Addendum to an Atmospheric Dispersion Modelling Assessment of Proposed Emissions from

Enviroparks Wales Ltd
Hirwaun Industrial Estate
Aberdare

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Executive Summary

In February 2017, an Atmospheric Dispersion Modelling Assessment(1) was prepared to consider the likely emissions from a materials recovery facility proposed by Enviroparks Wales Limited (EWL) on the Hirwaun Industrial Estate in Hirwaun, South Wales. The facility had gained planning consent in 2010, however due to proposed changes in the scheme and a requirement to amend the planning consents already in place, EWL commissioned an assessment of the likely emissions to atmosphere from the proposed plant. The results of that assessment were reported in:

Atmospheric Dispersion Modelling Assessment of Proposed Emissions from Enviroparks Wales Ltd, Hirwaun Industrial Estate, Aberdare. Environmental Visage Limited.
Report Issue No: Issue 2. Report Date: February 2017. Report Author: Amanda Owen(1)

That report confirmed that the potential impact of the emissions from the plant now proposed for the Enviroparks facility would be acceptable in terms of their air quality impact. However, subsequently, a Shadow Habitat Regulations Assessment has suggested that the potential for impacts on sensitive ecological receptors in the immediate vicinity of the site cannot readily be screened as insignificant for either contributions of nutrient Nitrogen or acid deposition. As such, this addendum report details considerations made specifically in relation to the potential impact of these pollutants on the three Special Areas of Conservation (SAC) in the vicinity of the plant. The assessment has been prepared by Environmental Visage Limited (Envisage), and considers the likely regulated releases from the three main gasification units now proposed at the site.

In summary, whilst the contributions to nutrient Nitrogen and acid deposition at the sensitive ecological receptors could not easily be screened as insignificant (< 1 % of the Critical Load), process contribution deposition at Cwm Cadlan and Coedydd Nedd a Mellte SACs is very low, amounting to less than 5 % when considering the maximum emissions and a worst-case modelling exercise, and less than 2 % when considering the more realistic emissions against the most stringent Critical Loads. Process contributions to nutrient Nitrogen and acid deposition from the Enviroparks facility cannot be screened as insignificant at Blaen Cynon. However, these remain a fraction of the current background levels which already exceed the most stringent Critical Loads.

CONTENTS

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 on-site advanced thermal treatment process. The site will include three gasification lines which will 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, proposed at 45 m high. Other releases of warm air will occur across the site, including from air cooled condensers, and building ventilation, although pollutant emissions are only associated with the gasification line releases. This addendum report further develops earlier modelling work which informed a detailed air quality assessment for submission with the Environmental Statement Addendum which confirmed that the air quality impacts of the site were acceptable, and reports the considerations made specifically in relation to the potential impact of nutrient Nitrogen and acid deposition on the three Special Areas of Conservation in the vicinity of the plant.

2. Principal Objectives and Scope of the Addendum

Further to the Atmospheric Dispersion Modelling Assessment(1) produced for submission with the revised applications and Environmental Statement Addendum, a Shadow Habitat Regulations Assessment has been developed by Middlemarch Environmental Limited, which considers the three local Special Areas of Conservation (SACs): Blaen Cynon, Coedydd Nedd a Mellte, and Cwm Cadlan.

Each of these 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".*

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 relevant criterion (in this instance, the Critical Load). 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 on the SACs has been assessed, and where this is not immediately achievable, consideration has been given as to how this could be achieved.

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

The scope of this addendum is limited to the impacts which could not initially be screened as insignificant in the Habitat Regulations Assessment. These amount to contributions of nutrient Nitrogen and acid deposition. The original modelling exercise provided details of the release characteristics to be considered and had their base in the maximum allowable emission limits that will be imposed on the site operations. These are taken from Annex VI (Technical provisions relating to waste incineration plants and waste co-incineration plants) of the Industrial Emissions Directive (Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on Industrial Emissions (Integrated Pollution Prevention and Control) (Recast)). As legally binding emission limit values, it is recognised that these limits constitute an absolute maximum value and would not generally be experienced for any significant period. Hence consideration has also been given to the more likely level of emissions from the plant, as advised by the technology providers.

3.1 Emission Parameters

The main pollutant releases will comprise three discharge flues, each serving a single gasification Line (1 – 3), as advised in the main Atmospheric Dispersion Modelling Assessment(1). There has been no change to the physical characteristics of the discharge points.

An initial assessment of the impact of the discharges was made using the original emission rates from the earlier study, although as requested by Natural Resources Wales, modelling for the Habitat Regulations Assessment considered the point of the SACs located nearest to the site, and applied standard deposition factors, specified by receptor type (grassland or forest). Where impacts could not be screened as insignificant at this initial stage, further modelling was undertaken for specific discharges which will contribute to the build-up of nutrient Nitrogen and acid levels at the site with the following considerations:

1) The likely long term release of NO_2 equates to 50 % of the overall NO_x release (to account for the limited release of NO_2 from combustion activities, and the time taken for atmospheric conversion of NO to NO_2);
2) The more realistic (long-term) release rates proposed by the technology providers, as the limit values constitute a maximum release and will not be an average release value over the course of the year;

It is noted that not all pollutants were able to have a reduced, long-term discharge rate specified, although they are not expected to be released at the rates modelled for substantial periods. One example of this is the release of Ammonia, which is a function of the abatement process applied to control releases of Oxides of Nitrogen. Although a rate of 'Ammonia slip' has been applied, the presence of Ammonia within the flue gases is a function of overdosing of the abatement chemical (Urea), and hence would automatically be minimised by the monitoring and abatement plant. However, as the technology providers could not readily and reliably confirm a more likely lower release, the discharge is assumed to remain at the higher emission rate and has been modelled as such.

When considering the release of Oxides of Nitrogen (NO_x) from combustion based processes, it is accepted that only a small fraction of the release is emitted as Nitrogen Dioxide (NO_2). The main portion, Nitric Oxide (NO) generally accounts for more than 90 % of the release. In recognition of this, the Regulator's methodology(2) specifies the following:

Emissions of oxides of nitrogen should be recorded as nitrogen dioxide in your risk assessment (as nitrogen oxide converts to nitrogen dioxide over time):

- *for short-term PCs and PECs, assume only 50% of emissions of oxides of nitrogen convert to nitrogen dioxide in the environment*
- *for long-term PCs and PECs, assume all oxides of nitrogen convert to nitrogen dioxide*

Whilst the requirement specified in the Regulator's guidance is to only halve inputs or contributions for short term assessment periods (e.g. 1-hour, 1 day etc.) and the Critical Loads for vegetation are considered over the longer term, additional studies(3) suggest that, in the local vicinity of a release, the contribution of NO_2 from NO_x should be halved.

Professor Duncan Laxen and Dr Ben Marner of Air Quality Consultants(3) assert that, close to a source it is usual for the proportion of NO_2 in NO_x from industrial sources to be lower than the proportion of NO, as identified above, and that the conversion to NO_2 can take some time in the environment, particularly from a confined (stationary, point source) plume where available ozone in the atmosphere will be rapidly depleted. Laxen and Marner also note that NO does not deposit at a significant rate. As such, they identify an assumption of 50 % NO_2 in a NO_x release as being a robust approach for considering impacts on receptors close to the source, and hence this approach has been applied here.

At each stage, the results were compared against the lower and the higher Critical Load figures, although by way of applying a truly precautionary approach, the requirements of the Habitat Regulations Assessment have only been assessed and screened against the lower Critical Loads.

Table 1 Modelled Emissions to Atmosphere, Enviroparks Wales Limited

Emission Concentration (Daily Average)	**Industrial Emissions Directive Limits**		
	Basic Emission (mg m^{-3})	**Release Rate (g s^{-1})**	**Release Rate where NOx = 50 % (g s^{-1})**
Oxides of Nitrogen (NO_x)	200	2.6162	1.3081
Ammonia (NH_3)	10	0.1308	0.1308
Sulphur Dioxide (SO_2)	50	0.6541	0.6541
Hydrogen Chloride (HCl)	10	0.1308	0.1308
Emission Concentration (Daily Average)	**Realistic Emissions**		
	Basic Emission (mg m^{-3})	**Release Rate (g s^{-1})**	**Release Rate where NOx = 50 % (g s^{-1})**
Oxides of Nitrogen (NO_x)	150	1.9611	0.9811
Ammonia (NH_3)	10	0.1308	0.1308
Sulphur Dioxide (SO_2)	10	0.1308	0.1308
Hydrogen Chloride (HCl)	7	0.0916	0.0916

Emissions of Oxides of Sulphur are assumed to consist wholly of Sulphur Dioxide.

3.2 Sensitive Receptors

As the Habitat Regulations Assessment that this addendum has been produced to inform considers only the impacts on the three local Special Areas of Conservation, the outputs from the models consider these sites in isolation, with no general gridded assessment of the discharges to atmosphere. The modelled locations within the SACs have been selected to represent the nearest point to the stack discharges and are detailed in Table 2 below:

Table 2 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 SAC	294099	206960	290	East
2	Cwm Cadlan SAC	294970	209125	2,565	North East
3	Coedydd Nedd a Mellte SAC	292525	207199	1,370	North West

When considering the rate at which the deposition of chemicals occurs, CERC, the company which developed the ADMS model, confirm 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. However, wet deposition of Hydrogen Chloride would need to be considered as HCl is more soluble in water. Only dry deposition was modelled directly, however total deposition, the combination of wet and dry deposition, can roughly be estimated as dry deposition x 3. As deposition rates vary depending on the receiving landscape, distinct factors have been applied for the grassland receptors (Blaen Cynon and Cwm Cadlan), and the forest receptor, Coedydd Nedd a Mellte as follows:

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

The current loading of nutrient Nitrogen and acid at each site was taken from the Air Pollution Information System website (APIS) (www.apis.ac.uk) and were as follows:

Table 3 Current Minimum Background Levels of Nutrient Nitrogen and Acid Deposition at Local SACs

Background Level per Ha per year	Blaen Cynon	Cwm Cadlan	Coedydd Nedd a Mellte
Nutrient N (kgN)	21.98	19.6	23.57
Nitrogen (Keq)	1.57	1.40	1.78
Sulphur (Keq)	0.53	0.46	0.47

The Critical Loads at each receptor were again taken from the APIS website and are specific to the nature and sensitivities of the receptor. Table 4 over page details the lower and higher Critical Loads considered by the assessment.

Table 4 Critical Loads at Sensitive Receptors

Critical Load	Lower Critical Load per Ha per year			Higher Critical Load per Ha per year		
	Blaen Cynon	**Cwm Cadlan**	**Coedydd Nedd a Mellte**	**Blaen Cynon**	**Cwm Cadlan**	**Coedydd Nedd a Mellte**
Nutrient N (kg N)	10	15	10	15	25	15
Nitrogen (Keq)	0.438	0.223	0.142	2.28	4.493	7.925
Sulphur (Keq)	0.58	0.58	1.552	1.77	4.27	7.783
Acid (Kg)	1.018	0.803	1.694	4.050	8.763	15.708

3.3 Other Modelling Parameters and Assumptions

All other modelling parameters remained the same as those applied to the original Atmospheric Dispersion Modelling Assessment(1), including the consideration of nearby buildings and structures, the in-combination effects of third party sites which have planning permission but are either very new or not yet built, the meteorological data, surface roughness and terrain data applied.

The output for the model was set as ‘long term’, which provides a single concentration averaged over all of the lines of meteorological data per year, for each modelled point, that is, providing an annual average concentration for each pollutant at each grid point or receptor. This is in line with the Critical Loads specified for nutrient Nitrogen and acid deposition.

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

- The discharges from the Enviroparks site release points 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.

4 Calculating Nutrient Nitrogen and Acid Deposition

The calculation of nutrient Nitrogen and acid deposition are produced from the basic deposition values ($\mu g\ m^{-2}\ s^{-1}$) for species containing Nitrogen and acids, in this instance NO_x, NH_3, SO_2, and HCl. Dry deposition of HCl is multiplied by 3 to provide an assumed total deposition figure. This is then included with the Sulphur element at the end of the acid deposition calculation.

The deposition values are first converted to Nitrogen or Sulphur from their deposited form, and multiplied up to provide a deposited rate in kg (N or S) per hectare, per year.

These deposition values are then converted to kilo equivalent values (Keq) for Nitrogen (multiplied by 0.0714) and Sulphur (multiplied by 0.0625). The total deposited rate of Hydrogen (kg per hectare per year) is then calculated and the three elements are summed to provide the acid deposition rate (Keq per hectare, per year).

5. Results and Discussion

Tabulated results are presented in Appendix A and detail the deposition of pollutants at the nearest point of the sensitive ecological SACs to the Enviroparks site. It should be remembered therefore that these results will likely represent the worst-case contributions and will not be experienced at these levels across the extent of the SACs. Critical Load diagrams are presented as Figures 1 – 3, which consider the results of realistic emissions modelling at each sensitive site.

Appendix A Tables 1 and 2 present the maximum nutrient Nitrogen and acid deposition contributions from the Enviroparks scheme when considered in isolation, and when considered with other locally planned sites. In light of the limited detail available for the in-combination effect sites, no amendments were made to the inputs for these facilities. That is, only the data available was included, and NO_x releases were always considered at the full discharge rates specified. The figures represent the maximum results at each receptor, when considering five years' worth of meteorological data. Meteorological conditions in 2015 resulted in the highest contributions to Blaen Cynon. The year reporting the highest results at Cwm Cadlan was 2011, and for Coedydd Nedd a Mellte the highest results were identified when modelling 2014 meteorological conditions.

Although nutrient Nitrogen contributions from the Enviroparks scheme can be screened as insignificant at Cwm Cadlan when considering the lower Critical Load, these cannot be screened as insignificant at the other two receptors (1.8 % at Coedydd Nedd a Mellte and 17.5 % at Blaen Cynon), and acid deposition exceeds the 1 % insignificance threshold at all sites, ranging from 2.7 % of the Critical Load at Coedydd Nedd a Mellte to 38.4 % at Blaen Cynon). When considering the higher Critical Loads, impacts at Cwm Cadlan can be screened for nutrient Nitrogen and acid deposition when considering the impact of the Enviroparks scheme in isolation and when including other local schemes. The impacts of acid deposition on Coedydd Nedd a Mellte can be similarly screened, although the contributions of nutrient Nitrogen are still above 1 % (1.2 % of the Critical Load). Impact at the nearest site, Blaen Cynon cannot be screened.

Appendix A Tables 3 and 4 show results for similar modelling, albeit with the reduced NO_x emission rate to represent the likely contribution of Nitrogen Dioxide. Whilst some reduction to the contributions of nutrient Nitrogen and acid deposition are identified, resulting in 1.4 % nutrient Nitrogen and 2.6 % acid deposition at Coedydd Nedd a Mellte, the reductions are not especially significant.

Appendix A Tables 5 and 6 therefore consider the more likely long-term emissions as identified by the technology provider, and assuming that NO_2 releases are 50 % of the overall NO_x release. Some further reductions are therefore observed. When considering the most stringent Critical Loads, the only pollutant which can conclusively be screened as insignificant remains the contributions to nutrient Nitrogen at Cwm Cadlan. However, contributions of nutrient Nitrogen at Coedydd Nedd a Mellte and Blaen Cynon reduce to 1.3 % and 13.6 % of the lower Critical Load respectively. Levels of acid deposition equate to 1.48 % of the lower Critical Load at Coedydd Nedd a Mellte, 1.9 % at Cwm Cadlan, and 21.5 % at Blaen Cynon.

When considering the higher Critical Loads for the sites, process contributions from the site can almost always be screened as insignificant at Cwm Cadlan and Coedydd Nedd a Mellte, and even when considering realistic but cumulative effects with other local releases at these two sites, only nutrient Nitrogen contributions at Coedydd Nedd a Mellte exceeds the 1 % screening threshold (1.7 %). However, impacts on the very nearest sensitive receptor, Blaen Cynon, cannot be screened as insignificant due to its proximity to the site, just a few hundred metres from the discharge point.

It is noted that the current minimum background levels of nutrient Nitrogen and acid deposition are consistently above the lower Critical Loads. It is also noted that the contributions of the third-party sites which have been modelled in combination with the Enviroparks site are suggested to exceed the insignificance threshold even without additional contributions from Enviroparks for nutrient Nitrogen at Blaen Cynon and Coedydd Nedd a Mellte, and for acid deposition at Blaen Cynon when comparing against the lower Critical Loads.

The APIS website (www.apis.ac.uk) specifies that where:

PEC is greater than CLminN (the majority of cases), the combined inputs of sulphur and nitrogen need to be considered. In such cases, the total acidity input should be calculated as a proportion of the CLmaxN.
Where PEC N Deposition > CLminN
*PC as %CL function = ((PC of S+N deposition)/CLmaxN)*100*

Hence Appendix A Table 7 recalculates the percentage process contributions of acid deposition to each site when considering the maximum Critical Load for Nitrogen. These results reduce slightly, although not significantly, and are then directly comparable with the Critical Load Function Tool charts presented as Figures 1 to 3. The Critical Load Function Tool charts presented consider the acid contributions calculated when applying realistic emissions and halving the discharge of NO_x to represent NO_2 releases only.

6. 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 prepared Refuse Derived Fuel. Since receiving their original planning consent, various changes have been made to the plans for the facility, and these include changes to layout and the technologies to be applied. As such, a revision to the current planning consent has been requested, and a Shadow Habitat Regulations Assessment is being prepared.

Although, due to the location of the site and the sensitivities of some of the ecological receptors in the immediate vicinity, the potential impact of the revised facility on the contributions to nutrient Nitrogen and acid deposition cannot immediately be screened as insignificant, process contribution deposition at Cwm Cadlan and Coedydd Nedd a Mellte SACs is very low, amounting to less than 5 % when considering the maximum emissions and a worst-case modelling exercise, and less than 2 % when considering the more realistic emissions against the most stringent Critical Loads. Process contributions to nutrient Nitrogen and acid deposition from the Enviroparks facility cannot be screened as insignificant at Blaen Cynon. However, these remain a fraction of the current background levels which already exceed the most stringent Critical Loads.

The Shadow Habitat Regulations Assessment will consider the likely impact of the calculated contributions on the ecology of the SACs.

7. References

1. Atmospheric Dispersion Modelling Assessment of Proposed Emissions from Enviroparks Wales Ltd, Hirwaun Industrial Estate, Aberdare. Environmental Visage Limited. Report Issue No: Issue 2. Report Date: February 2017. Report Author: Amanda Owen.

2. Air Emissions Risk Assessment. DEFRA / the Environment Agency (linked from Natural Resources Wales website) (https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit).

3. An Assessment of Possible Air Quality Impacts on Vegetation from Processes Set Out in the Bournemouth, Dorset and Poole Waste Local Plan. Prof. Duncan Laxen and Dr. Ben Marner; Air Quality Consultants Ltd. April 2005.

APPENDIX A
MODELLING RESULTS TABLES

Note: results highlighted in yellow exceed the 1 % insignificance screening threshold. Results which are greater than 1.0 % but remain less than 2 % are highlighted in orange.

Table 1 **Modelling at the Industrial Emissions Directive Limits and Comparing Against the Low End of the Critical Load Range**

Total 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)	1.752	0.128	0.182	2.351	0.203	0.305
Current Minimum Background (kg N/ha/yr)	21.98	19.6	23.57	21.98	19.6	23.57
Low End of Critical Load Range (kg N/ha/yr)	10	15	10	10	15	10
Deposition as % of Lower Critical Load	17.5%	0.9%	1.8%	23.5%	1.4%	3.0%
Rate of Total Dry Deposition as N (keq/ha/yr)	0.125	0.009	0.013	0.168	0.015	0.022
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	28.6%	4.1%	9.2%	38.3%	6.5%	15.3%
Current Minimum N Background (keq/ha/yr)	1.57	1.40	1.78	1.57	1.40	1.78
PEC N (keq/ha/yr)	1.695	1.409	1.793	1.738	1.415	1.802
Rate of Total Dry Deposition as S (kg S/ha/yr)	2.059	0.150	0.245	2.168	0.180	0.310
Rate of Total Dry Deposition as S (keq/ha/yr)	0.129	0.009	0.015	0.135	0.011	0.019
Rate of Total Deposition as HCl (kg H/ha/yr)	0.1368	0.0094	0.0180	0.1368	0.0094	0.0180
Rate of Total Deposition as S and H (keq/ha/yr)	0.2655	0.0188	0.0334	0.2723	0.0207	0.0374
Low End of Critical Load Range S (keq/ha/yr)	0.58	0.58	1.552	0.580	0.580	1.552
Deposition as % of Lower Critical Load	45.8%	3.2%	2.1%	46.9%	3.6%	2.4%
Current Minimum S Background (keq/ha/yr)	0.53	0.46	0.47	0.53	0.46	0.47
PEC S and H (keq/ha/yr)	0.7955	0.4788	0.5034	0.8023	0.4807	0.5074
PC Acid (keq/ha/yr)	0.3906	0.0279	0.0464	0.4402	0.0352	0.0592
% of Critical Load	38.4%	3.5%	2.7%	43.2%	4.4%	3.5%
PEC Acid (keq/ha/yr)	2.49	1.89	2.30	2.54	1.90	2.31
% of Critical Load	245%	235%	136%	250%	236%	136%

Table 2 Modelling at the Industrial Emissions Directive Limits and Comparing Against the High End of the Critical Load Range

Total 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)	1.752	0.128	0.182	2.351	0.203	0.305
Current Minimum Background (kg N/ha/yr)	21.98	19.6	23.57	21.98	19.6	23.57
High End of Critical Load Range (kg N/ha/yr)	15	25	15	15	25	15
Deposition as % of Higher Critical Load	11.7%	0.5%	1.2%	15.7%	0.8%	2.0%
Rate of Total Dry Deposition as N (keq/ha/yr)	0.125	0.009	0.013	0.168	0.015	0.022
High End of Critical Load Range N (keq/ha/yr)	2.28	4.493	7.925	2.28	4.493	7.925
Deposition as % of Higher Critical Load	5.5%	0.2%	0.2%	7.4%	0.3%	0.3%
Current Minimum N Background (keq/ha/yr)	1.57	1.40	1.78	1.57	1.40	1.78
PEC N (keq/ha/yr)	1.695	1.409	1.793	1.738	1.415	1.802
Rate of Total Dry Deposition as S (kg S/ha/yr)	2.059	0.150	0.245	2.168	0.180	0.310
Rate of Total Dry Deposition as S (keq/ha/yr)	0.129	0.009	0.015	0.135	0.011	0.019
Rate of Total Deposition as HCl (kg H/ha/yr)	0.1368	0.0094	0.0180	0.1368	0.0094	0.0180
Rate of Total Deposition as S and H (keq/ha/yr)	0.2655	0.0188	0.0334	0.2723	0.0207	0.0374
High End of Critical Load Range S (keq/ha/yr)	1.77	4.27	7.783	1.77	4.27	7.783
Deposition as % of Higher Critical Load	15.0%	0.4%	0.4%	15.4%	0.5%	0.5%
Current Minimum S Background (keq/ha/yr)	0.53	0.46	0.47	0.53	0.46	0.47
PEC S and H (keq/ha/yr)	0.7955	0.4788	0.5034	0.8023	0.4807	0.5074
PC Acid (keq/ha/yr)	0.3906	0.0279	0.0464	0.4402	0.0352	0.0592
% of Critical Load	9.6%	0.3%	0.3%	10.9%	0.4%	0.4%
PEC Acid (keq/ha/yr)	2.49	1.89	2.30	2.54	1.90	2.31
% of Critical Load	61%	22%	15%	63%	22%	15%

Table 3 Modelling at the Industrial Emissions Directive Limits with NO_x at 50 % and Comparing Against the Low End of the Critical Load Range

Total 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)	1.430	0.103	0.140	2.030	0.178	0.263
Current Minimum Background (kg N/ha/yr)	21.98	19.6	23.57	21.98	19.6	23.57
Low End of Critical Load Range (kg N/ha/yr)	10	15	10	10	15	10
Deposition as % of Lower Critical Load	14.3%	0.7%	1.4%	20.3%	1.2%	2.6%
Rate of Total Dry Deposition as N (keq/ha/yr)	0.102	0.007	0.010	0.145	0.013	0.019
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	23.3%	3.3%	7.1%	33.1%	5.7%	13.2%
Current Minimum N Background (keq/ha/yr)	1.57	1.40	1.78	1.57	1.40	1.78
PEC N (keq/ha/yr)	1.672	1.407	1.790	1.715	1.413	1.799
Rate of Total Dry Deposition as S (kg S/ha/yr)	2.059	0.150	0.245	2.168	0.180	0.310
Rate of Total Dry Deposition as S (keq/ha/yr)	0.129	0.009	0.015	0.135	0.011	0.019
Rate of Total Deposition as HCl (kg H/ha/yr)	0.1368	0.0094	0.0180	0.1368	0.0094	0.0180
Rate of Total Deposition as S and H (keq/ha/yr)	0.2655	0.0188	0.0334	0.2723	0.0207	0.0374
Low End of Critical Load Range S (keq/ha/yr)	0.58	0.58	1.552	0.580	0.580	1.552
Deposition as % of Lower Critical Load	45.8%	3.2%	2.1%	46.9%	3.6%	2.4%
Current Minimum S Background (keq/ha/yr)	0.53	0.46	0.47	0.53	0.46	0.47
PEC S and H (keq/ha/yr)	0.7955	0.4788	0.5034	0.8023	0.4807	0.5074
PC Acid (keq/ha/yr)	0.3676	0.0262	0.0434	0.4172	0.0334	0.0562
% of Critical Load	36.1%	3.3%	2.6%	41.0%	4.2%	3.3%
PEC Acid (keq/ha/yr)	2.47	1.89	2.29	2.52	1.89	2.31
% of Critical Load	242%	235%	135%	247%	236%	136%

Table 4 Modelling at the Industrial Emissions Directive Limits with NO_x at 50 % and Comparing Against the High End of the Critical Load Range

Total 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)	1.430	0.103	0.140	2.030	0.178	0.263
Current Minimum Background (kg N/ha/yr)	21.98	19.6	23.57	21.98	19.6	23.57
High End of Critical Load Range (kg N/ha/yr)	15	25	15	15	25	15
Deposition as % of Higher Critical Load	9.5%	0.4%	0.9%	13.5%	0.7%	1.8%
Rate of Total Dry Deposition as N (keq/ha/yr)	0.102	0.007	0.010	0.145	0.013	0.019
High End of Critical Load Range N (keq/ha/yr)	2.28	4.493	7.925	2.28	4.493	7.925
Deposition as % of Higher Critical Load	4.5%	0.2%	0.1%	6.4%	0.3%	0.2%
Current Minimum N Background (keq/ha/yr)	1.57	1.40	1.78	1.57	1.40	1.78
PEC N (keq/ha/yr)	1.672	1.407	1.790	1.715	1.413	1.799
Rate of Total Dry Deposition as S (kg S/ha/yr)	2.059	0.150	0.245	2.168	0.180	0.310
Rate of Total Dry Deposition as S (keq/ha/yr)	0.129	0.009	0.015	0.135	0.011	0.019
Rate of Total Deposition as HCl (kg H/ha/yr)	0.1368	0.0094	0.0180	0.1368	0.0094	0.0180
Rate of Total Deposition as S and H (keq/ha/yr)	0.2655	0.0188	0.0334	0.2723	0.0207	0.0374
High End of Critical Load Range S (keq/ha/yr)	1.77	4.27	7.783	1.77	4.27	7.783
Deposition as % of Higher Critical Load	15.0%	0.4%	0.4%	15.4%	0.5%	0.5%
Current Minimum S Background (keq/ha/yr)	0.53	0.46	0.47	0.53	0.46	0.47
PEC S and H (keq/ha/yr)	0.7955	0.4788	0.5034	0.8023	0.4807	0.5074
PC Acid (keq/ha/yr)	0.3676	0.0262	0.0434	0.4172	0.0334	0.0562
% of Critical Load	9.1%	0.3%	0.3%	10.3%	0.4%	0.4%
PEC Acid (keq/ha/yr)	2.47	1.89	2.29	2.52	1.89	2.31
% of Critical Load	61%	22%	15%	62%	22%	15%

Table 5 **Modelling at Realistic Release Rates with NO_x at 50 % and Comparing Against the Low End of the Critical Load Range**

Total 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)	1.358	0.096	0.130	1.958	0.172	0.252
Current Minimum Background (kg N/ha/yr)	21.98	19.6	23.57	21.98	19.6	23.57
Low End of Critical Load Range (kg N/ha/yr)	10	15	10	10	15	10
Deposition as % of Lower Critical Load	13.6%	0.6%	1.30%	19.6%	1.15%	2.5%
Rate of Total Dry Deposition as N (keq/ha/yr)	0.097	0.007	0.009	0.140	0.012	0.018
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	22.1%	3.1%	6.6%	31.9%	5.5%	12.7%
Current Minimum N Background (keq/ha/yr)	1.57	1.40	1.78	1.57	1.40	1.78
PEC N (keq/ha/yr)	1.667	1.407	1.789	1.710	1.412	1.798
Rate of Total Dry Deposition as S (kg S/ha/yr)	0.410	0.030	0.049	0.552	0.060	0.114
Rate of Total Dry Deposition as S (keq/ha/yr)	0.026	0.002	0.003	0.034	0.004	0.007
Rate of Total Deposition as HCl (kg H/ha/yr)	0.0960	0.0065	0.0127	0.0960	0.0065	0.0127
Rate of Total Deposition as S and H (keq/ha/yr)	0.1216	0.0084	0.0158	0.1305	0.0102	0.0198
Low End of Critical Load Range S (keq/ha/yr)	0.58	0.58	1.552	0.580	0.580	1.552
Deposition as % of Lower Critical Load	21.0%	1.4%	1.0%	22.5%	1.8%	1.3%
Current Minimum S Background (keq/ha/yr)	0.53	0.46	0.47	0.53	0.46	0.47
PEC S and H (keq/ha/yr)	0.6516	0.4684	0.4858	0.6605	0.4702	0.4898
PC Acid (keq/ha/yr)	0.2186	0.0152	0.0251	0.2703	0.0225	0.0378
% of Critical Load	21.5%	1.9%	1.48%	26.6%	2.8%	2.2%
PEC Acid (keq/ha/yr)	2.32	1.88	2.28	2.37	1.88	2.29
% of Critical Load	228%	234%	134%	233%	234%	135%

Table 6 Modelling at Realistic Release Rates with NO_x at 50 % and Comparing Against the High End of the Critical Load Range

Total 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)	1.358	0.096	0.130	1.958	0.172	0.252
Current Minimum Background (kg N/ha/yr)	21.98	19.6	23.57	21.98	19.6	23.57
High End of Critical Load Range (kg N/ha/yr)	15	25	15	15	25	15
Deposition as % of Higher Critical Load	9.1%	0.4%	0.87%	13.1%	0.7%	1.7%
Rate of Total Dry Deposition as N (keq/ha/yr)	0.097	0.007	0.009	0.140	0.012	0.018
High End of Critical Load Range N (keq/ha/yr)	2.28	4.493	7.925	2.28	4.493	7.925
Deposition as % of Higher Critical Load	4.3%	0.2%	0.1%	6.1%	0.3%	0.2%
Current Minimum N Background (keq/ha/yr)	1.57	1.40	1.78	1.57	1.40	1.78
PEC N (keq/ha/yr)	1.667	1.407	1.789	1.710	1.412	1.798
Rate of Total Dry Deposition as S (kg S/ha/yr)	0.410	0.030	0.049	0.552	0.060	0.114
Rate of Total Dry Deposition as S (keq/ha/yr)	0.026	0.002	0.003	0.034	0.004	0.007
Rate of Total Deposition as HCl (kg H/ha/yr)	0.0960	0.0065	0.0127	0.0960	0.0065	0.0127
Rate of Total Deposition as S and H (keq/ha/yr)	0.1216	0.0084	0.0158	0.1305	0.0102	0.0198
High End of Critical Load Range S (keq/ha/yr)	1.77	4.27	7.783	1.77	4.27	7.783
Deposition as % of Higher Critical Load	6.9%	0.2%	0.2%	7.4%	0.2%	0.3%
Current Minimum S Background (keq/ha/yr)	0.53	0.46	0.47	0.53	0.46	0.47
PEC S and H (keq/ha/yr)	0.6516	0.4684	0.4858	0.6605	0.4702	0.4898
PC Acid (keq/ha/yr)	0.2186	0.0152	0.0251	0.2703	0.0225	0.0378
% of Critical Load	5.4%	0.2%	0.2%	6.7%	0.3%	0.2%
PEC Acid (keq/ha/yr)	2.32	1.88	2.28	2.37	1.88	2.29
% of Critical Load	57%	21%	14%	59%	21%	15%

Table 7 Assessment of Process Contributions to Acid Deposition Against the Minimum Critical Load Maximum for Nitrogen (minCLmaxN)

Scenario	Blaen Cynon	Cwm Cadlan	Coedydd Nedd a Mellte
minCLmaxN (keq/ha/yr)	1.161	1.161	1.837
IED Limits			
Process Contribution of Acid	0.39060	0.02793	0.04637
Percent of Critical Load	34%	2.4%	2.5%
IED Limits with NO2 modelled as 50 % NOx			
Process Contribution of Acid	0.36761	0.02616	0.04337
Percent of Critical Load	32%	2.3%	2.4%
Realistic Emissions with NO2 modelled as 50 % NOx			
Process Contribution of Acid	0.218607	0.015227	0.025081
% of Critical Load	19%	1.3%	1.4%

Figure 1 Critical Load Function Tool for Acid Deposition at Blaen Cynon Realistic Longer Term Emissions with NOx at 50 %

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	18.9
Background	0.94	180.9
Predicted Environmental Concentration (PEC)	1.16	199.8

* % of CL function is calculated after the value of PEC relative to CLminN is taken into account. See detailed explanation for further information and justification.

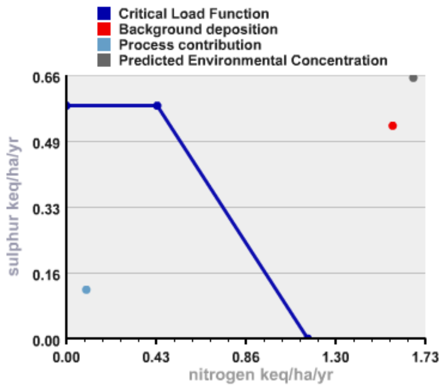

Figure 2 Critical Load Function Tool for Acid Deposition at Cwm Cadlan Realistic Longer Term Emissions with NOx at 50 %

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	1.7
Background	0.7	160.2
Predicted Environmental Concentration (PEC)	0.72	161.9

* % of CL function is calculated after the value of PEC relative to CLminN is taken into account. See detailed explanation for further information and justification.

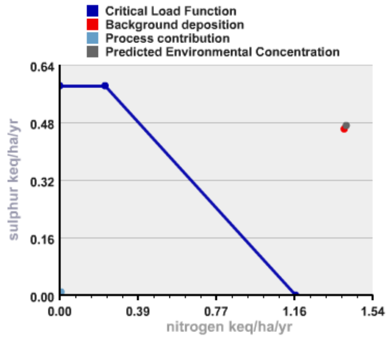

Figure 3 Critical Load Function Tool for Acid Deposition at Coedydd Nedd a Mellte Realistic Longer Term Emissions with NOx at 50 %

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	1.1
Background	0.41	122.5
Predicted Environmental Concentration (PEC)	0.43	123.6

* % of CL function is calculated after the value of PEC relative to CLminN is taken into account. See detailed explanation for further information and justification.