ISOPLETH

AVIAGEN TURKEYS

BRYN GOLAU, SARON

ODOUR IMPACT ASSESSMENT

February 2023

Report Ref: 01.0196.003 OIA v1

Isopleth Ltd.
Registered in England and Wales No. 9150373

CONTENTS

1.0 INTRODUCTION

Isopleth Ltd has been commissioned by Ian Pick Associates, on behalf of Aviagen Turkeys, to carry out a detailed Odour Impact Assessment (OIA) for the proposed of an existing poultry farm at Bryn Golau, Saron, LL16 4TH. When complete, it is planned that the existing broiler farm will be replaced with a turkey breeder egg laying unit.

This assessment presents the result of the detailed dispersion modelling exercise aimed at quantifying and comparing the potential odour impacts from the existing and proposed farm layouts.

1.1 Site Setting

The proposed replacement buildings are to be located on the site of the existing poultry farm buildings at Bryn Golau, Saron, LL16 4TH.

The site lies within the administrative area of Denbighshire County Council (planning) and Natural Resources Wales is responsible for regulating the site under an Environmental Permit.

The location of the site can be seen in Appendix A.

1.2 Description

The 7 existing broiler buildings are no longer in good condition and therefore must be replaced with units consistent with modern standards of welfare and husbandry. As such there is an opportunity for the farm operators to review the market and react to future consumer needs. The applicant is therefore seeking planning permission to:

- demolish the existing 7 broiler sheds which house approximately 87200 broilers over a 38 day growth cycle; and
- replace the broiler sheds with 2 new houses for turkeys to be used for turkey breeder egg laying.

The proposed unit is therefore not a turkey meat rearing unit and the bird sizes, housing and numbers across the growth cycle reflect this. For this reason, standard SCAIL ammonia factors for turkey meat rearing units are not appropriate in this case. The complete turkey cycle length will be approximately 27 weeks:

- Mature turkeys (hens and stags) will be placed at day 1. There will be a maximum of 5,500 hens and 500 stags placed;
- The bird numbers are then broadly maintained reduced over the flock, meaning that for purposed of modelling:
    - by week 24 100% of the original birds remain on site;
    - 25% of the original birds will be removed in subsequent weeks;
    - By the end of the 28 no birds remain on site.

- sheds are cleaned followed by 8 weeks empty.

For the comfort and productivity of the birds the temperature within the houses must be regulated. The existing broiler buildings use capped roof fans, with no vertical momentum to the action of the cap. The proposed buildings will be fitted with high speed roof fans in accordance with modern standards, with a maximum velocity of 12 m/s and no vertical obstruction. The fans will operate at a variable rate dependent upon the age of the birds and will only be switched off when the sheds are vacant.

Plans of the existing and proposed shed layouts are shown in Appendix B.

1.3 Scope and Limitations

The scope of this OIA is limited to the quantification, through atmospheric dispersion modelling, of odour impacts from the existing and proposed poultry sheds at Bryn Golau, Saron on local sensitive receptors based on design information and desktop emission rates.

1.4 Aims and Objectives

The objectives of the assessment are as follows:

- To estimate odour emissions from the turkey farm;
- To quantify impacts on sensitive receptors based upon the emission values;
- To assess the significance of these impacts; and
- Propose mitigation options, if required.

1.5 Experience of Assessor

According to guidance issued by the IAQM, odour assessments must only be completed by a qualified assessor if they are to be considered robust. This includes both experience in the field of odour assessment as well as a defined odour acuity, where relevant.

This assessment has been completed by Matt Stoaling of Isopleth ltd and Fellow of the IAQM. Matt has been involved in the field of odour assessment for over 25 years, including having been Head of Olfactometry at a UKAS accredited odour laboratory. During this time, Matt has also provided air quality and odour advice and services to a range of industry sectors and clients, including the chemical industry, solid waste, wastewater and agriculture. Matt has worked on behalf of local authority and government agencies advising on odour issues, including documents published by the Environment Agency, Sniffer and the IAQM.

2.0 ASSESSMENT METHODOLOGY

2.1 Assessment of Odour Exposure

In the UK, odour assessments for poultry facilities are most commonly undertaken using the concept of the European Odour Unit (ou_E), as defined in BS EN 13725[1]. This approach allows impact assessment of any odorous gas as it is independent of chemical constituents and centres instead on multiples of the detection threshold of the gas in question.

As the odour unit is a Standard Unit in the same way as gram or milligram, the notation used in odour assessment follows the conventions of any mass emission unit as follows:

- concentration: ou_E/m^3
- emission: ou_E/s
- specific emission (emission per unit area): $ou_E/m^2/s$

Like air quality standards for individual pollutants, exposure to odour is given in terms of a percentile of averages over the course of a year. The exposure criteria most accepted in the UK at present is given in terms of (concentration) European Odour Units as a 98th percentile (C_{98}) of hourly averages. This allows 2% of the year when the impact may be above the limit criterion (175 hours). The notation for impact is therefore: $C_{98,\ 1\ hour}$ X ou_E/m^3.

Odour perception, annoyance and nuisance is related to more than simply odour impact, the five 'FIDOL' factors[2] must also be considered when assessing the acceptability of a scheme and the appropriateness of a limit criterion.

2.2 Identification of Odour Sources

Potential sources of odorous emissions from the proposed facility have been identified on the basis of a review of the proposed development design. This involves identifying sources of potential releases to atmosphere. The identified potential odour sources are as follows:

- Point sources (from the broiler and turkey house ventilation); and
- Waste product handling and spillages etc.

Control of fugitive / intermittent releases of odour is addressed a part of the general site management.

[1] BS EN 13725:2003 *Air Quality – Determination of Odour Concentration by Dynamic Olfactometry.*

[2] The FIDOL factors are defined as **F**requency, **I**ntensity (and therefore concentration), **D**uration, relative **O**ffensiveness (hedonic tone/character) and **L**ocation,

2.3 Derivation of Emissions

Ventilation is important for the birds' health and will therefore affect production levels. It is applied when cooling is required, and for maintaining the composition of the indoor air at the required levels. The 'Red tractor' Turkey Standards 1st October 2017 (updated 1st October 2019) Version 4.2 describes the minimum requirements for environmental parameters that need to be ensured, such as:

- Housing/ poult areas must be of sufficient size
- Housing/ the hatchery must be appropriately and effectively ventilated
- On farm records kept of minimum and maximum daily temperatures at bird/ poult level

The anticipated odour emissions for the proposal have been estimated using values given in published literature in the UK and Europe for similar facilities. Ventilation flows are based on information from the operator. The assessment is based on a values calculated from the odour emission rate of 0.53 ouE/s/kg bird which is a figure taken from Hayes et al[3].

2.4 Quantification of Odour Impact

Data derived from the previous stages is input to an atmospheric dispersion model. For this assessment the AERMOD model[4] has been applied with due consideration to relevant guidance[5]. This model is widely used and accepted by the EA and UK planning authorities for undertaking such assessments and its predictions have been validated against real-time monitoring data by the USEPA. It is therefore considered a suitable model for this assessment.

Dispersion modelling guidance indicates that at least 3 (and ideally 5) years of meteorological data should be applied to ensure that infrequent weather conditions do not unduly bias the results. This results in a range of predicted impacts for different years of meteorological data and the average value is used to assess compliance, with the range of impacts used to assess likely variation between years and the risk of shorter-term impacts. This is particularly important in relation to odour, where acceptability of impacts is assessed by receptor over long time periods rather than as a result of infrequent or unusual meteorological conditions.

[3] E.T. Hayes, T.P. Curran, V.A. Dodd (2006) *Odour and ammonia emissions from intensive poultry units in Ireland*. Bioresource Technology 97 (2006) 933–939

[4] Software used: BREEZE AERMOD Pro, v8.1.0.17

[5] USEPA, Aermod Implementation Workgroup, Aermod Implementation Guide, (EPA-454/B-18-003 April, 2018).

2.5 Assessment Scenarios

Two scenarios have been modelled:

- Scenario 0: Existing site (as built) with 87200 broiler chickens in 7 sheds; and
- Scenario 1: Proposed site with up to 5,500 hens and 500 stags in 2 new sheds.

A comparison of the models has been undertaken in order to quantify the change in levels of ammonia as a result of the proposed scheme.

The results of the dispersion modelling have been presented in the form of:

- illustrations of the odour footprint as isopleths (contours of concentration) for the criteria selected enabling determination of impact at any locations within the study area; and
- tabulated odour concentrations ($C_{98,\ 1\text{-hour}}$ X ou_E/m^3) at discrete receptor locations to facilitate the discussion of results.

3.0 REGULATORY STANDARDS AND GUIDELINES

Currently, in the UK there are no statutory numerical standards for assessing the acceptability of predicted odour impacts from quantitative odour impact assessments. On this basis, odour impact criteria are typically based upon guideline documents (predominately based on research from outside of the UK), case law and research which differ depending on the regime i.e. planning (to avoid significant detriment to amenity) or permitting (to avoid unacceptable pollution).

The numerical limits applied have largely been derived from the findings of a limited number of epidemiological assessments where modelled odour impacts have been compared to the findings of quality of life surveys; a dose-effect study. These dose-effect studies have only been undertaken for a limited number of odour types; however they have been used as the foundation for the setting of acceptable odour standards in many countries.

The actual acceptable level of impact will be dependent on the nature (offensiveness) of the odour and the broad sensitivity of the population. To account for this differing numerical limits are often set not only depending on the offensiveness of the odour but also the broad sensitivity of the environment.

3.1 UK Guidance

UK guidance identifies a range of odour impact criteria depending primarily on the nature of the odour (i.e. its pleasantness/unpleasantness) and the likelihood of causing unacceptable impacts based on the 98th percentile of predicted hourly average concentrations over a year.

It is therefore evident that such criteria apply only to locations where an individual's exposure is likely to occur for prolonged periods of time i.e. residential properties. Where exposure is more transient (i.e. roads, footpaths etc.) the direct application of such criteria should be treated with caution and further consideration should be given to how the duration and frequency of exposure of the individual will influence the acceptability of the predicted impact.

3.2 EA H4 guidance

The EA has published a number of guidance documents relating to odour assessment. These include the Horizontal Guidance EPR H4 – Odour Management[6]. Although the turkey farm is not of a sufficient size to require an environmental permit, the H4 Guidance remains a relevant source of information relating to assessment approach.

The H4 guidance proposes the use of installation-specific exposure criteria (benchmarks) on the basis that not all odours are equally offensive, and not all receptors are equally sensitive. The conditions of a Permit will balance these installation-specific odour exposure criteria against what is realistically achievable in accordance with the concept of Best Available Techniques (BAT).

6 H4 Odour Management: How to comply with your environmental permit.

The Guidance states:

'..benchmarks are based on the 98th percentile of hourly average concentrations of odour modelled over a year at the site/installation boundary. The benchmarks are:

1.5 odour units for most offensive odours;

3 odour units for moderately offensive odours;

6 odour units for less offensive odours.'

Examples of these three categories are:

'Highly offensive:

processes involving animal or fish remains
processes involving septic effluent or sludge
biological landfill odours

Moderately offensive:

intensive livestock rearing
fat frying (food processing)
sugar beet processing
well aerated green waste composting

Less offensive:

brewery
confectionery
coffee roasting
bakery'

These benchmark limits are precautionary and may be relaxed in cases where the source is familiar to the location. This is particularly the case in relation to intensive agriculture in a rural setting. For example, research relating to broiler and turkey farms indicates that a more representative nuisance threshold for an agricultural area should be anywhere from 3.3 – 8.8 ou_E/m^3 as a 98^{th} percentile of hourly means[7], or even 9.7 ou_E/m^3 (as a 98^{th} percentile)[8]. This is consistent with guidance published by the EA in relation to nuisance thresholds as a function of site setting[9,10] and also regulation applied in Ireland, where the Environmental Protection Agency (EPA, Ireland) recommended criterion is 6.0 ou_E/m^3 as a 98^{th} percentile of hourly means for existing units. The H4 (and IPPC SRG 6.02, below) benchmarks should therefore be seen as a guide of the relative likelihood of an odour issue being caused rather than an absolute limit value, particularly in an agricultural setting.

[7] Misselbrook, Clarkson and Pain (1993) *Relationship between concentration and intensity of odours for pig slurry and broiler houses.*

[8] Hayes, E.T., Curran, T.P and Dodd, V.A. (2006) *Odour and ammonia emissions from intensive poultry units in Ireland*. Bioresource Technology 97 pp933-939

[9] EPA (2001) *Odour Impacts and Odour Emission Control Measures for Intensive Agriculture. R&D REPORT SERIES* No. 14. pp31.

[10] Environment Agency (2002) *Assessment of Community Response to Odorous Emissions. R&D Technical Report P4-095/TR*. pp63

3.3 IAQM Odour Guidance[11]

On 20th May 2014 the Institute of Air Quality Management released guidance on the assessment of odour for planning. This was updated in 2018.

The guidance is for assessing odour impacts for planning purposes. It provides background information relating to requirements for odour impact assessments and suitable impact criteria and draws from other sources of information such as that described in the H4 guidance (Section 3.3, above).

The IAQM odour guidance requires a degree of professional judgement when considering potential effects of environmental odours. Given the site setting and the number of residences potentially affected, the IAQM odour guidance may be used to classify to the impact from an intensive agricultural facility (i.e. for a 'moderately offensive odour') at a high sensitivity receptor as:

- 'negligible' at below 1.5 ou_E/m^3;
- 'slight adverse' from 1.5 ou_E/m^3 – 3.0 ou_E/m^3 as a 98th percentile of hourly means; or
- 'moderate adverse' impact above from 3.0 ou_E/m^3 to 5.0 ou_E/m^3 as a 98th percentile of hourly means.

Only a moderate impact (or greater) would be regarded as 'significant' for purposes of environmental assessment when considering the overall planning balance.

This document is not intended to provide guidance on odour for environmental protection regulatory purposes (e.g. Environmental Permitting).

[11] IAQM (2018) *Guidance on the assessment of odour for planning*

4.0 RECEPTORS, VENTILATION FLOWS AND EMISSIONS

4.1 Site Setting

Discrete receptor locations have been selected for comparative purposes to facilitate the discussion of predicted odour impacts; in general they represent the closest residential locations in each direction. These are as presented in Table 4-1 and shown in Drawing AQ1.

Table 4-1
Discrete Receptor Locations Modelled

Ref	Description	National Grid Reference OS Xm	OS Ym	Elevation (mAoD)
HR1	Bryn Glas	302114.8	361051.6	294.2
HR2	Cefn Maen Isa	302270.2	360980.7	296.0
HR3	Cefn Maen	302312.3	361062.0	291.6
HR4	Pant-Y-Foel	302457.9	360400.0	327.0

In addition to assessment of impact at discrete receptors, a receptor grid has been used to allow the production of and odour isopleth drawing. Modelling was carried out at 20m resolution over a 0.6 km by 0.8 km grid.

4.2 Building and Stack Layouts

Modelling inputs for the existing and proposed buildings are shown in Appendix C. The site details (existing and proposed) have been provided by the applicant. The height of all existing buildings has been taken as 4m above ground level.

Table 4-2
Building Details: Existing

Building	Width (m)	Length (m)	Basal Height (mAoD)	Angle (°)
Building 1	22.3	20.4	306	100.3
Building 2	22.4	20.4	305	99.9
Building 3	22.0	21.4	304	100.0
Building 4	29.3	20.4	302	88.6
Building 5	30.4	20.6	302	89.0
Building 6	29.6	20.4	300	91.0
Building 7	29.8	20.6	300	90.0

The proposed buildings will be as follows. The height of all proposed buildings has been taken as 5m above ground level.

Table 4-3
Building Details: Proposed

Building	Width (m)	Length (m)	Basal Height (mAoD)	Angle (°)
Building 1	101	18	304	90
Building 2	111	18	304	90

4.3 Emission Rates

As described in section 2.4, the emission rates used are calculated from the weight of birds within each house using a specific emission rate taken from published values which indicate a likely range for a well run modern farm. Emissions have been calculated from the odour emission rate of 0.53 ou_E/s/kg bird which is a figure taken from E.T. Hayes, T.P. Curran, V.A. Dodd (2006) *Odour and ammonia emissions from intensive poultry units in Ireland*. **Bioresource Technology 97 (2006)** 933–939. The emission calculations are time varied across the cycle as shown in Appendix D.

4.4 Emission Parameters

Modelling inputs for the existing and proposed buildings are shown in Appendix C. The emission parameters for the new turkey buildings are as shown in Table 4-4 below.

Table 4-4
Stack Details

Building	Stack height (m)	Stack diameter (m)	Velocity (m/s)
Proposed Turkey Buildings	6.0	0.8	12.0

The temperature of emissions from the proposed turkey houses has been taken as 25°C for all hours of the year.

4.5 Topography

Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away. The Bryn Golau site is set on ground at approximately 304m AOD and the height of the surrounding land is highly variable. Information relating to the topography of the area surrounding the site has been used to assess the impact of terrain features on the dispersion of emissions from the site. Topographical data has been obtained in digital (.ntf) format and incorporated into the assessment.

4.6 Local Wind Speed and Direction Data

The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability. For meteorological data to be suitable for dispersion modelling purposes a number of meteorological parameters need to be measured on a continuous basis.

There are only a limited number of sites where the required meteorological measurements are made. In the UK, all of these sites are quality controlled by the Met Office. Suitable meteorological data is not however available for all sites, in which case NRW guidance states:

> *'If observed suitable meteorological data are not available, then high quality numerical weather prediction (NWP) data, e.g. Met Office high horizontal resolution (1.5 km) NWP data extracted at the proposed site, should be used…'*

In this case, the closest meteorological data stations are:

- Rhyl No 2. WMO Identifier 3313 (76m AoD); and
- Bala. WMO Identifier 3409 (163m AoD).

It is considered that neither of these sites is suitable, particularly in relation to the setting of the meteorological data site and also the elevation (the site is located at 344m AoD). For this reason, a 5 year NWP data set has been obtained in order to ensure compliance with NRW Guidance. This NWP data set covers the years 2016 – 2020.

NWP meteorological data was obtained in .met format and converted to .sfc and .pfl formats for use in AERMOD using AERMET Pro according to US EPA methodology[12]. Surface roughness length is based upon land use characteristics 1km from the point source. The determination of Bowen ratio and albedo is defined by a 10km by 10km region around the site. In this case the site is characterised by water, forest and grassland. A site roughness of 0.1m has been used for the modelling.

[12] US Environmental Protection Agency (2008). AERMOD Implementation Guide, AERMOD Implementation Group.

5.0 RESULTS

Results may be compared against the benchmark criterion of 3 ou_E/m^3 as a 98th percentile of hourly means appropriate for a 'moderately offensive' odour although this should be regarded as precautionary as should the emission rates.

5.1 Existing Farm layout (Broilers)

The 5-year average odour exposures predicted as a result of emission from the existing broiler farm layout are presented in Table 5-1 below.

Table 5-1
Odour Results (ou_E/m^3)

Ref	Description	2016	2017	2018	2019	2020	Ave
HR1	Bryn Glas	5.0	4.8	4.5	6.3	7.2	5.5
HR2	Cefn Maen Isa	3.9	4.6	3.8	3.8	3.7	4.0
HR3	Cefn Maen	2.3	2.8	2.3	2.2	2.3	2.4
HR4	Pant-Y-Foel	0.3	0.3	0.2	0.2	0.3	0.3

The modelling indicates that there are two properties where the average existing odour impact results are above 3.0ou_E/m^3. The impact at HR1 and HR2 would be regarded as 'moderate adverse', whilst the impact at HR3 would be 'slight adverse'. The impact at HR4 is 'negligible'.

5.2 Proposed Farm layout (Turkeys)

The 5-year average odour exposures predicted as a result of emission from the proposed farm layout are presented in Table 5-2 below.

Table 5-2
Odour Results (ou_E/m^3)

Ref	Description	2016	2017	2018	2019	2020	Ave
HR1	Bryn Glas	4.4	4.4	4.4	5.3	5.2	4.7
HR2	Cefn Maen Isa	4.0	4.2	4.1	4.0	3.6	4.0
HR3	Cefn Maen	2.7	2.9	2.8	2.7	2.5	2.7
HR4	Pant-Y-Foel	0.6	0.5	0.6	0.4	0.5	0.5

The modelling indicates that there remain two properties where the average future odour impact results are above 3.0ou_E/m^3. The impact at HR1 and HR2 would be regarded as 'moderate adverse', whilst the impact at HR3 would be 'slight adverse'. The impact at HR4 is 'negligible'.

5.3 Scenario Comparison

A comparison of the 5-year average odour exposures is presented in Table 5-3 below.

Table 5-3
Odour Results Comparison (ou_E/m^3)

Ref	Description	Existing	Proposed	Difference
HR1	Bryn Glas	5.5	4.7	-0.8
HR2	Cefn Maen Isa	4.0	4.0	0.0
HR3	Cefn Maen	2.4	2.7	0.4
HR4	Pant-Y-Foel	0.3	0.5	0.3

A comparison of the 5-year maximum odour exposures is presented in Table 5-4 below.

Table 5-4
Odour Results Comparison (ou_E/m^3)

Ref	Description	Existing	Proposed	Difference
HR1	Bryn Glas	7.2	5.3	-1.9
HR2	Cefn Maen Isa	4.6	4.2	-0.3
HR3	Cefn Maen	2.8	2.9	0.1
HR4	Pant-Y-Foel	0.3	0.6	0.3

It can be seen that the redevelopment of the Bryn Golau site as proposed is predicted to result in a betterment at receptors HR1 and HR2 as a result of the improved ventilation system consistent with modern standards and lower overall emissions from the turkeys than the broilers currently at the site as a result of the stocking and selection methods proposed. The impacts at HR3 and HR4 remain under the $3.0ou_E/m^3$ limit value.

6.0 MITIGATION

The emission rate used above is calculated from the standard emission factors for turkeys, factored for the size of bird at the farm. No reduction applied for:

- ideal protein diets;
- use of probiotics;
- indirect heating; or
- maintenance of good quality litter across the unit.

Notwithstanding this, the redevelopment of the Bryn Golau site as proposed is predicted to result in a betterment at all receptors where impact is above the $3.0ou_E/m^3$ limit value.

7.0 CONCLUSIONS

This report presents a detailed odour impact assessment (OIA) for the proposed redevelopment of an existing poultry farm at Bryn Golau, Saron, LL16 4TH. When complete, it is planned that the existing broiler farm will be replaced with a turkey breeder egg laying unit.

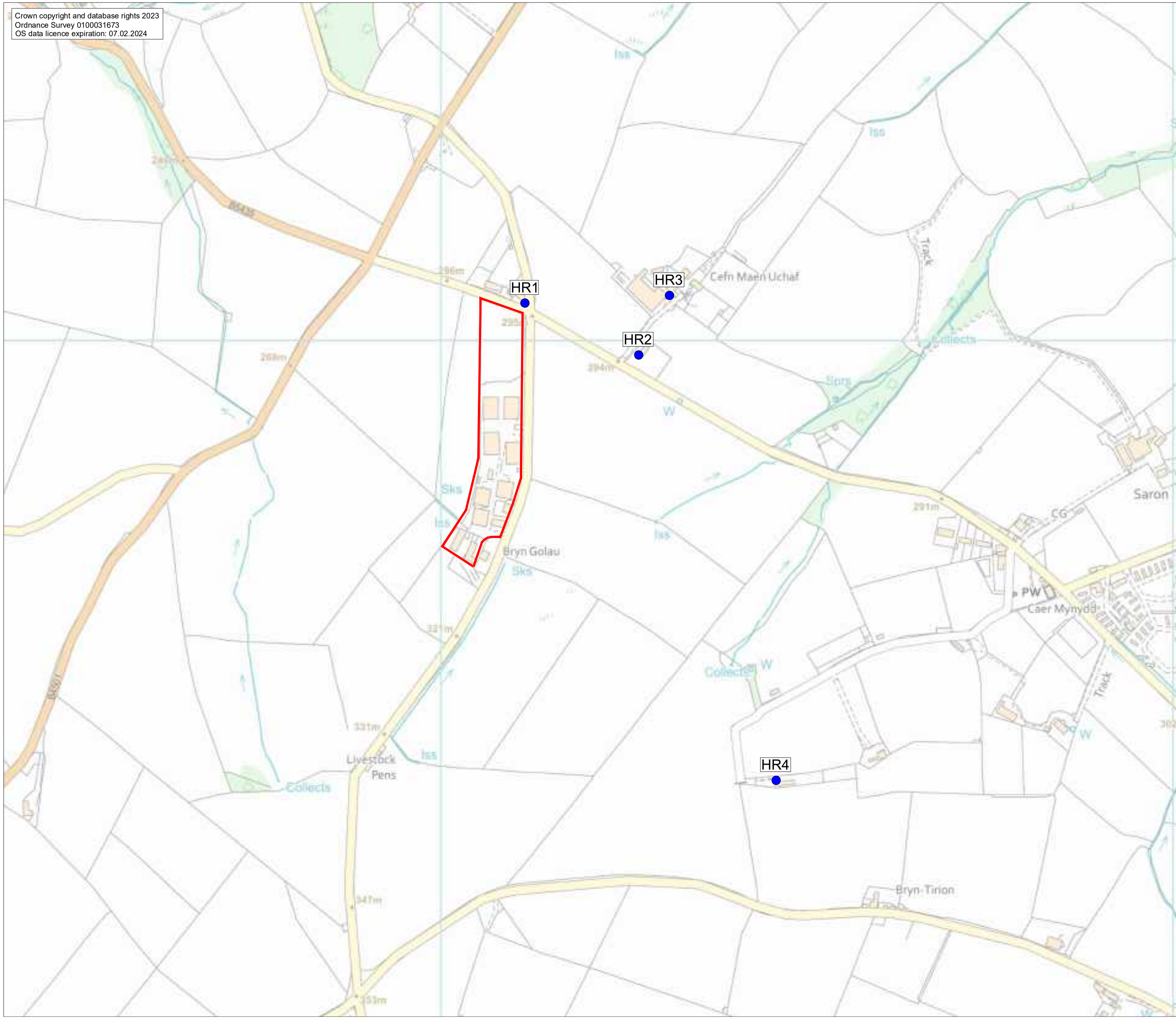
This assessment presents the result of the detailed dispersion modelling exercise aimed at quantifying the potential odour impacts from the existing and proposed farm layouts and proposals for mitigation

Dispersion modelling has been completed, which predicts that:

- The proposed odour impacts are likely to remain above limits typically applied in the UK for such sources;
- With the proposed development in place, odour will continue to be perceived the closest locations; however
- The redevelopment of the Bryn Golau site as proposed is predicted to result in a betterment at all receptors where the impact is above the 3.0ou_E/m^3 limit value.

Should the odour control measures detailed in a site odour management plan be followed during typical operation and abnormal events, these potential impacts will be reduced even further.

APPENDIX A



NOTES

LEGEND

SITE BOUNDARY

HUMAN RECEPTOR LOCATION

N
W E
S

Aviagen Turkeys

SITE
Bryn Golau

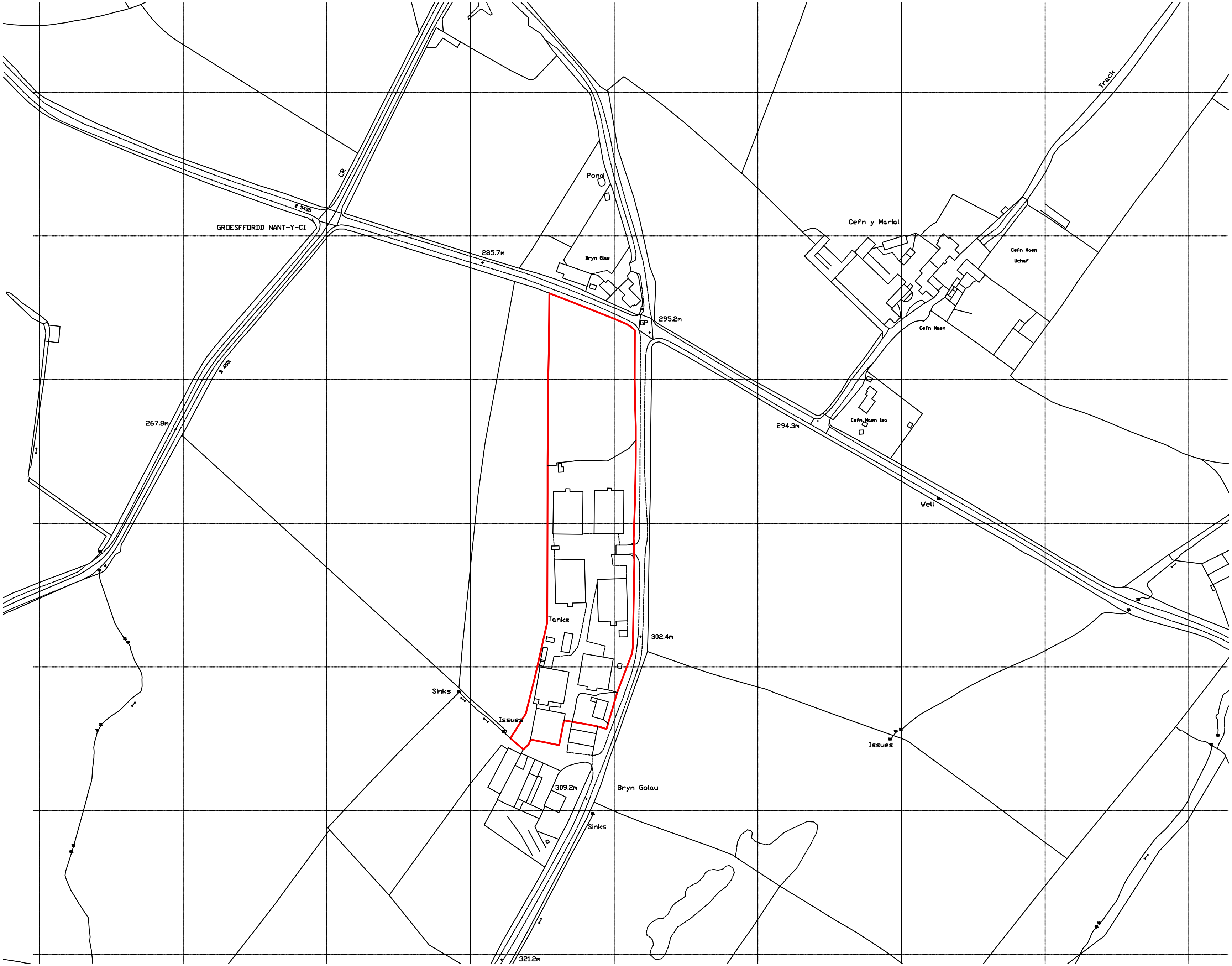
PROJECT
Air Quality Assessment

DRAWING TITLE
Human Receptor Locations

DRAWING NUMBER	REVISION
OIA1	0
SCALE	DATE
1:5000 @ A3	07.02.2023

ISOPLETH

APPENDIX B



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CLIENT
Knights Construction

JOB TITLE
Poultry Unit Redevelopment at Bryn Golau Poultry Farm, Saron, LL16 4TH

DWG. TITLE
Location Plan

SCALE	DRN
1=2500	IP

DWG. NUMBER
IP/KC/01

DATE	REV
Aug 21	-

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CLIENT
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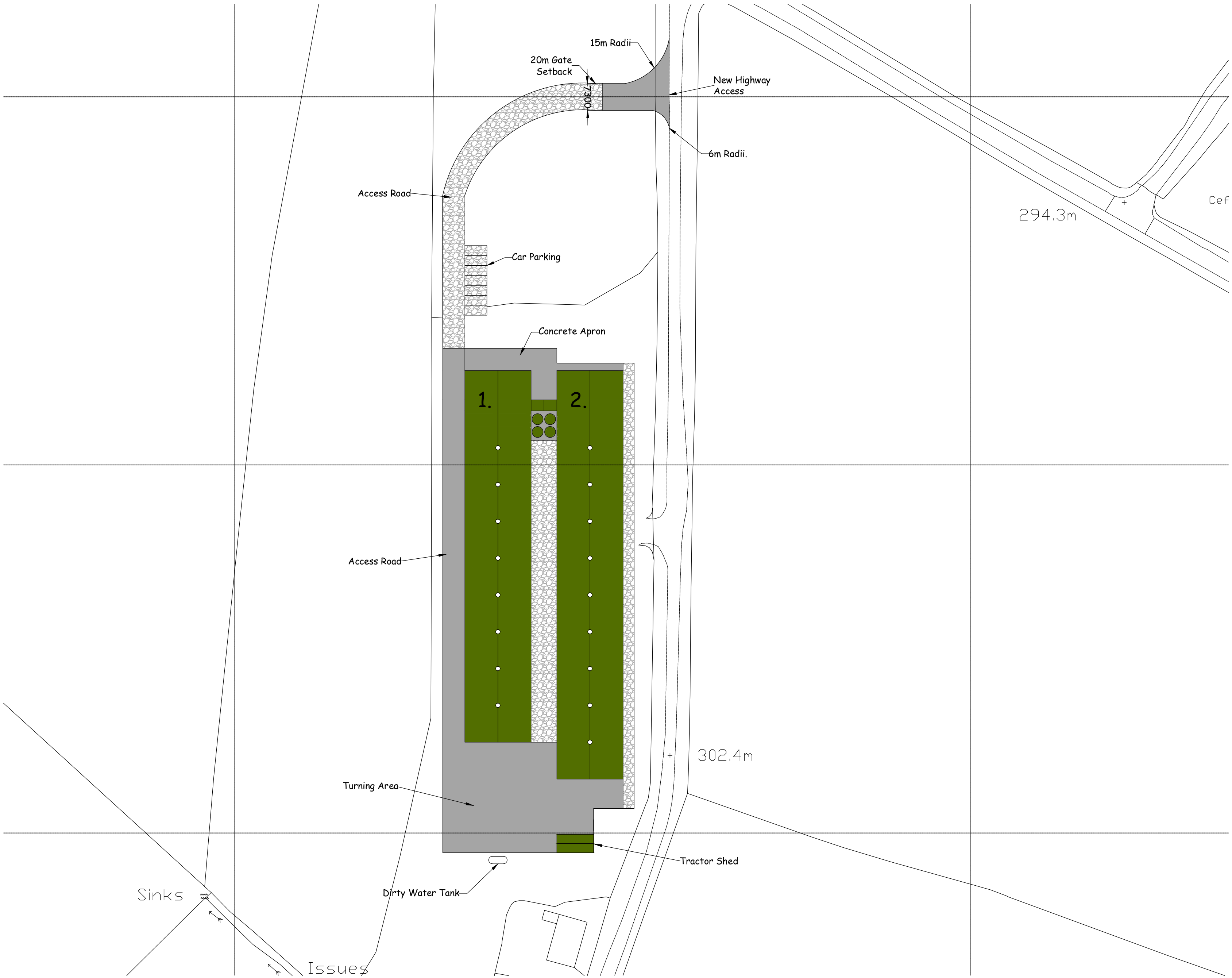
JOB TITLE
Poultry Unit Redevelopment at Byrn Golau, Saron, LL16 4TH

DWG. TITLE
Existing Site Plan A1

SCALE 1=500
DRN IP

DWG. NUMBER IP/KC/02

DATE Aug 21
REV -



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JOB TITLE
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DWG. TITLE
Proposed Site Plan A1

SCALE	DRN
1=500	IP

DWG. NUMBER
IP/ATL/03

DATE	REV
Jan 23	-

APPENDIX C

Table C-1
Sc0: Building Locations

ID	Ref	OSGR Xm	OSGR Ym
B1	Building 1	302046.0	360771.8
B2	Building 2	302048.4	360800.6
B3	Building 3	302078.5	360810.1
B4	Building 4	302088.1	360861.5
B5	Building 5	302058.7	360875.2
B6	Building 6	302057.8	360922.6
B7	Building 7	302086.3	360923.3

Table C-2
Sc0: Stack Locations

ID	Ref	OSGR Xm	OSGR Ym
S1	Building 1	302049.4	360753.3
S2	Building 1	302050.4	360758.8
S3	Building 1	302051.3	360763.6
S4	Building 1	302054.8	360754.5
S5	Building 1	302055.7	360760.1
S6	Building 1	302056.9	360765.8
S7	Building 2	302052.7	360782.3
S8	Building 2	302059.4	360792.1
S9	Building 3	302083.2	360792
S10	Building 3	302084.5	360800.3
S11	Building 3	302089.5	360795.1
S12	Building 3	302090.8	360803.6
S13	Building 4	302099.5	360835.8
S14	Building 4	302099.1	360841.8
S15	Building 4	302098.6	360847.8
S16	Building 4	302098.4	360854
S17	Building 4	302099.8	360838.9
S18	Building 4	302099.6	360845
S19	Building 4	302099.4	360851.1
S20	Building 4	302099.1	360857.5
S21	Building 5	302068.8	360849.5
S22	Building 5	302068.6	360855.3
S23	Building 5	302068.5	360861.7
S24	Building 5	302068.4	360867.1
S25	Building 5	302069.8	360852.6
S26	Building 5	302069.3	360858.7

ID	Ref	OSGR Xm	OSGR Ym
S27	Building 5	302069.4	360864.5
S28	Building 5	302069.3	360870.3
S29	Building 6	302067.4	360897.4
S30	Building 6	302067.3	360903.5
S31	Building 6	302067.3	360909.6
S32	Building 6	302067.2	360915.1
S33	Building 6	302068.3	360900.6
S34	Building 6	302068.3	360906.6
S35	Building 6	302068.1	360912.4
S36	Building 6	302068.1	360918.2
S37	Building 7	302096.9	360897.5
S38	Building 7	302096.8	360903.4
S39	Building 7	302096.6	360909.4
S40	Building 7	302096.2	360915.1
S41	Building 7	302097.9	360900.7
S42	Building 7	302097.6	360906.6
S43	Building 7	302097.2	360912.3
S44	Building 7	302096.8	360918.3

Table C-3
Sc1: Building Locations

ID	Ref	OSGR Xm	OSGR Ym
B1	Building 1	302062.8	360925.8
B2	Building 2	302087.8	360925.8

Table C-4
Sc1: Stack Locations

Ref	OSGR Xm	OSGR Ym
B1S1	302071.8	360904.7
B1S2	302071.8	360894.9
B1S3	302071.8	360884.7
B1S4	302071.7	360874.8
B1S5	302071.7	360864.8
B1S6	302071.8	360854.9
B1S7	302071.8	360844.8
B1S8	302071.8	360834.8
B2S1	302096.8	360904.6
B2S2	302096.9	360894.6
B2S3	302096.9	360884.7
B2S4	302096.9	360874.6
B2S5	302096.8	360864.7

Ref	OSGR Xm	OSGR Ym
B2S6	302096.9	360854.7
B2S7	302096.8	360844.7
B2S8	302096.9	360834.5
B2S9	302096.9	360824.8

APPENDIX D

Stocking calculations are based on the following for hens:

- 1200 x hens of 22.0kg;
- 700 x hens of 11.5kg;
- 500 x hens of 10.0kg;
- 2000 x hens of 14.5kg; and
- 1100 x hens of 9.5kg.

Males will range from 15.0 to 35.0kg and will be dependent on the matings required. The average mass of males is therefore 25.0kg and for hens is 14.345kg.

Table D-1
Sc1: Stocking and Ammonia Emissions (Males)

Week	% remaining	number remaining	Total mass (kg)	OU_E emission / sec
0-24	100.0	500.0	12500	6625.0
25	75.0	375.0	9375	4968.8
26	50.0	250.0	6250	3312.5
27	25.0	125.0	3125	1656.3
clean	0.0	0.0	0	0.0

[Notes: Emissions calculated from the odour emission rate of 0.53 ou_E/s/kg bird which is a figure taken from E.T. Hayes, T.P. Curran, V.A. Dodd (2006) *Odour and ammonia emissions from intensive poultry units in Ireland*. **Bioresource Technology 97 (2006)** 933–939]

Table D-2
Sc1: Stocking and Ammonia Emissions (Females)

Week	% remaining	number remaining	Total mass (kg)	OU_E emission / sec
0-24	100.0	5500.0	78900	41817.0
25	75.0	4125.0	59175	31362.8
26	50.0	2750.0	39450	20908.5
27	25.0	1375.0	19725	10454.3
clean	0.0	0.0	0	0.0

[Notes: Emissions calculated from the odour emission rate of 0.53 ou_E/s/kg bird which is a figure taken from E.T. Hayes, T.P. Curran, V.A. Dodd (2006) *Odour and ammonia emissions from intensive poultry units in Ireland*. **Bioresource Technology 97 (2006)** 933–939]

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