlan SAC	294970	209125	0.0215996	0.04%	0.00765478	0.02%	0.0122718	0.05%	6.36077E-05	0.00128744	0.013%
Coedydd Nedd a Mellte SAC	292525	207199	0.0349992	0.07%	0.00866674	0.02%	0.0117829	0.05%	5.91666E-05	0.00191335	0.019%
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	293790	208448	0.0217747	0.04%	0.00712794	0.02%	0.0106586	0.04%	5.40011E-05	0.00168051	0.017%
Cwm Gwrelych and Nant Llynfach Streams SSSI	289980	206868	0.00628057	0.01%	0.00179336	0.004%	0.00291683	0.01%	1.56032E-05	0.0016274	0.016%
Craig-y-Llyn	291083	203873	0.00489513	0.01%	0.00133901	0.003%	0.00215717	0.01%	1.12646E-05	0.000506301	0.005%
Bryn Bwch SSSI	291990	210505	0.00596216	0.01%	0.00169421	0.004%	0.00295124	0.01%	1.59866E-05	0.00168951	0.017%
Caeau Nant-y-Llechau SSSI	290235	210177	0.00308587	0.01%	0.000752226	0.002%	0.0013477	0.01%	7.28319E-06	0.00144364	0.014%
Gweunedd Dyffern Nedd SSSI	291341	210980	0.00410794	0.01%	0.00111965	0.003%	0.00198887	0.01%	1.09782E-05	0.00103035	0.010%
Bryncarnau Grasslands Llwyncoed SSSI	299424	206366	0.00845455	0.02%	0.00239962	0.01%	0.00365997	0.01%	2.43956E-05	0.00111087	0.011%
Blaenrhondda Road Cutting SSSI	292768	201528	0.00436017	0.01%	0.00121936	0.003%	0.00189093	0.01%	1.15355E-05	0.0026511	0.027%
Blaen Nedd SSSI	291234	212551	0.00292123	0.01%	0.000802076	0.002%	0.00151683	0.01%	8.09468E-06	0.000602984	0.006%
Ogof Ffynnon Ddu Pant Mawr SSSI	290258	213083	0.00172131	0.00%	0.000483401	0.001%	0.000919623	0.004%	5.05886E-06	0.000263905	0.003%
Caeau Ton-y-Fildre SSSI	286882	210448	0.00242577	0.00%	0.000630941	0.002%	0.00112099	0.00%	7.04438E-06	0.000636861	0.006%
Penmoelallt SSSI	301892	209166	0.00361068	0.01%	0.00119224	0.003%	0.00206672	0.01%	1.26123E-05	0.000502898	0.005%
Mynydd Ty-Isaf Rhondda SSSI	292688	198555	0.00253636	0.01%	0.000593637	0.001%	0.000984912	0.004%	5.1457E-06	0.000367189	0.004%
Plas-y-Gors SSSI	292223	215231	0.00184483	0.00%	0.000490536	0.001%	0.000960315	0.004%	5.32199E-06	0.000370166	0.004%
Daren Fach SSSI	301984	210048	0.00340825	0.01%	0.00117434	0.003%	0.0021002	0.01%	0.000012152	0.000303579	0.003%
Cwm Glo a Glyndyrys SSSI	302548	205327	0.00483789	0.01%	0.00127171	0.003%	0.0019254	0.01%	1.55448E-05	0.000582775	0.006%
Waun Ton-y-Spyddaden SSSI	286406	211980	0.00133286	0.00%	0.000309936	0.001%	0.000549297	0.002%	3.12277E-06	0.000510472	0.005%
Gorsllwyn Onllwyn SSSI	285547	210323	0.00257501	0.01%	0.000607182	0.002%	0.00112373	0.00%	7.49488E-06	0.000831203	0.008%
Cwm Taf Fechan Woodlands SSSI	303358	208182	0.00345809	0.01%	0.00103865	0.003%	0.0017058	0.01%	0.000012352	0.0005886	0.006%
Nant Llech SSSI	285246	211804	0.00147732	0.00%	0.000368215	0.001%	0.000660572	0.003%	4.42406E-06	0.000388863	0.004%
Caeau Nant Y Groes SSSI	302672	202490	0.00310572	0.01%	0.000774953	0.002%	0.00119035	0.00%	8.33136E-06	0.000409815	0.004%
Tir Mawr A Dderi Hir, Llwydcoed SSSI	297977	206236	0.0155346	0.03%	0.00408772	0.01%	0.006079	0.02%	3.88342E-05	0.00169861	0.017%
Penderyn Reservoir	293890	207015	0.162324	0.32%	0.04785	0.12%	0.0640266	0.26%	0.000316728	0.00698187	0.070%
Eden Trading	294020	206800	0.1837	0.37%	0.0419962	0.10%	0.0457452	0.18%	0.000241091	0.00987109	0.099%
House at Penderyn Reservoir	294100	207270	0.206807	0.41%	0.0753023	0.19%	0.101398	0.41%	0.000500052	0.00486093	0.049%
Ty Newydd Hotel	294600	206940	0.154234	0.31%	0.0508969	0.13%	0.064457	0.26%	0.000327885	0.00642228	0.064%
Caer Llwyn Cottage	293253	207151	0.0740057	0.15%	0.020173	0.05%	0.0265044	0.11%	0.00013037	0.00401484	0.040%
Rhombic Farm	292958	206712	0.073124	0.15%	0.0188936	0.05%	0.0249653	0.10%	0.000120754	0.0032822	0.033%
Castell Farm	292871	206783	0.0572714	0.11%	0.0151368	0.04%	0.0201258	0.08%	0.000097079	0.00281991	0.028%
TY Newydd Cottage	294514	207025	0.200231	0.40%	0.068997	0.17%	0.0886312	0.35%	0.000441177	0.00935871	0.094%
Residence Woodland Park	294824	207560	0.107963	0.22%	0.0382961	0.10%	0.0537787	0.22%	0.000270541	0.00399528	0.040%
Pontbren Llwyd School	295057	208264	0.0487078	0.10%	0.0179519	0.04%	0.0272442	0.11%	0.000138708	0.00224221	0.022%
Ffynnon Ddu (spring)	292273	208364	0.0118262	0.02%	0.00310211	0.01%	0.00464855	0.02%	0.000024412	0.00169118	0.017%
Ton-Y-Gilfach	289565	208712	0.00667035	0.01%	0.00163678	0.00%	0.00277764	0.01%	1.61225E-05	0.00123482	0.012%
Rose Cottage	291284	208150	0.0133227	0.03%	0.00325077	0.01%	0.00507255	0.02%	2.73452E-05	0.00271789	0.027%
The Don Bungalow	291512	207044	0.0138855	0.03%	0.00370904	0.01%	0.00556691	0.02%	2.87928E-05	0.0022874	0.023%
Werfa Farm	291944	206721	0.0193605	0.04%	0.00557064	0.01%	0.00793829	0.03%	4.06053E-05	0.00278177	0.028%
Willows Farm	294129	205879	0.0524383	0.10%	0.0110246	0.03%	0.0135263	0.05%	9.01962E-05	0.00544108	0.054%
Trebanog Uchaf Farm	294063	207416	0.137681	0.28%	0.0435248	0.11%	0.0599398	0.24%	0.00029828	0.00426854	0.043%
Tai-Cwpla Farm	293519	207024	0.0979296	0.20%	0.0259508	0.06%	0.0338041	0.14%	0.000166607	0.00573079	0.057%
Neuadd Farm	294906	207282	0.106288	0.21%	0.0374028	0.09%	0.0507261	0.20%	0.00025475	0.00533815	0.053%
John Street Allotments, Hirwaun	296180	205605	0.0256658	0.05%	0.00667439	0.02%	0.00875109	0.04%	5.07509E-05	0.0034952	0.035%
Dwr Cymru Service Reservoir	294068	206939	0.360474	0.72%	0.132433	0.33%	0.169242	0.68%	0.000834711	0.00785594	0.079%

Table 9 Process Contributions of VOCs, Mercury, Cadmium/Thallium, Heavy Metals and Hydrogen Fluoride to Sensitive Receptors

SENSITIVE RECEPTOR	X (m)	Y (m)	Annual Average VOC (ug/m3)	PC as % EQS	Annual Average Hg (ug/m3)	PC as % EQS	Annual Average Cd / Tl as Cd (ng/m3)	PC as % EQS	Annual Average Heavy Metals as Pb (ug/m3)	PC as % EQS	Maximum Hourly HF (ug/m3)	PC as % EQS
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294099	206960	0.200081	4.00%	0.00100143	0.401%	1.00143	20.0%	0.0100143	4.01%	0.0189366	0.01184%
Cwm Cadlan SAC	294970	209125	0.0135044	0.27%	6.75911E-05	0.027%	0.0675911	1.4%	0.000675912	0.27%	0.00116088	0.00073%
Coedydd Nedd a Mellte SAC	292525	207199	0.0122439	0.24%	6.12822E-05	0.025%	0.0612822	1.2%	0.000612822	0.25%	0.00109233	0.00068%
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	293790	208448	0.0115146	0.23%	5.76322E-05	0.023%	0.0576322	1.2%	0.000576322	0.23%	0.00100586	0.00063%
Cwm Gwrelych and Nant Llynfach Streams SSSI	289980	206868	0.00322785	0.06%	1.61558E-05	0.006%	0.0161558	0.3%	0.000161558	0.06%	0.000265638	0.00017%
Craig-y-Llyn	291083	203873	0.00231553	0.05%	1.15895E-05	0.005%	0.0115895	0.2%	0.000115895	0.05%	0.00018684	0.00012%
Bryn Bwch SSSI	291990	210505	0.00334501	0.07%	1.67422E-05	0.007%	0.0167422	0.3%	0.000167422	0.07%	0.00027044	0.00017%
Caeau Nant-y-Llechau SSSI	290235	210177	0.00150547	0.03%	7.53504E-06	0.003%	0.00753504	0.2%	7.53504E-05	0.03%	0.000120539	0.00008%
Gweunedd Dyffern Nedd SSSI	291341	210980	0.00226072	0.05%	1.13152E-05	0.005%	0.0113152	0.2%	0.000113152	0.05%	0.000182226	0.00011%
Bryncarnau Grasslands Llwyncoed SSSI	299424	206366	0.00483723	0.10%	2.42109E-05	0.010%	0.0242109	0.5%	0.000242109	0.10%	0.00036195	0.00023%
Blaenrhondda Road Cutting SSSI	292768	201528	0.00206734	0.04%	1.03473E-05	0.004%	0.0103473	0.2%	0.000103473	0.04%	0.000159661	0.00010%
Blaen Nedd SSSI	291234	212551	0.00169356	0.03%	8.47646E-06	0.003%	0.00847646	0.2%	8.47645E-05	0.03%	0.000132286	0.00008%
Ogof Ffynnon Ddu Pant Mawr SSSI	290258	213083	0.00105085	0.02%	5.25962E-06	0.002%	0.00525962	0.1%	5.25961E-05	0.02%	8.22118E-05	0.00005%
Caeau Ton-y-Fildre SSSI	286882	210448	0.0013469	0.03%	6.74139E-06	0.003%	0.00674139	0.1%	6.74138E-05	0.03%	9.86032E-05	0.00006%
Penmoelallt SSSI	301892	209166	0.00251681	0.05%	1.25969E-05	0.005%	0.0125969	0.3%	0.000125969	0.05%	0.000192044	0.00012%
Mynydd Ty-Isaf Rhondda SSSI	292688	198555	0.000947853	0.02%	4.74412E-06	0.002%	0.00474412	0.1%	4.74412E-05	0.02%	7.36395E-05	0.00005%
Plas-y-Gors SSSI	292223	215231	0.00111101	0.02%	5.56072E-06	0.002%	0.00556072	0.1%	5.56072E-05	0.02%	8.15598E-05	0.00005%
Daren Fach SSSI	301984	210048	0.0024755	0.05%	1.23902E-05	0.005%	0.0123902	0.2%	0.000123902	0.05%	0.000192036	0.00012%
Cwm Glo a Glyndyrys SSSI	302548	205327	0.00311824	0.06%	1.56072E-05	0.006%	0.0156072	0.3%	0.000156072	0.06%	0.000204366	0.00013%
Waun Ton-y-Spyddaden SSSI	286406	211980	0.000617277	0.01%	3.08955E-06	0.001%	0.00308955	0.1%	3.08954E-05	0.01%	4.75266E-05	0.00003%
Gorsllwyn Onllwyn SSSI	285547	210323	0.00140649	0.03%	7.03964E-06	0.003%	0.00703964	0.1%	7.03965E-05	0.03%	9.90619E-05	0.00006%
Cwm Taf Fechan Woodlands SSSI	303358	208182	0.00241581	0.05%	1.20914E-05	0.005%	0.0120914	0.2%	0.000120914	0.05%	0.000169751	0.00011%
Nant Llech SSSI	285246	211804	0.000810929	0.02%	4.0588E-06	0.002%	0.0040588	0.1%	4.05879E-05	0.02%	5.78372E-05	0.00004%
Caeau Nant Y Groes SSSI	302672	202490	0.00164277	0.03%	8.22226E-06	0.003%	0.00822226	0.2%	8.22225E-05	0.03%	0.000125052	0.00008%
Tir Mawr A Dderi Hir, Llwydcoed SSSI	297977	206236	0.00773645	0.15%	3.87218E-05	0.015%	0.0387218	0.8%	0.000387218	0.15%	0.000598407	0.00037%
Penderyn Reservoir	293890	207015	0.0677761	1.36%	0.000339229	0.136%	0.339229	6.8%	0.00339228	1.36%	0.00639202	0.00400%
Eden Trading	294020	206800	0.0464373	0.93%	0.000232424	0.093%	0.232424	4.6%	0.00232424	0.93%	0.00447348	0.00280%
House at Penderyn Reservoir	294100	207270	0.10737	2.15%	0.000537397	0.215%	0.537397	10.7%	0.00537397	2.15%	0.0100268	0.00627%
Ty Newydd Hotel	294600	206940	0.0678253	1.36%	0.000339474	0.136%	0.339474	6.8%	0.00339474	1.36%	0.00621743	0.00389%
Caer Llwyn Cottage	293253	207151	0.0276184	0.55%	0.000138233	0.055%	0.138233	2.8%	0.00138233	0.55%	0.00254632	0.00159%
Rhombic Farm	292958	206712	0.0260639	0.52%	0.000130453	0.052%	0.130453	2.6%	0.00130453	0.52%	0.00238941	0.00149%
Castell Farm	292871	206783	0.0209397	0.42%	0.000104806	0.042%	0.104806	2.1%	0.00104805	0.42%	0.00191535	0.00120%
TY Newydd Cottage	294514	207025	0.0930432	1.86%	0.000465692	0.186%	0.465692	9.3%	0.00465692	1.86%	0.00860515	0.00538%
Residence Woodland Park	294824	207560	0.0577465	1.15%	0.000289028	0.116%	0.289028	5.8%	0.00289028	1.16%	0.00528884	0.00331%
Pontbren Llwyd School	295057	208264	0.0296518	0.59%	0.000148411	0.059%	0.148411	3.0%	0.00148411	0.59%	0.00264039	0.00165%
Ffynnon Ddu (spring)	292273	208364	0.005022	0.10%	2.51357E-05	0.010%	0.0251357	0.5%	0.000251357	0.10%	0.000443291	0.00028%
Ton-Y-Gilfach	289565	208712	0.00317243	0.06%	1.58784E-05	0.006%	0.0158784	0.3%	0.000158784	0.06%	0.000248014	0.00016%
Rose Cottage	291284	208150	0.00554455	0.11%	2.77511E-05	0.011%	0.0277511	0.6%	0.000277511	0.11%	0.000463929	0.00029%
The Don Bungalow	291512	207044	0.00602489	0.12%	3.01553E-05	0.012%	0.0301553	0.6%	0.000301553	0.12%	0.000518997	0.00032%
Werfa Farm	291944	206721	0.00864544	0.17%	4.32714E-05	0.017%	0.0432714	0.9%	0.000432714	0.17%	0.000762771	0.00048%
Willows Farm	294129	205879	0.0158895	0.32%	7.95289E-05	0.032%	0.0795289	1.6%	0.000795288	0.32%	0.00142718	0.00089%
Trebanog Uchaf Farm	294063	207416	0.0640877	1.28%	0.000320767	0.128%	0.320767	6.4%	0.00320766	1.28%	0.00593159	0.00371%
Tai-Cwpla Farm	293519	207024	0.0354336	0.71%	0.000177349	0.071%	0.177349	3.5%	0.00177349	0.71%	0.00331167	0.00207%
Neuadd Farm	294906	207282	0.0540046	1.08%	0.000270299	0.108%	0.270299	5.4%	0.00270299	1.08%	0.0049212	0.00308%
John Street Allotments, Hirwaun	296180	205605	0.00953037	0.19%	4.77006E-05	0.019%	0.0477006	1.0%	0.000477006	0.19%	0.000839222	0.00052%
Dwr Cymru Service Reservoir	294068	206939	0.176982	3.54%	0.000885816	0.354%	0.885816	17.7%	0.00885816	3.54%	0.0167639	0.01048%

Process contributions over 1 % of the long-term or 10 % of the short-term assessment level are highlighted in yellow

Table 10 Process Contributions of PAH, PCBs and Ammonia to Sensitive Receptors

SENSITIVE RECEPTOR	X (m)	Y (m)	Annual Average PAH (ng/m3)	PC as % EQS	Annual Average PCB (ug/m3)	PC as % EQS	Maximum Hourly PCB (ug/m3)	PC as % EQS	Annual Average NH3 (ug/m3)	PC as % EQS	Maximum Hourly NH3 (ug/m3)	PC as % EQS
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294099	206960	0.0200081	2.00%	0.000100143	0.0501%	0.00095048	0.016%	0.00190983	0.00106%	0.0180534	0.00072%
Cwm Cadlan SAC	294970	209125	0.00135044	0.14%	6.75911E-06	0.0034%	0.00026379	0.004%	0.000116832	0.00006%	0.00352774	0.00014%
Coedydd Nedd a Mellte SAC	292525	207199	0.00122439	0.12%	6.12823E-06	0.0031%	0.000706137	0.012%	0.000108972	0.00006%	0.00990064	0.00040%
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	293790	208448	0.00115147	0.12%	5.76322E-06	0.0029%	0.00040881	0.007%	0.000100799	0.00006%	0.0060185	0.00024%
Cwm Gwrelych and Nant Llynfach Streams SSSI	289980	206868	0.000322785	0.03%	1.61558E-06	0.0008%	0.000179386	0.003%	0.000026511	0.00001%	0.00282241	0.00011%
Craig-y-Llyn	291083	203873	0.000231553	0.02%	1.15895E-06	0.0006%	0.000306875	0.005%	1.83965E-05	0.00001%	0.00449374	0.00018%
Bryn Bwch SSSI	291990	210505	0.000334501	0.03%	1.67422E-06	0.0008%	0.000353736	0.006%	2.70741E-05	0.00002%	0.00468505	0.00019%
Caeau Nant-y-Llechau SSSI	290235	210177	0.000150547	0.02%	7.53505E-07	0.0004%	0.000341875	0.006%	1.19474E-05	0.00001%	0.00377845	0.00015%
Gweunedd Dyffern Nedd SSSI	291341	210980	0.000226072	0.02%	1.13152E-06	0.0006%	0.000398076	0.007%	1.82264E-05	0.00001%	0.00509206	0.00020%
Bryncarnau Grasslands Llwyncoed SSSI	299424	206366	0.000483722	0.05%	2.42109E-06	0.0012%	0.000212616	0.004%	3.40057E-05	0.00002%	0.00290064	0.00012%
Blaenrhondda Road Cutting SSSI	292768	201528	0.000206734	0.02%	1.03473E-06	0.0005%	0.000479462	0.008%	1.49581E-05	0.00001%	0.00596767	0.00024%
Blaen Nedd SSSI	291234	212551	0.000169356	0.02%	8.47646E-07	0.0004%	0.000239368	0.004%	1.32151E-05	0.00001%	0.00274186	0.00011%
Ogof Ffynnon Ddu Pant Mawr SSSI	290258	213083	0.000105085	0.01%	5.25961E-07	0.0003%	0.00010567	0.002%	8.2421E-06	0.00000%	0.00144697	0.00006%
Caeau Ton-y-Fildre SSSI	286882	210448	0.00013469	0.01%	6.74138E-07	0.0003%	7.08477E-05	0.001%	9.63544E-06	0.00001%	0.000907509	0.00004%
Penmoelallt SSSI	301892	209166	0.000251681	0.03%	1.25969E-06	0.0006%	0.000100244	0.002%	1.86713E-05	0.00001%	0.00106787	0.00004%
Mynydd Ty-Isaf Rhondda SSSI	292688	198555	9.47853E-05	0.01%	4.74412E-07	0.0002%	0.000084287	0.001%	7.04522E-06	0.00000%	0.000904901	0.00004%
Plas-y-Gors SSSI	292223	215231	0.000111101	0.01%	5.56072E-07	0.0003%	0.000075067	0.001%	0.000008063	0.00000%	0.000899903	0.00004%
Daren Fach SSSI	301984	210048	0.00024755	0.02%	1.23902E-06	0.0006%	8.92724E-05	0.001%	1.89103E-05	0.00001%	0.00108044	0.00004%
Cwm Glo a Glyndyrys SSSI	302548	205327	0.000311824	0.03%	1.56072E-06	0.0008%	0.00010337	0.002%	0.000018519	0.00001%	0.000941596	0.00004%
Waun Ton-y-Spyddaden SSSI	286406	211980	6.17277E-05	0.01%	3.08954E-07	0.0002%	0.000060571	0.001%	4.74296E-06	0.00000%	0.000739793	0.00003%
Gorsllwyn Onllwyn SSSI	285547	210323	0.000140649	0.01%	7.03964E-07	0.0004%	8.50139E-05	0.001%	9.59947E-06	0.00001%	0.000937286	0.00004%
Cwm Taf Fechan Woodlands SSSI	303358	208182	0.000241581	0.02%	1.20914E-06	0.0006%	0.000075186	0.001%	1.58501E-05	0.00001%	0.000990911	0.00004%
Nant Llech SSSI	285246	211804	8.10929E-05	0.01%	4.05879E-07	0.0002%	4.95009E-05	0.001%	5.63808E-06	0.00000%	0.000599601	0.00002%
Caeau Nant Y Groes SSSI	302672	202490	0.000164277	0.02%	8.22225E-07	0.0004%	9.54695E-05	0.002%	1.16781E-05	0.00001%	0.001205	0.00005%
Tir Mawr A Dderi Hir, Llwydcoed SSSI	297977	206236	0.000773645	0.08%	3.87218E-06	0.0019%	0.000336023	0.006%	5.63921E-05	0.00003%	0.0051712	0.00021%
Penderyn Reservoir	293890	207015	0.00677762	0.68%	3.39228E-05	0.0170%	0.00190803	0.032%	0.000644562	0.00036%	0.0311326	0.00125%
Eden Trading	294020	206800	0.00464372	0.46%	2.32424E-05	0.0116%	0.00141151	0.024%	0.00044234	0.00025%	0.0276046	0.00110%
House at Penderyn Reservoir	294100	207270	0.010737	1.07%	5.37397E-05	0.0269%	0.00208052	0.035%	0.00101181	0.00056%	0.0330383	0.00132%
Ty Newydd Hotel	294600	206940	0.00678253	0.68%	3.39473E-05	0.0170%	0.00192775	0.032%	0.000620011	0.00034%	0.0224287	0.00090%
Caer Llwyn Cottage	293253	207151	0.00276184	0.28%	1.38233E-05	0.0069%	0.0013516	0.023%	0.000255744	0.00014%	0.022711	0.00091%
Rhombic Farm	292958	206712	0.00260639	0.26%	1.30453E-05	0.0065%	0.00120069	0.020%	0.000239981	0.00013%	0.0177814	0.00071%
Castell Farm	292871	206783	0.00209397	0.21%	1.04806E-05	0.0052%	0.0012097	0.020%	0.000192427	0.00011%	0.0176739	0.00071%
TY Newydd Cottage	294514	207025	0.00930431	0.93%	4.65691E-05	0.0233%	0.00281037	0.047%	0.000863123	0.00048%	0.032276	0.00129%
Residence Woodland Park	294824	207560	0.00577464	0.58%	2.89028E-05	0.0145%	0.00133091	0.022%	0.000533666	0.00030%	0.0196781	0.00079%
Pontbren Llwyd School	295057	208264	0.00296519	0.30%	1.48411E-05	0.0074%	0.000684693	0.011%	0.000266594	0.00015%	0.00961128	0.00038%
Ffynnon Ddu (spring)	292273	208364	0.0005022	0.05%	2.51357E-06	0.0013%	0.000509585	0.008%	4.46674E-05	0.00002%	0.00760288	0.00030%
Ton-Y-Gilfach	289565	208712	0.000317243	0.03%	1.58784E-06	0.0008%	0.000233808	0.004%	2.44432E-05	0.00001%	0.00354212	0.00014%
Rose Cottage	291284	208150	0.000554455	0.06%	2.77511E-06	0.0014%	0.000430764	0.007%	4.61872E-05	0.00003%	0.00643773	0.00026%
The Don Bungalow	291512	207044	0.000602489	0.06%	3.01553E-06	0.0015%	0.000317529	0.005%	5.20188E-05	0.00003%	0.00521673	0.00021%
Werfa Farm	291944	206721	0.000864545	0.09%	4.32715E-06	0.0022%	0.000909172	0.015%	0.000076396	0.00004%	0.0119211	0.00048%
Willows Farm	294129	205879	0.00158895	0.16%	7.95289E-06	0.0040%	0.00205977	0.034%	0.000138443	0.00008%	0.0219966	0.00088%
Trebanog Uchaf Farm	294063	207416	0.00640876	0.64%	3.20766E-05	0.0160%	0.00179126	0.030%	0.000598155	0.00033%	0.0284392	0.00114%
Tai-Cwpla Farm	293519	207024	0.00354336	0.35%	1.77349E-05	0.0089%	0.000724743	0.012%	0.000333928	0.00019%	0.0133618	0.00053%
Neuadd Farm	294906	207282	0.00540046	0.54%	0.00002703	0.0135%	0.00160297	0.027%	0.000494602	0.00027%	0.0182571	0.00073%
John Street Allotments, Hirwaun	296180	205605	0.000953037	0.10%	4.77006E-06	0.0024%	0.000699755	0.012%	8.11414E-05	0.00005%	0.0103645	0.00041%
Dwr Cymru Service Reservoir	294068	206939	0.0176982	1.77%	8.85816E-05	0.0443%	0.00110085	0.018%	0.0016879	0.00094%	0.0215308	0.00086%

Process contributions over 1 % of the long-term or 10 % of the short-term assessment level are highlighted in yellow

Table 11 Sensitive Receptors Where Process Contributions of Oxides of Nitrogen, Volatile Organic Compounds 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	9.03	0.801701	9.8317	**2.7%**	No	32.77%	Yes
House at Penderyn Reservoir	294100	207270	40	8.692089	0.430361	9.1225	**1.1%**	No	22.81%	Yes
Dwr Cymru Service Reservoir	294068	206939	40	8.692089	0.709137	9.4012	**1.8%**	No	23.50%	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 %?**
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294600	206600	5	0.207036	0.200081	0.41	**4.0%**	No	8.14%	Yes
Penderyn Reservoir	293839	207170	5	0.207036	0.0677761	0.27	**1.4%**	No	5.50%	Yes
House at Penderyn Reservoir	294100	207270	5	0.207036	0.10737	0.31	**2.1%**	No	6.29%	Yes
Ty Newydd Hotel	294600	206940	5	0.207036	0.0678253	0.27	**1.4%**	No	5.50%	Yes
TY Newydd Cottage	294514	207025	5	0.207036	0.0930432	0.30	**1.9%**	No	6.00%	Yes
Residence Woodland Park	294824	207560	5	0.207036	0.0577465	0.26	**1.2%**	No	5.30%	Yes
Trebanog Uchaf Farm	294063	207416	5	0.207036	0.0640877	0.27	**1.3%**	No	5.42%	Yes
Neuadd Farm	294906	207282	5	0.207036	0.0540046	0.26	**1.1%**	No	5.22%	Yes
Dwr Cymru Service Reservoir	294068	206939	5	0.207036	0.176982	0.38	**3.5%**	No	7.68%	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 %?**
Blaen Cynon Cors Bryn-Y-Gaer SSSI / SAC	294600	206600	1	0.188333333	0.0200081	0.21	**2.0%**	No	20.83%	Yes
House at Penderyn Reservoir	294100	207270	1	0.188333333	0.010737	0.20	**1.1%**	No	19.91%	Yes
Dwr Cymru Service Reservoir	294068	206939	1	0.188333333	0.0176982	0.21	**1.8%**	No	20.60%	Yes

Table 12 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	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	294099	206960	5	0.154934615	1.00143	1.16	**20.0%**	No	**10.0%**	No	23.13%	Yes
Cwm Cadlan SAC	294970	209125	5	0.154934615	0.0675911	0.22	**1.4%**	No	0.7%	Yes	4.45%	Yes
Coedydd Nedd a Mellte SAC	292525	207199	5	0.154934615	0.0612822	0.22	**1.2%**	No	**0.6%**	Yes	4.32%	Yes
Dyffrynoedd Nedd a Mellte a Moel Penderyn SSSI	293790	208448	5	0.154934615	0.0576322	0.21	**1.2%**	No	**0.6%**	Yes	4.25%	Yes
Penderyn Reservoir	293890	207015	5	0.154934615	0.339229	0.49	**6.8%**	No	**3.4%**	No	9.88%	Yes
Eden Trading	294020	206800	5	0.154934615	0.232424	0.39	**4.6%**	No	**2.3%**	No	7.75%	Yes
House at Penderyn Reservoir	294100	207270	5	0.154934615	0.537397	0.69	**10.7%**	No	**5.4%**	No	13.85%	Yes
Ty Newydd Hotel	294600	206940	5	0.154934615	0.339474	0.49	**6.8%**	No	**3.4%**	No	9.89%	Yes
Caer Llwyn Cottage	293253	207151	5	0.154934615	0.138233	0.29	**2.8%**	No	**1.4%**	No	5.86%	Yes
Rhombic Farm	292958	206712	5	0.154934615	0.130453	0.29	**2.6%**	No	**1.3%**	No	5.71%	Yes
Castell Farm	292871	206783	5	0.154934615	0.104806	0.26	**2.1%**	No	**1.0%**	No	5.19%	Yes
TY Newydd Cottage	294514	207025	5	0.154934615	0.465692	0.62	**9.3%**	No	**4.7%**	No	12.41%	Yes
Residence Woodland Park	294824	207560	5	0.154934615	0.289028	0.44	**5.8%**	No	2.9%	No	8.88%	Yes
Pontbren Llwyd School	295057	208264	5	0.154934615	0.148411	0.30	**3.0%**	No	**1.5%**	No	6.07%	Yes
Ty Newydd Hotel	294600	206940	5	0.154934615	0.0795289	0.23	**1.6%**	No	**0.8%**	Yes	4.69%	Yes
TY Newydd Cottage	294514	207025	5	0.154934615	0.320767	0.48	**6.4%**	No	**3.2%**	No	9.51%	Yes
Residence Woodland Park	294824	207560	5	0.154934615	0.177349	0.33	**3.5%**	No	**1.8%**	No	6.65%	Yes
Trebanog Uchaf Farm	294063	207416	5	0.154934615	0.270299	0.43	**5.4%**	No	2.7%	No	8.50%	Yes
Dwr Cymru Service Reservoir	294068	206939	5	0.154934615	0.885816	1.04	**17.7%**	No	**8.9%**	No	20.82%	Yes

Sensitive Receptor	X (m)	Y (m)	Environmental Quality Standard	Background Concentration	Annual Average Heavy Metals	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	0.0100143	0.016	**4.0%**	No	Yes	**18.5%**	6.58%	Yes
Penderyn Reservoir	293839	207170	0.25	0.006434423	0.00339228	0.010	**1.4%**	No	Yes	**6.3%**	3.93%	Yes
House at Penderyn Reservoir	294100	207270	0.25	0.006434423	0.00537397	0.012	**2.1%**	No	Yes	**10.0%**	4.72%	Yes
Ty Newydd Hotel	294600	206940	0.25	0.006434423	0.00339474	0.010	**1.4%**	No	Yes	**6.3%**	3.93%	Yes
TY Newydd Cottage	294514	207025	0.25	0.006434423	0.00465692	0.011	**1.9%**	No	Yes	**8.6%**	4.44%	Yes
Residence Woodland Park	294824	207560	0.25	0.006434423	0.00289028	0.009	**1.2%**	No	Yes	**5.4%**	3.73%	Yes
Trebanog Uchaf Farm	294063	207416	0.25	0.006434423	0.00320766	0.010	**1.3%**	No	Yes	**5.9%**	3.86%	Yes
Neuadd Farm	294906	207282	0.25	0.006434423	0.00270299	0.009	**1.1%**	No	Yes	**5.0%**	3.65%	Yes
Dwr Cymru Service Reservoir	294068	206939	0.25	0.006434423	0.00885816	0.015	**3.5%**	No	Yes	**16.4%**	6.12%	Yes

Table 13 Results of Modelling Cumulative Effects of Third Party Operations

CUMULATIVE EFFECTS Blaen Cynon	**Predicted Cumulative Contribution (ug m-3)**	**EQS (ug/m3)**	**PC < 1 % LT EQS or < 10 % ST EQS?**	**Background Concentration (ug/m3)**	**PEC (ug/m3)**	**PEC < 70 % EQS?**
Annual Average Total NOx (ug/m3)	4.803	30	**No**	9.03	13.83	Yes
24-Hourly Average Total NOx (ug/m3)	27.48	75	**No**			
Annual Average SO2 (ug/m3)	0.093	20	**Yes**	0.46	0.55	Yes
Annual Average PM10 (ug/m3)	0.153	40	**Yes**	12.97	13.12	Yes
Maximum 8 Hour Rolling Average CO (mg/m3)	0.057	10	**Yes**	0.0965	0.15	Yes
CUMULATIVE EFFECTS Cwm Cadlan	**Predicted Cumulative Contribution (ug m-3)**	**EQS (ug/m3)**	**PC < 1 % LT EQS or < 10 % ST EQS?**	**Background Concentration (ug/m3)**	**PEC (ug/m3)**	**PEC < 70 % EQS?**
Annual Average Total NOx (ug/m3)	0.580	30	**No**	7.41	7.99	Yes
24-Hourly Average Total NOx (ug/m3)	4.27	75	**Yes**			
Annual Average SO2 (ug/m3)	0.017	20	**Yes**	0.61	0.63	Yes
Annual Average PM10 (ug/m3)	0.008	40	**Yes**	12.42	12.43	Yes
Maximum 8 Hour Rolling Average CO (mg/m3)	0.021	10	**Yes**	0.0905	0.11	Yes
CUMULATIVE EFFECTS Coedydd Nedd a Mellte	**Predicted Cumulative Contribution (ug m-3)**	**EQS (ug/m3)**	**PC < 1 % LT EQS or < 10 % ST EQS?**	**Background Concentration (ug/m3)**	**PEC (ug/m3)**	**PEC < 70 % EQS?**
Annual Average Total NOx (ug/m3)	0.503	30	**No**	6.88	7.38	Yes
24-Hourly Average Total NOx (ug/m3)	12.33	75	**No**			
Annual Average SO2 (ug/m3)	0.019	20	**Yes**	0.35	0.37	Yes
Annual Average PM10 (ug/m3)	0.006	40	**Yes**	11.32	11.33	Yes
Maximum 8 Hour Rolling Average CO (mg/m3)	0.032	10	**Yes**	0.0901	0.12	Yes

Table 14 Calculation of Nitrogen and Acid Contributions to Special Areas of Conservation

RECEPTOR	Dry Deposition NO2 (ug/m2/s)	Rate of Deposition as N (kg N/ha/yr)	Ammonia Deposition (ug/m2/s)	Rate of Deposition as N (kg N/ha/yr)	Rate of Total N Deposition from NOx and NH3 (kg N/ha/yr)	Rate of Total Deposition as N (keq/ha/yr)	Dry Deposition SO2 (ug/m2/s)	Rate of Total S Deposition from SO2 (kg S/ha/yr)	Rate of Total Deposition as S (keq/ha/yr)
Blaen Cynon	0.000842	0.08079	3.81967E-05	0.00992	0.09071	0.006480	0.000233854	0.036874	0.002305
Cwm Cadlan	5.69737E-05	0.00547	2.33664E-06	0.00061	0.00608	0.000434	1.48516E-05	0.002342	0.000146
Coed Nedd a Mellte	0.000102	0.00979	3.11241E-06	0.00081	0.01060	0.000757	2.56233E-05	0.004040	0.000253
In Combination Effects									
Blaen Cynon	0.005215	0.50049	3.81967E-05	0.00992	0.51041	0.03646	0.000910	0.143530	0.008971
Cwm Cadlan	0.000609	0.05845	2.33664E-06	0.00061	0.05905	0.00422	0.000202	0.031913	0.001995
Coed Nedd a Mellte	0.000996	0.09561	3.11241E-06	0.00081	0.09642	0.00689	0.000435	0.068572	0.004286

Table 15 Contributions to Nutrient Nitrogen and Acid Deposition at Local SACs for Enviroparks Alone and In-Combination

DEPOSITED NUTRIENT NITROGEN AND ACID CONTRIBUTIONS	Enviroparks Only			In-Combination		
	Blaen Cynon	Cwm Cadlan	Coedydd Nedd a Mellte	Blaen Cynon	Cwm Cadlan	Coedydd Nedd a Mellte
Rate of Total Deposition as N (kg N/ha/yr)	0.091	0.006	0.011	0.510	0.059	0.096
Current Minimum Background (kg N/ha/yr)	23.8	21.42	26.6	23.8	21.42	26.6
Low End of Critical Load Range (kg N/ha/yr)	10	15	10	10	15	10
Deposition as % of Lower Critical Load	0.9%	0.04%	0.1%	5.1%	0.4%	1.0%
Rate of Total Dry Deposition as N (keq/ha/yr)	0.0065	0.00043	0.00076	0.036	0.0042	0.0069
Low End of Critical Load Range N (keq/ha/yr)	0.438	0.223	0.142	0.438	0.223	0.142
Deposition as % of Lower Critical Load	1.5%	0.2%	0.5%	8.3%	1.9%	4.8%
Current Minimum N Background (keq/ha/yr)	1.70	1.53	1.90	1.70	1.53	1.90
PEC N (keq/ha/yr)	1.706	1.5304	1.901	1.736	1.534	1.907
Rate of Total Dry Deposition as S (kg S/ha/yr)	0.037	0.002	0.004	0.144	0.032	0.069
Rate of Total Dry Deposition as S (keq/ha/yr)	0.0023	0.00015	0.00025	0.009	0.002	0.004
Low End of Critical Load Range S (keq/ha/yr)	0.58	0.58	1.552	0.58	0.58	1.552
Deposition as % of Lower Critical Load	0.40%	0.03%	0.02%	1.55%	0.34%	0.28%
Current Minimum S Background (keq/ha/yr)	0.49	0.43	0.44	0.49	0.43	0.44
PEC S (keq/ha/yr)	0.4923	0.4301	0.4403	0.4990	0.4320	0.4443
PC Acid (keq/ha/yr)	0.0088	0.0006	0.0010	0.0454	0.0062	0.0112
% of Critical Load	0.9%	0.1%	0.1%	4.5%	0.8%	0.7%
PEC Acid (keq/ha/yr)	2.20	1.96	2.34	2.24	1.97	2.35
% of Critical Load	216%	244%	138%	220%	245%	139%

Table 16 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	2.63E-03	1.09E-06	2.63E-03	0.526%
Nitrite (Cumulative)	0.5	2.73E-02	7.37E-06	2.73E-02	5.462%
Benzene	0.001	5.56E-06	1.77E-11	5.56E-06	0.556%
Fluoride	1.5	6.16E-04	1.59E-08	6.16E-04	0.041%
Mercury	0.001	2.78E-06	8.86E-10	2.78E-06	0.278%
Antimony	0.005	3.09E-06	1.09E-10	3.09E-06	0.062%

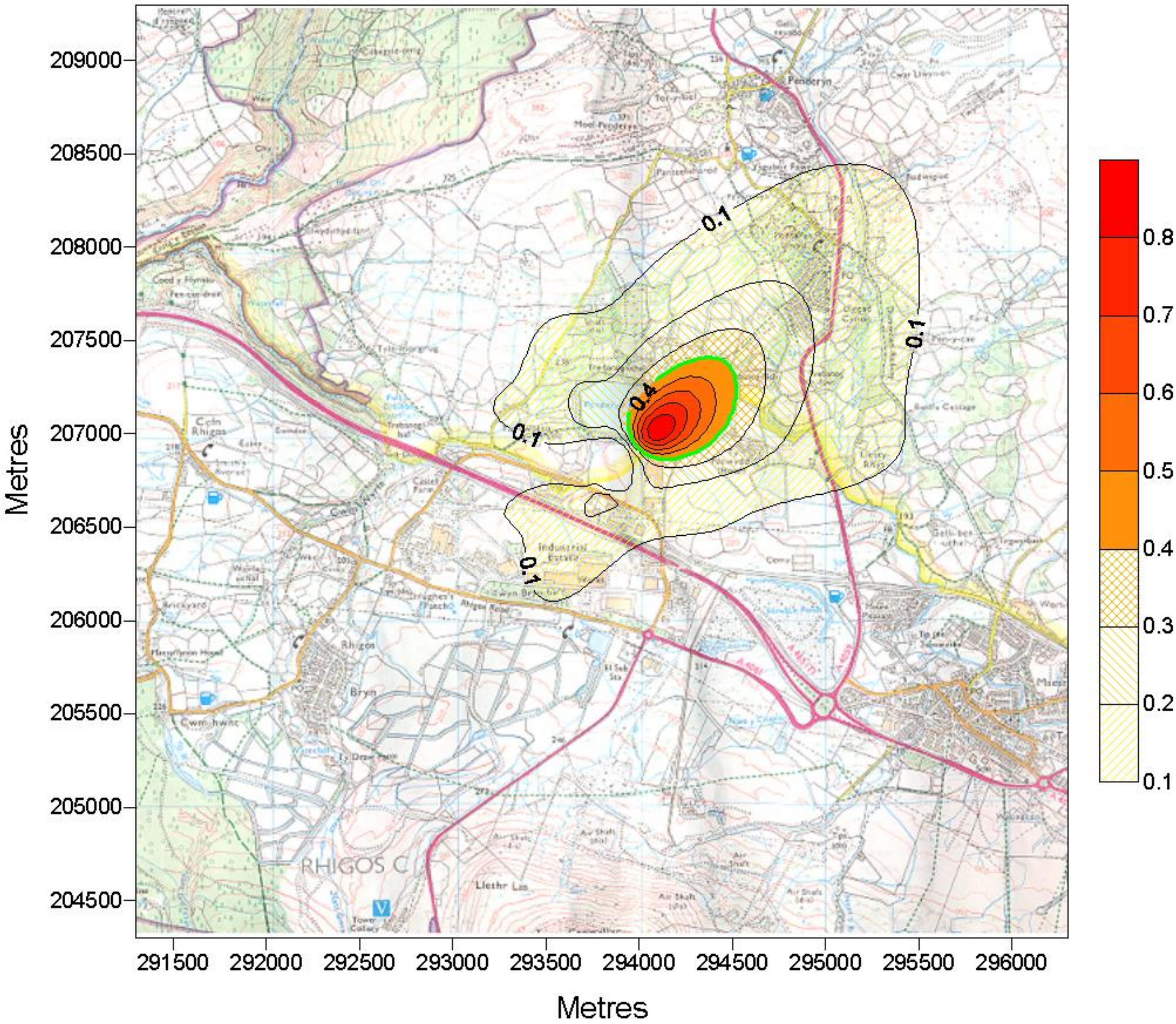
Notes:
Nitrite (Cumulative) considers the total exposure of the water storage infrastructure when considering the Enviroparks emissions in combination with other third-party sources proposed or recently built.
Benzene is assumed to comprise 1 % of the total VOC deposition, and Antimony is assumed to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

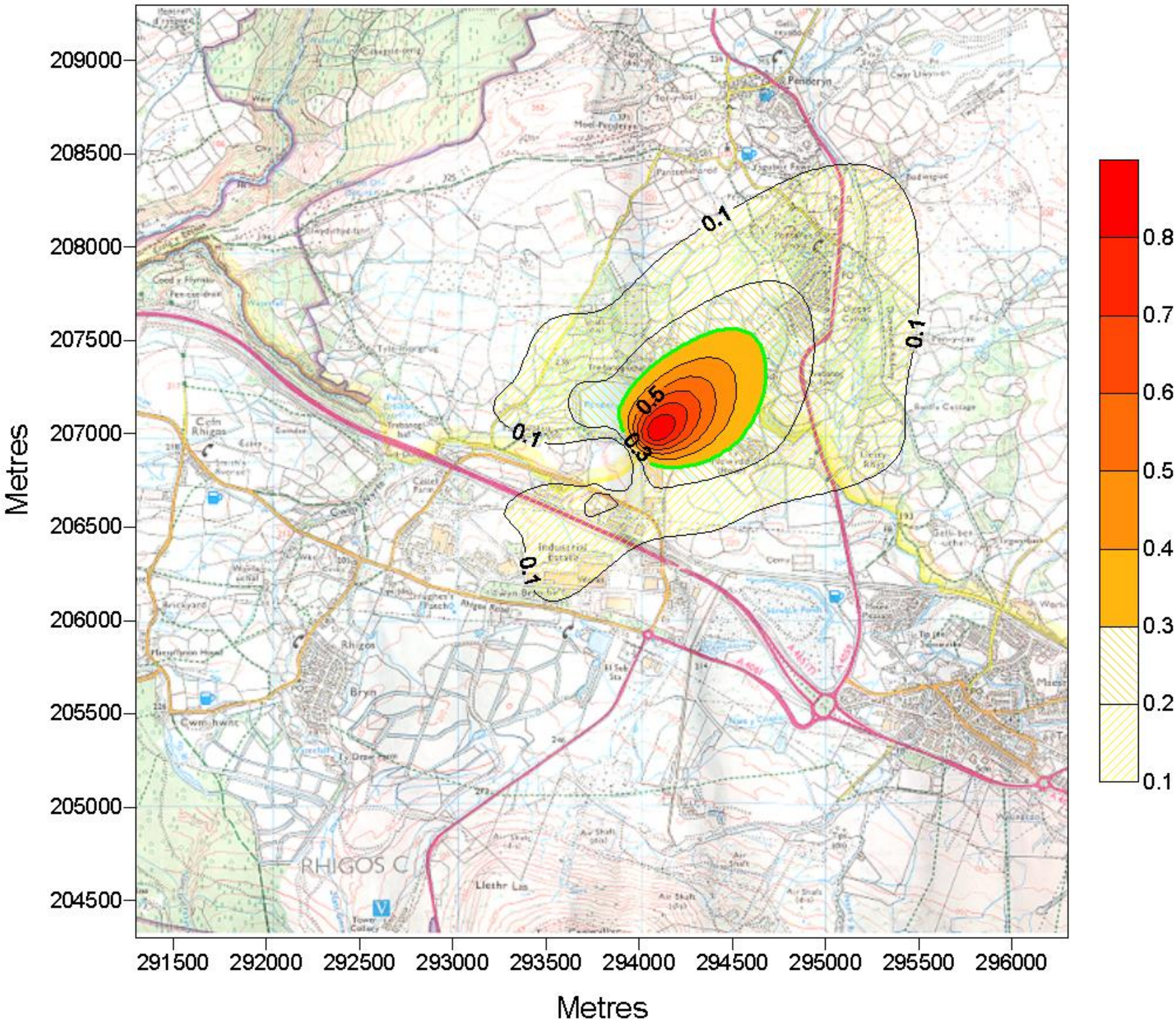
Base maps are taken from Ordnance Survey OS Select Explorer Map OL12, Brecon Beacon National Park, Western Area. 2016; 1:25,000 Scale, and OS Explorer Map 166 Rhondda and Merthyr Tydfil. 2015; 1:25,000 Scale.

FIGURE 1 Process Contribution to Annual Average Oxides of Nitrogen (as Total NO_x µg m^{-3}). Meteorological Data from 2011



Green isopleth denotes the air quality standard point of insignificance

FIGURE 2 Process Contribution to Annual Average Oxides of Nitrogen (as Total NO_x µg m^{-3}). Long-Term Assessment Level for the Protection of Vegetation. Meteorological Data from 2011



Green isopleth denotes the point of insignificance of the assessment level for vegetation

FIGURE 3 Process Contribution to 99.79th Percentile Hourly Average of Nitrogen Dioxide (as 50 % NO_x µg m^{-3}) Meteorological Data from 2011

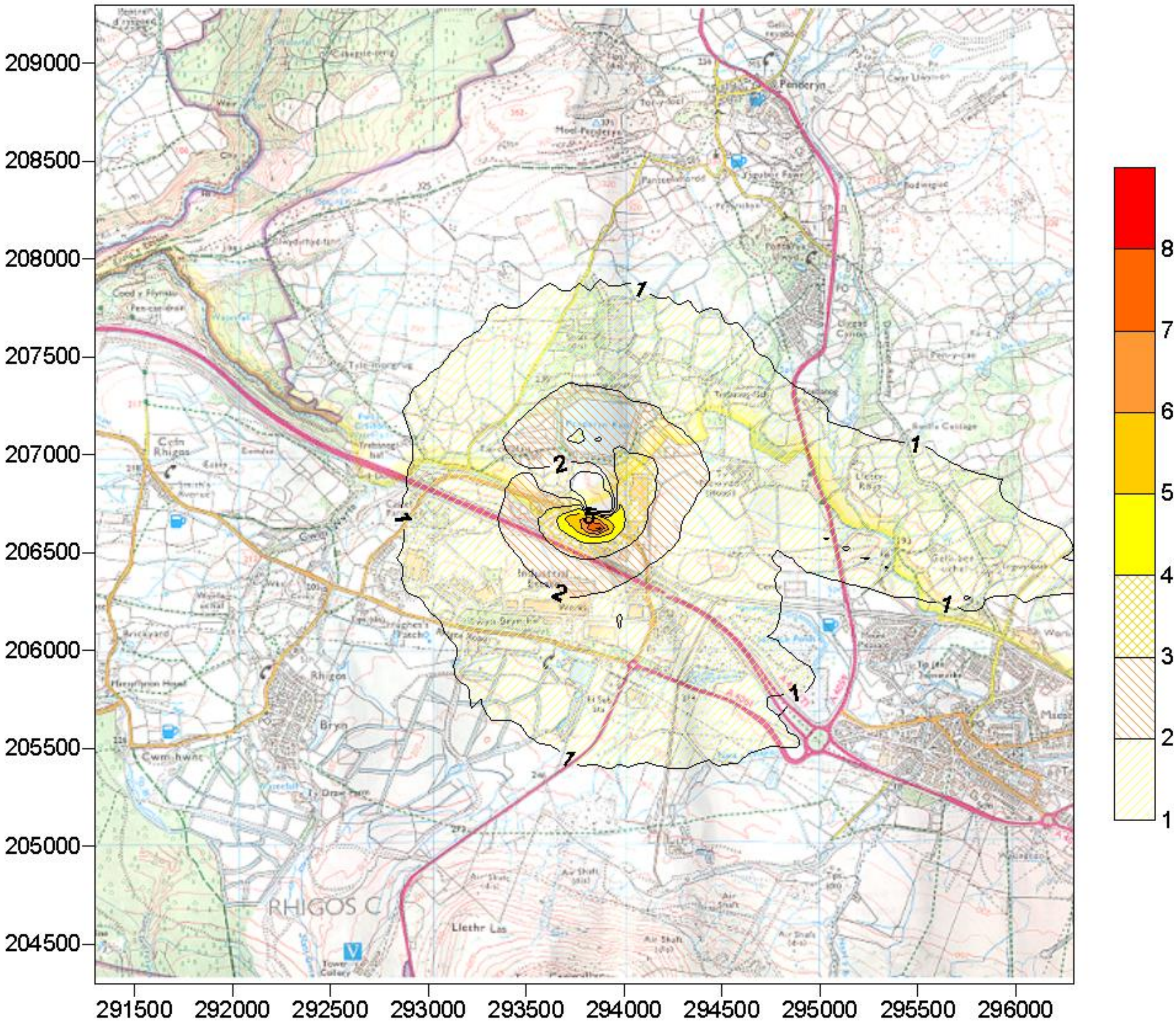


FIGURE 4 Process Contribution to 24-Hour Average Oxides of Nitrogen (as Total NO_x µg m^{-3}). Short-Term Assessment Level for the Protection of Vegetation. Meteorological Data from 2011

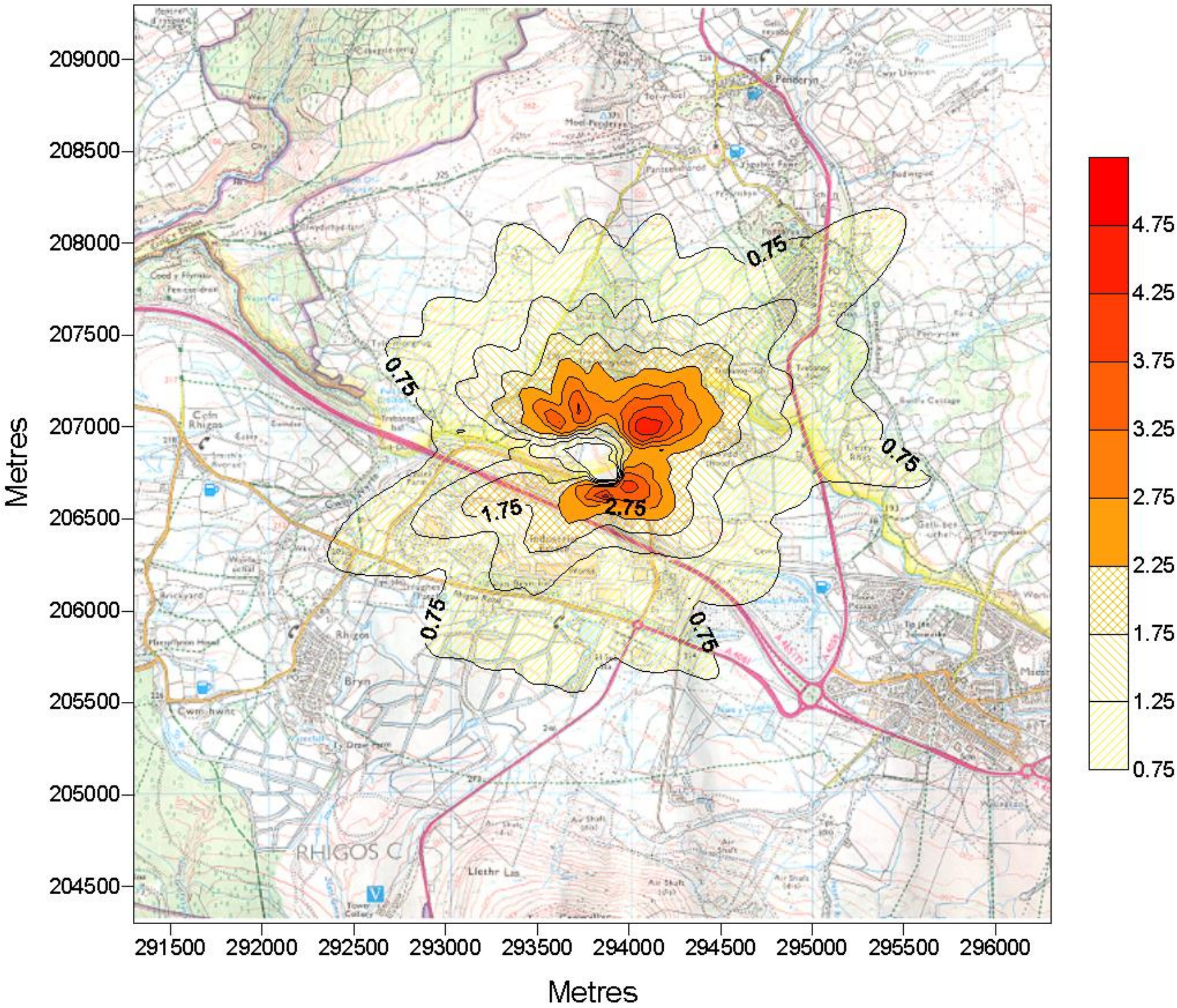


FIGURE 5 Process Contribution to 99.9 Percentile of 15-Minute Average Sulphur Dioxide (µg m^{-3}). Meteorological Data from 2011

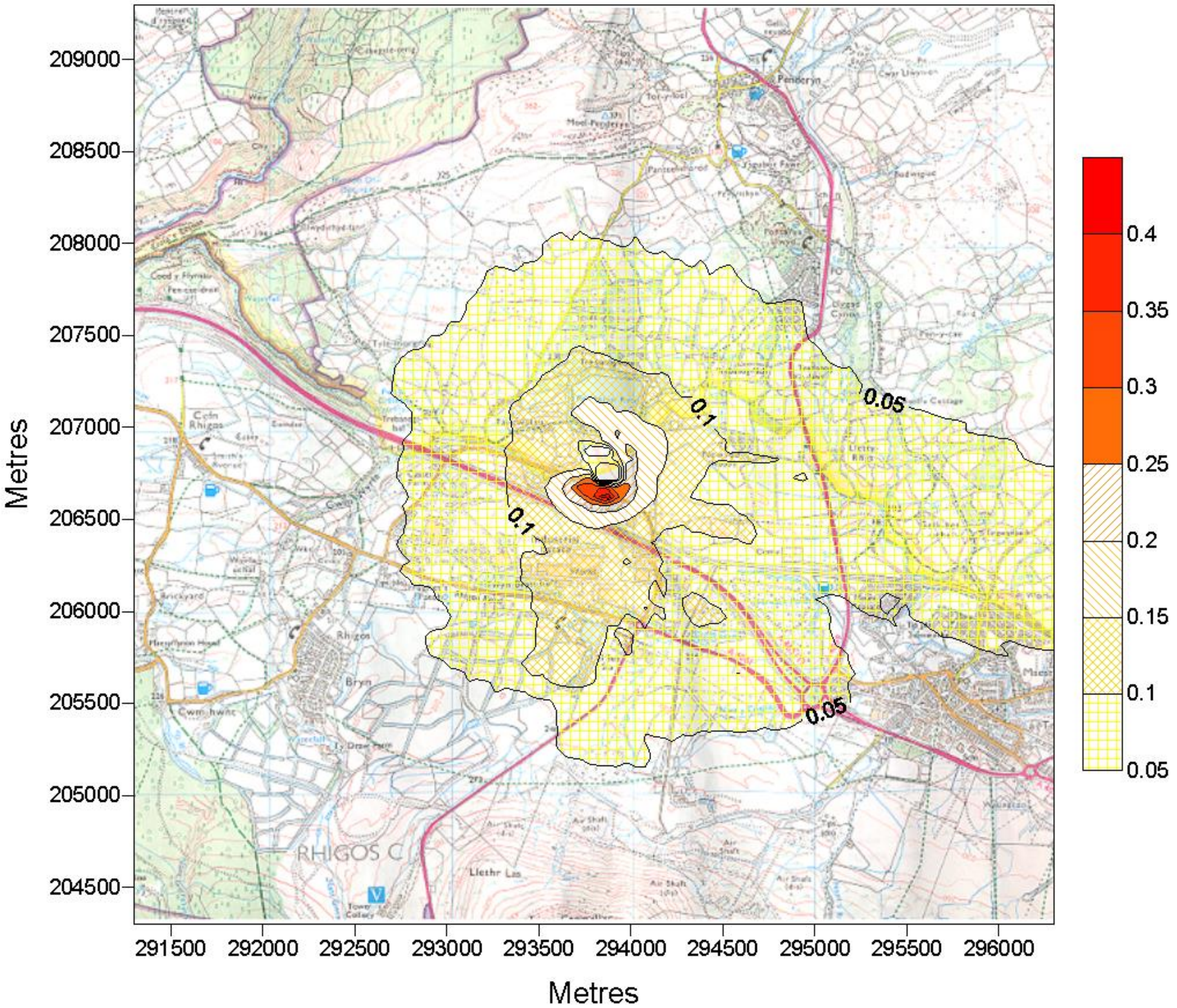


FIGURE 6 Process Contribution to 99.73 Percentile of Hourly Average Sulphur Dioxide (µg m^{-3}). Meteorological Data from 2011

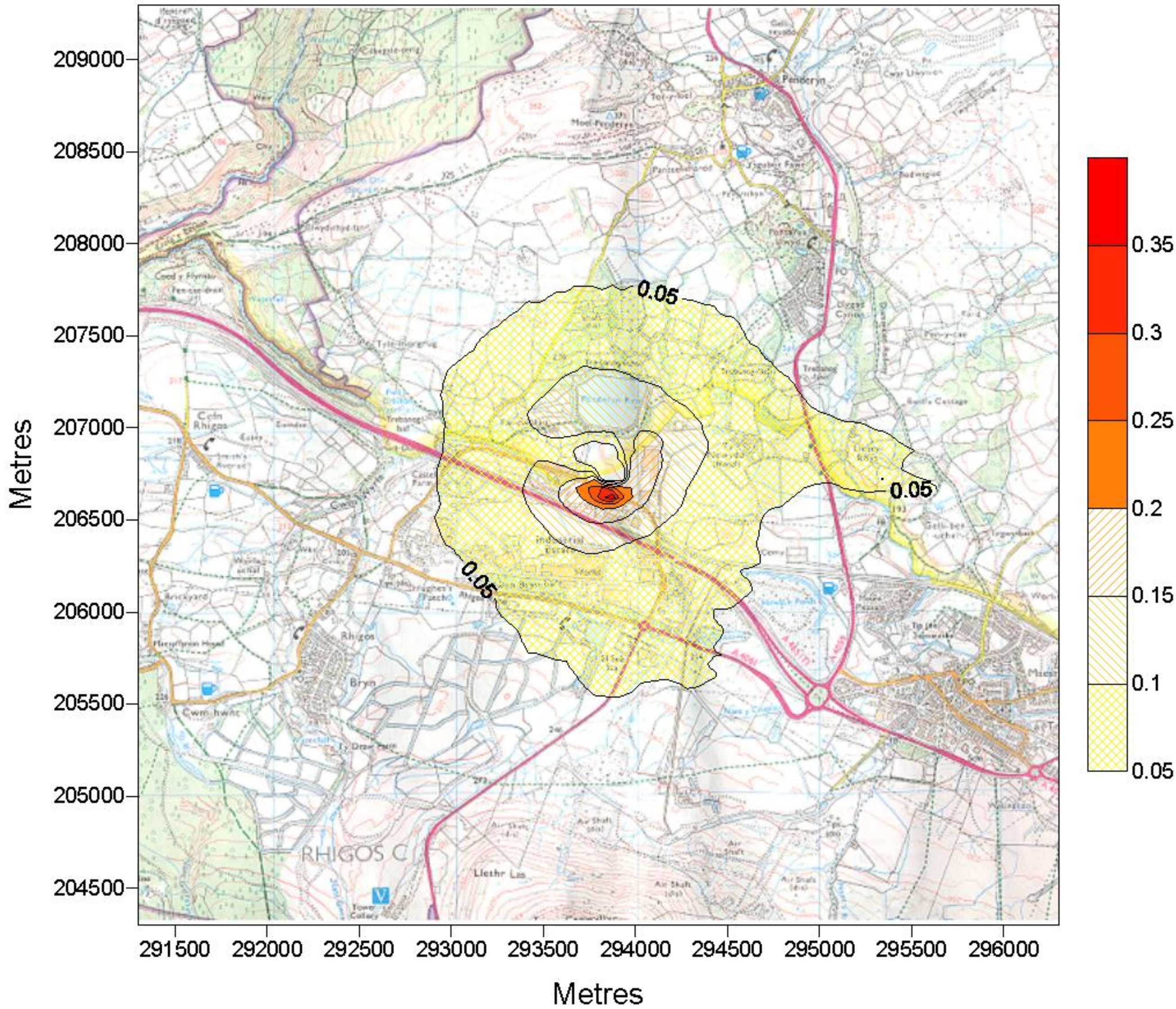


FIGURE 7 Process Contribution to 99.18 Percentile of 24-Hour Average Sulphur Dioxide (µg m^{-3}). Meteorological Data from 2011

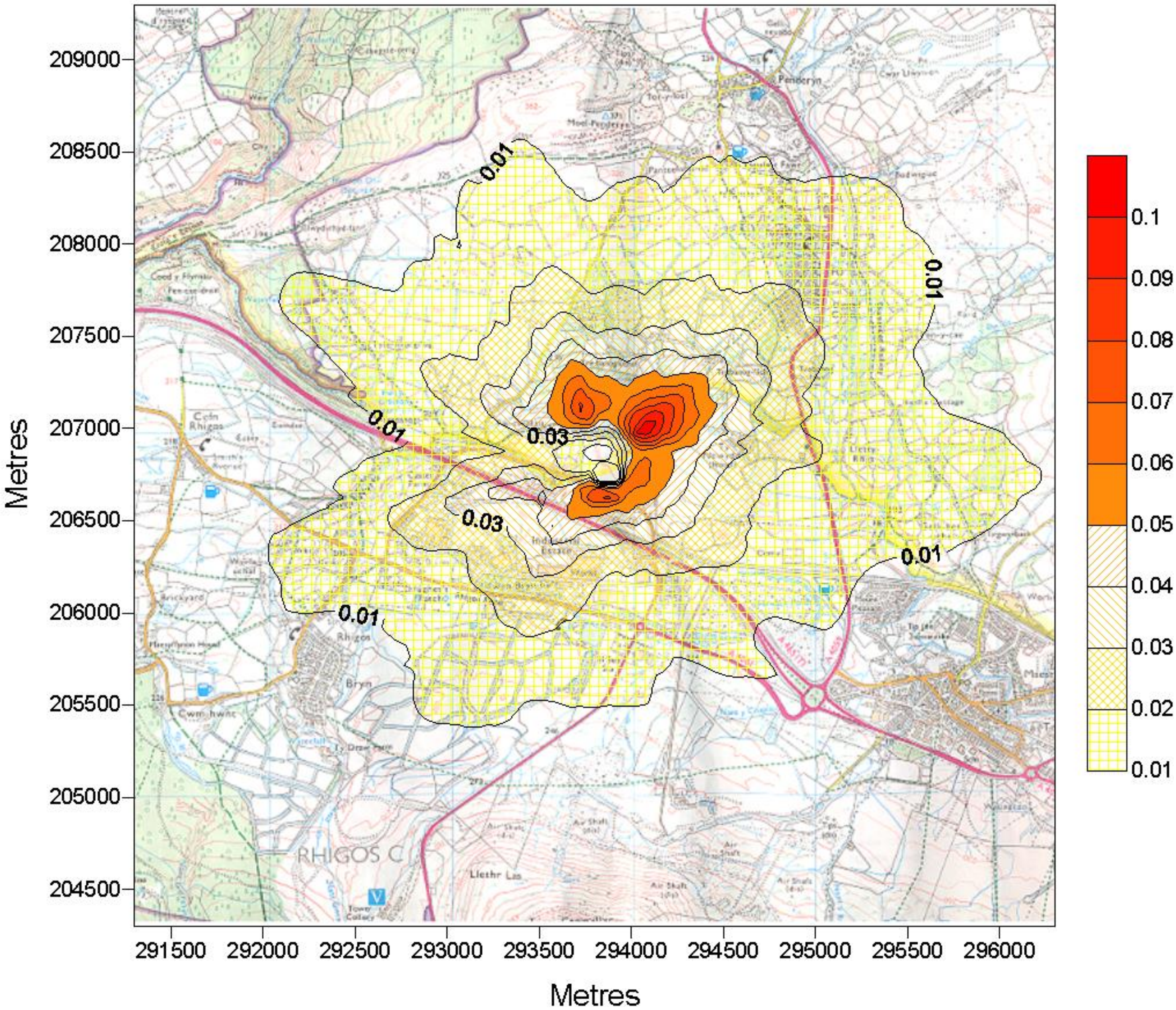


FIGURE 8 Process Contribution to Annual Average Sulphur Dioxide (µg m^{-3}). Long-Term Assessment Level for the Protection of Vegetation. Meteorological Data from 2011

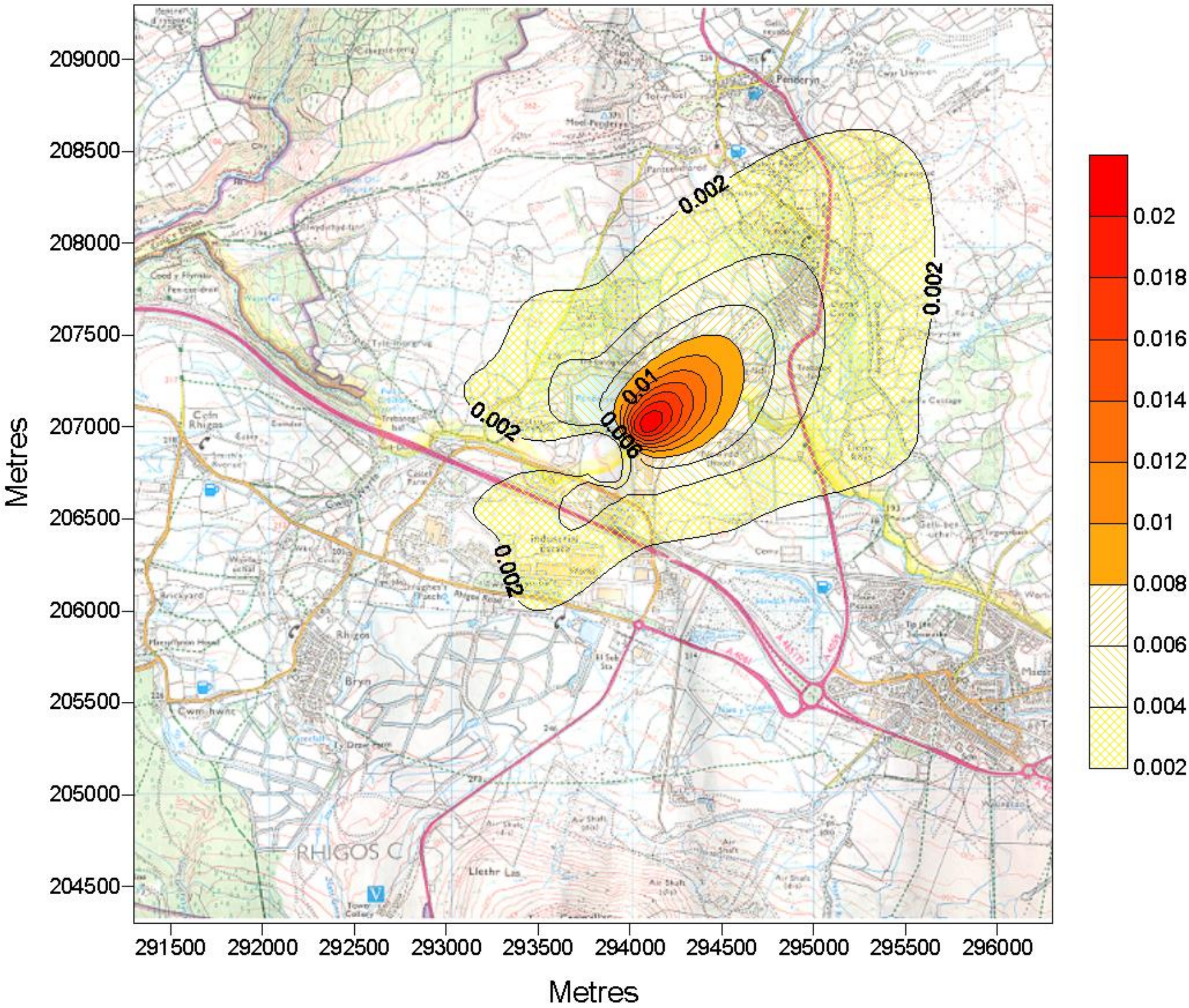


FIGURE 9 Process Contribution to Annual Average Particulate Matter (as PM_{10} µg m^{-3}). Meteorological Data from 2011

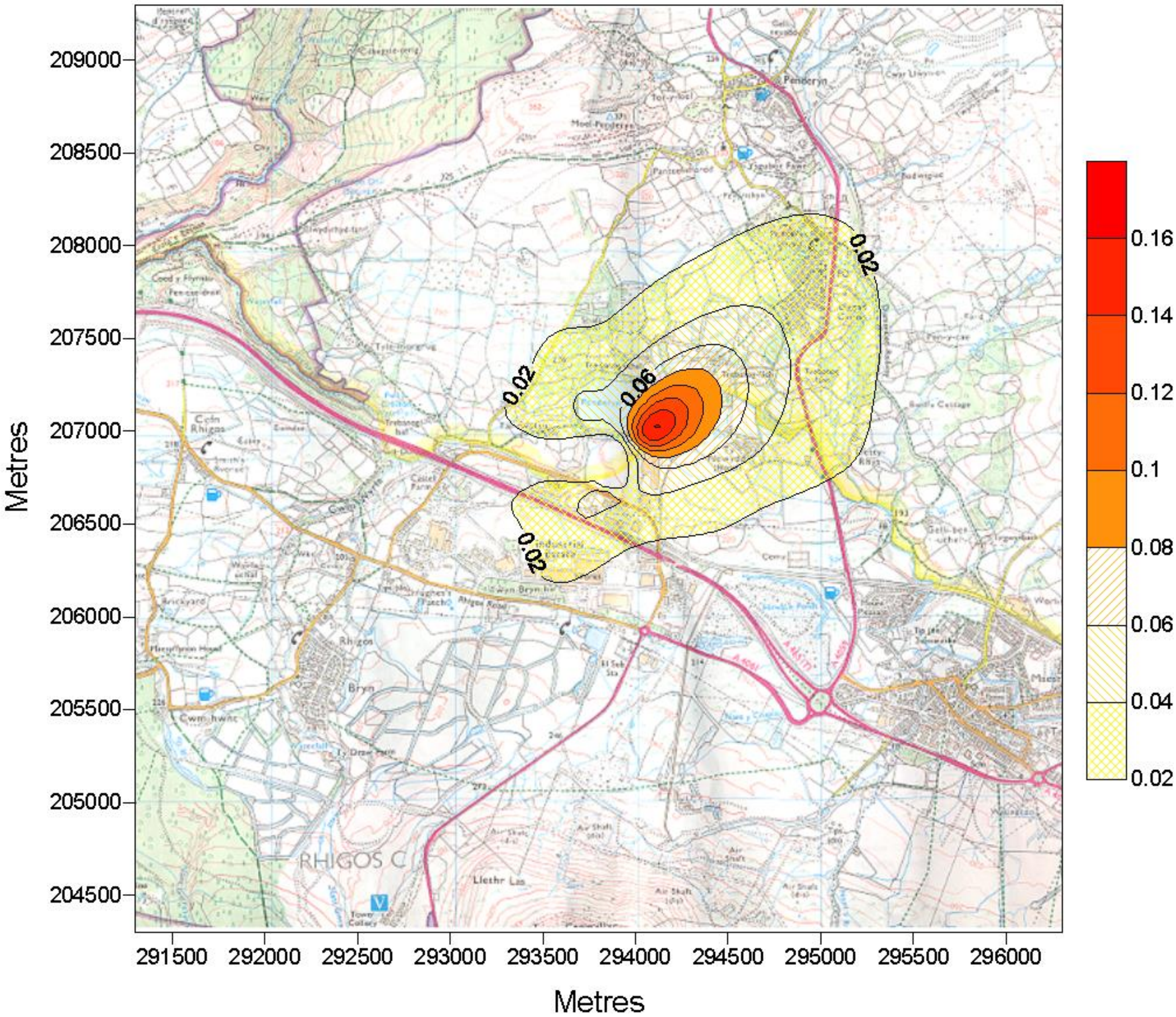


FIGURE 10 Process Contribution to 90.41 Percentile 24-Hour Average Particulate Matter (as PM_{10} µg m^{-3}). Meteorological Data from 2011

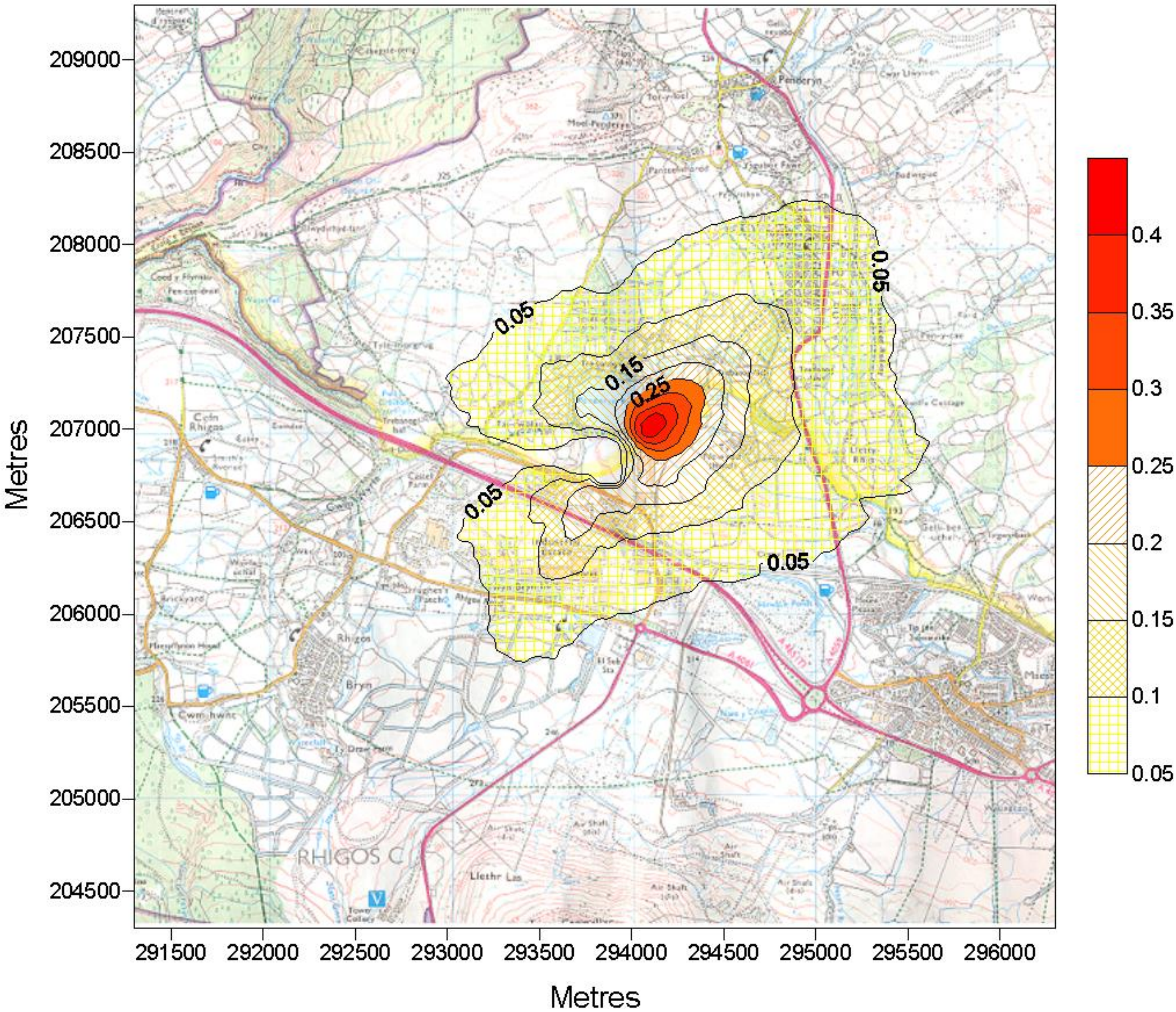


FIGURE 11 Process Contribution to Annual Average Particulate Matter (as $PM_{2.5}$ µg m^{-3}). Meteorological Data from 2011

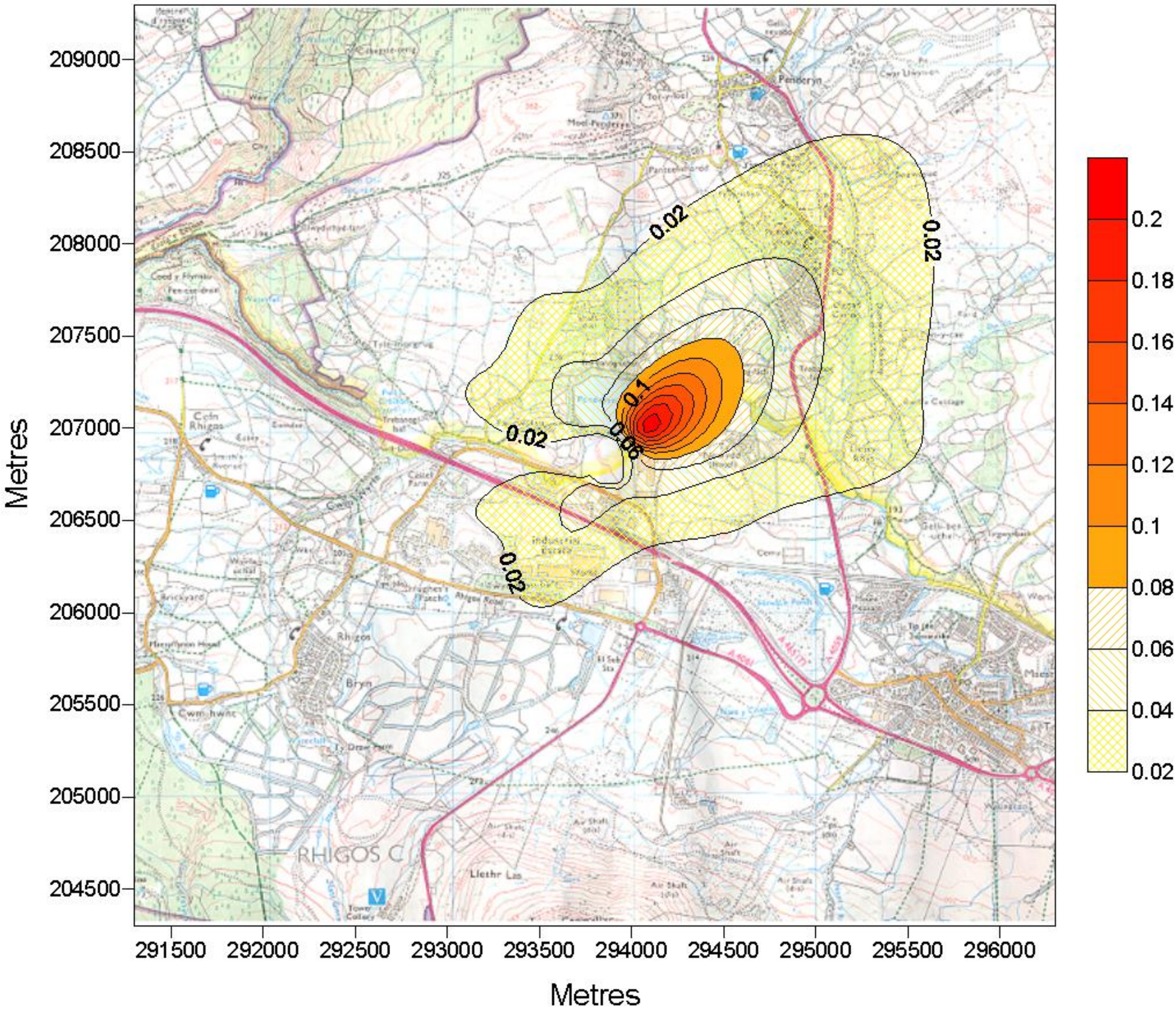


FIGURE 12 Process Contribution to Hourly Average Carbon Monoxide (mg m^{-3}). Meteorological Data from 2011

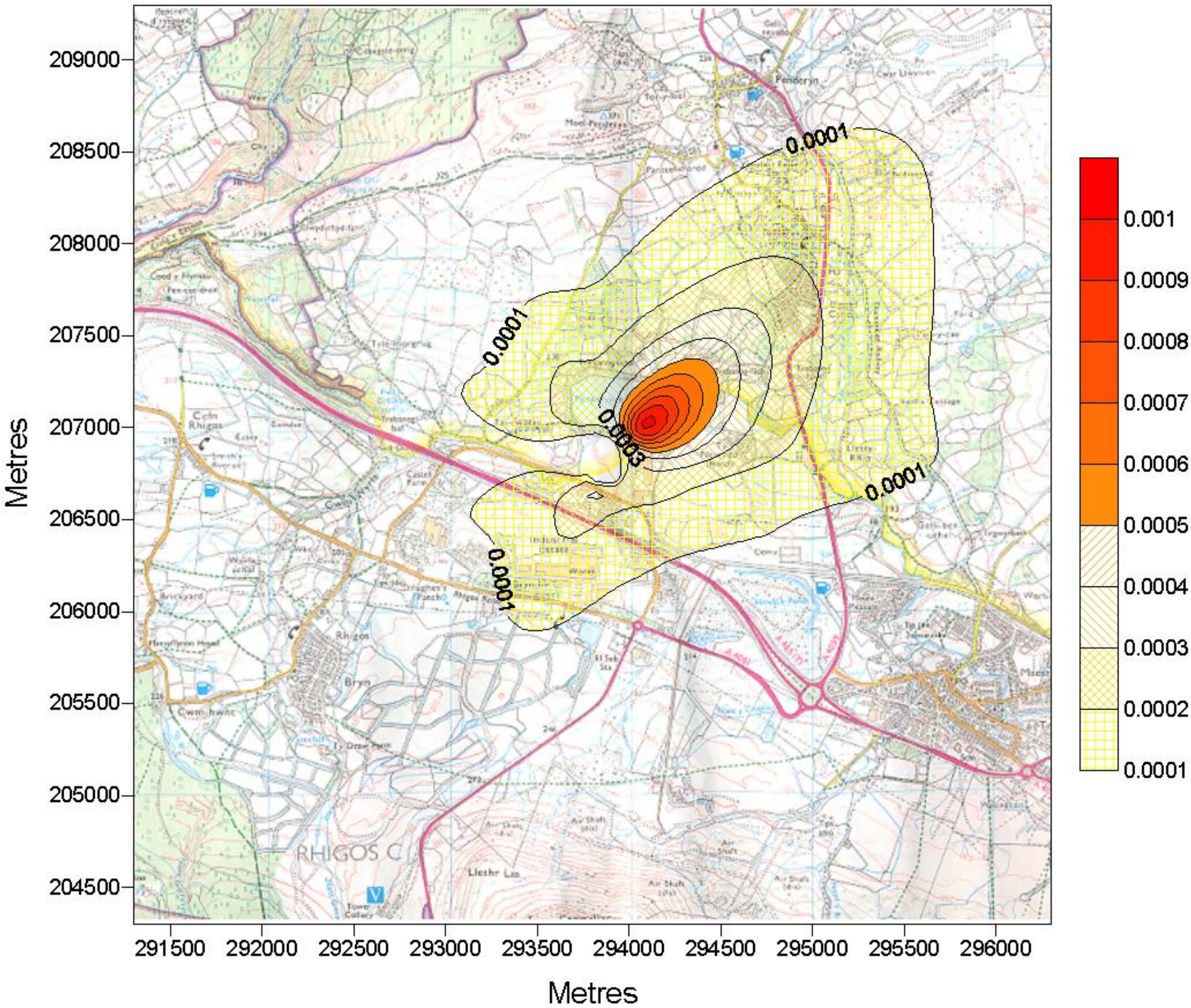


FIGURE 13 Process Contribution to Hourly Average Volatile Organic Compounds (µg m^{-3}). Meteorological Data from 2011

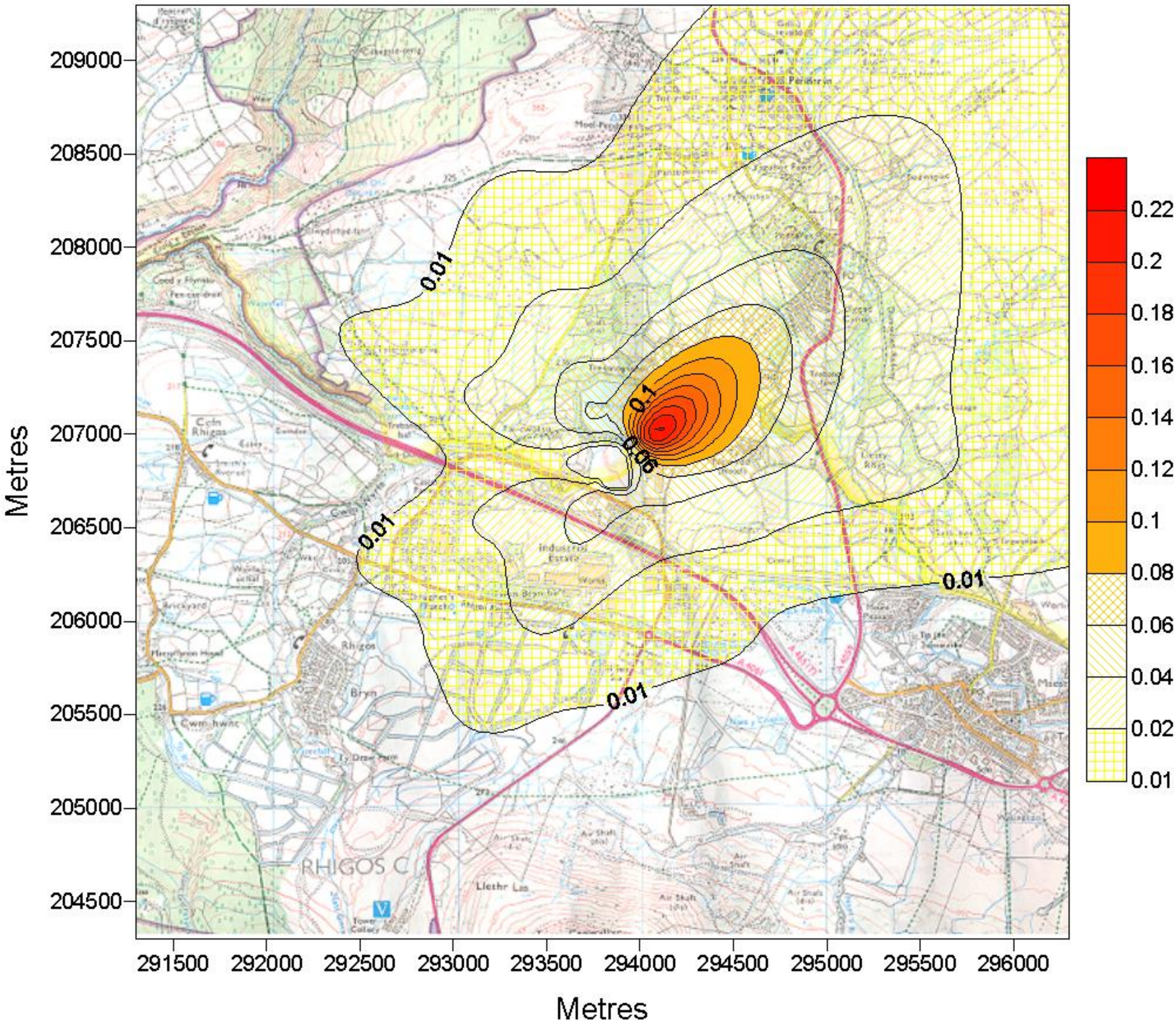


FIGURE 14 Process Contribution to Hourly Average Ammonia (µg m^{-3}) Meteorological Data from 2011

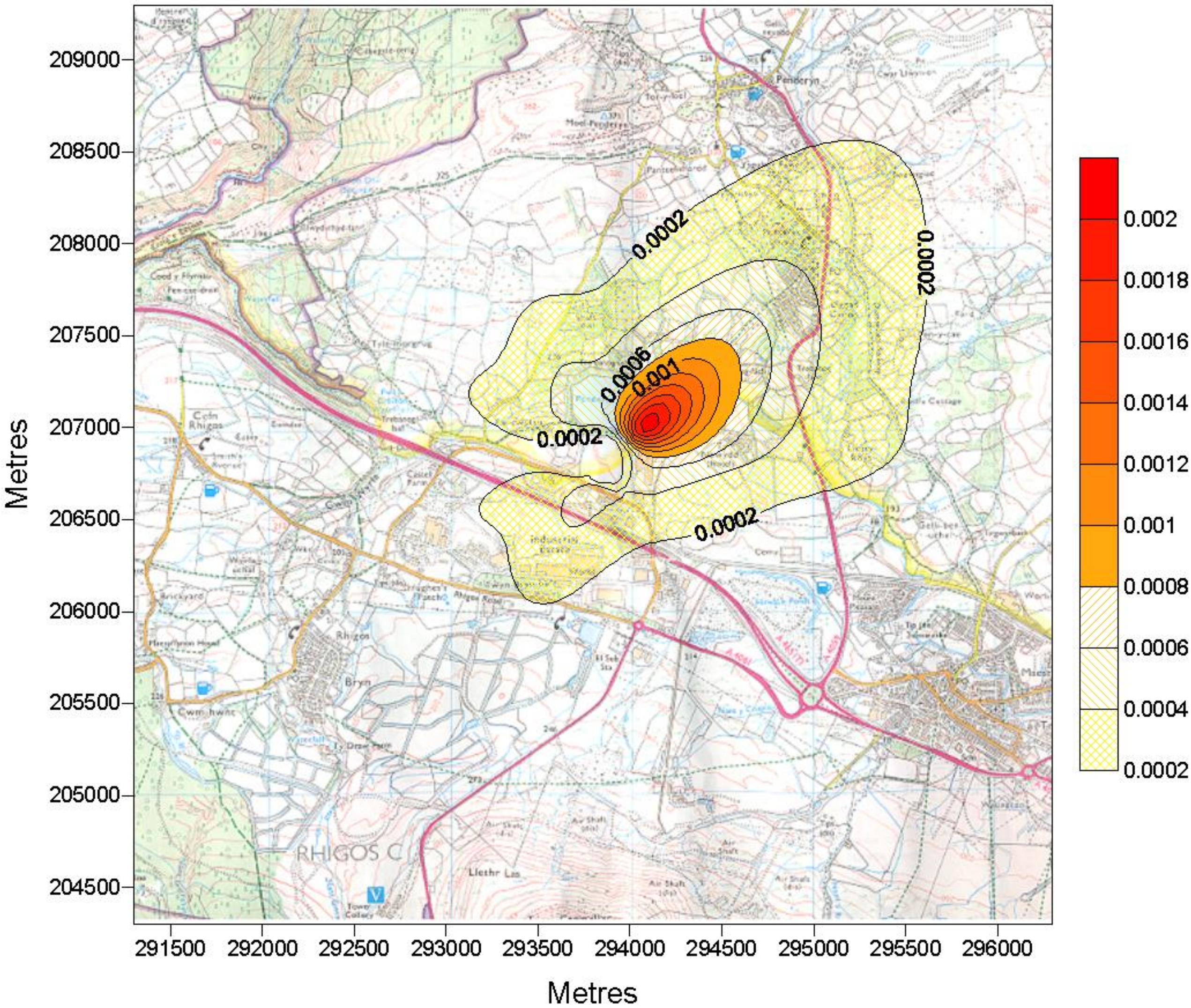


FIGURE 15 Critical Load Function Plot for Blaen Cynon SAC

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)	0.0023	0.0065	0.01
Background	0.49	1.7	2.19
Predicted Environmental Concentration (PEC)	0.49	1.71	2.2

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	0.9
Background	1.03	188.6
Predicted Environmental Concentration (PEC)	1.04	189.5

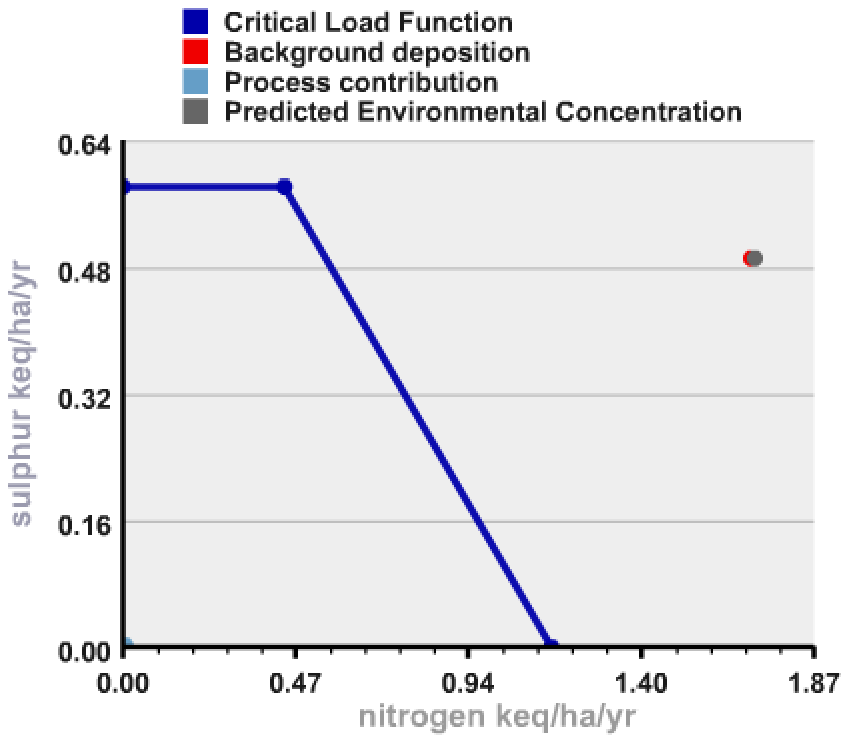


FIGURE 16 Critical Load Function Plot for Cwm Cadlan SAC

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)	0.00015	0.00043	0
Background	0.57	1.53	2.1
Predicted Environmental Concentration (PEC)	0.57	1.53	2.1

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
Background	0.94	180.9
Predicted Environmental Concentration (PEC)	0.94	180.9

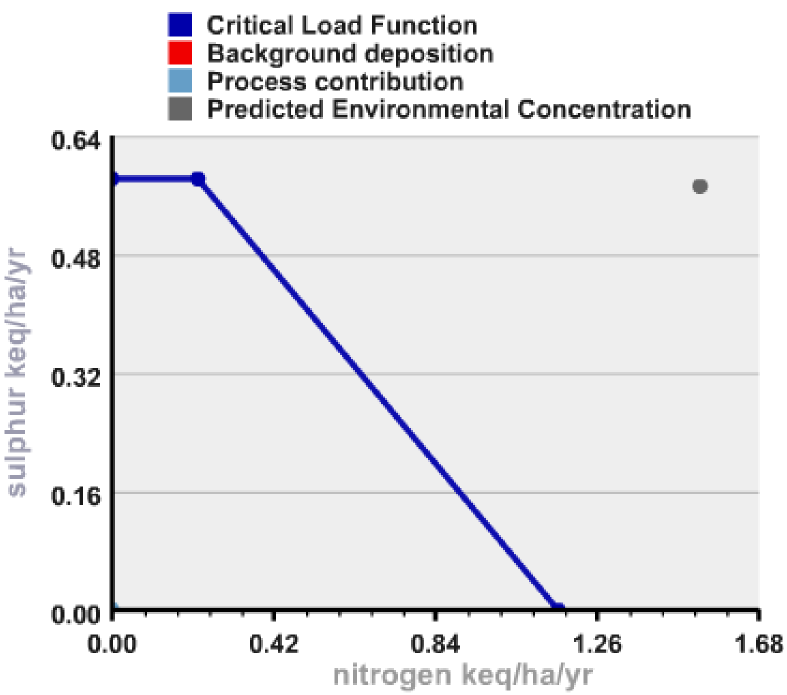


FIGURE 17 Critical Load Function Plot for Coedydd Nedd a Mellte SAC

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)	0.00025	0.00076	0
Background	0.44	1.9	2.34
Predicted Environmental Concentration (PEC)	0.44	1.9	2.34

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
Background	0.5	127.4
Predicted Environmental Concentration (PEC)	0.5	127.4