Long-term trends in spatial and temporal atmospheric ammonia across Ballynahone Bog: Sep 2014 – June 2022

Tang .Y.S, Stephens A.C.M, Iwanicka A.K., Duarte F., Williams, M.R, Carnell, E., Pearson C. and Dragosits U.

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Contents

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UKCEH reference	07102
UKCEH contact details	U Dragosits [Company Address] t: 0131 445 4343 e: ud@ceh.ac.uk
Authors	Tang .Y.S, Stephens A.C.M, Iwanicka A.K., Duarte F., Williams, M.R, Carnell, E., Pearson C. and Dragosits U.
Approved by	U Dragosits
Date	Click here to enter a date.

1. Executive Summary

1.1 Ballynahone Bog

Intensive poultry farms are recognised as large emission sources of atmospheric ammonia (NH_3) gas in agricultural landscapes. Emission and deposition of NH_3 from these sources can contribute substantially to total nitrogen input to nearby sensitive receptors, and cause harmful effects by contributing to eutrophication and acidification of terrestrial and freshwater habitats. In the summer of 2014, a poultry farm was constructed on the south-western edge of Ballynahone Bog nature reserve (https://www.ulsterwildlife.org/nature-reserves/ballynahone-bog). The sensitivity of bog habitats to nitrogen deposition and the prevailing south-westerly wind in the area raised concerns that Ballynahone Bog may be adversely affected by NH_3 emissions arising from the poultry installation.

Eight NH_3 monitoring points were established on the bog at strategic locations in early September 2014 to provide a detailed spatial and source attribution assessment. These are:

- Sites 1 to 5 = NE transect (30, 173, 275, 418 and 638 m), downwind of siting of new poultry housing.
- Site 6 = 320 m NNW of Site 1 (250m downwind of a pig farm located at the edge of the bog).
- Site 7 = 265 m ESE of Site 1 on the opposite side of transect to Site 6, to compare with Site 6 for source attribution assessment from the pig farm.
- Site 8 = “Background” site, furthest away from identified sources, to provide an indicative background concentration for the bog

1.2 Objectives

The aim of the project was to determine if NH_3 emissions from the operation of a poultry farm will increase atmospheric NH_3 concentrations and thereby enhance nitrogen deposition at the adjacent Ballynahone Bog nature reserve. A local-scale transect (5 sites) downwind of the poultry housing across the reserve and three other monitoring locations within the reserve were set up to help identify the effects of NH_3 emissions from the poultry housing to NH_3 concentrations on the bog. Monthly NH_3 measurements covered the first five months (September 2014 to January 2015) before the farm was fully operational.

1.3 Key Findings

This report provides a summary and analysis of data for the measurement period between September 2014 and March 2022.

- Monthly measurement data at the 8 sites up to March 2022 are provided in Appendix 6.2.

- All data up to 2022 have been fully ratified and published on The Environmental Information Data Centre (EIDC). The EIDC is a part of the Natural Environment Research Council's (NERC) Environmental Data Service and is hosted by the UK Centre for Ecology & Hydrology (UKCEH) to manage nationally-important datasets concerned with the terrestrial and freshwater sciences.

- Due to the COVID-19 lockdown in March 2020, site visits were suspended between March and May 2020 and resumed in June 2020. The March 2020 samples were exposed for approx. 2 months (26/02 – 30/04/2020). Data presented for March to April are therefore 2-month time integrated averaged NH_3 concentrations.

- Further COVID-19 restrictions later in 2020 also resulted in disruptions to site visits to change over samples. The sampling periods affected were July to October, with e.g. July samples exposed for just over a month (09/07 – 13/08/20), August samples exposed for 1.5 months (13/08 – 24/09/20) and October exposed for 2 months (24/09 – 25/11/2020).

Changes in NH_3 concentrations since operation of poultry farm

- Over the five months (Sep14 - Jan15) prior to the full population of the new poultry houses, NH_3 concentrations along the established transect (30, 173, 275, 418 and 638 m) downwind of the housing were fairly similar. Mean concentrations of 2.3 µg m^{-3} were measured at the site closest (30 m; range = 1.4 – 4.9 µg m^{-3}), and at the site furthest from the housing (638 m; range = 1.2 – 4.4 µg m^{-3}). The highest concentration was however recorded at 275 m (mean = 2.9 µg m^{-3}, range = 1.7 – 6.5 µg m^{-3}), indicating potential influence of local NH_3 emissions at this location.

- To avoid any differences due to seasonal variations in NH_3 (influence of weather and local agricultural practices, e.g. manure spreading), pre-population NH_3 concentrations (P0: Sep2014 - Jan2015) are compared with 6 years of data from corresponding months for 6 periods (P1 = Sep15 - Jan16, P2 = Sep16 - Jan17, P3 = Sep17 - Jan18, P4 = Sep18 – Jan19, P5 = Sep19 – Jan 20, P6 = Sep20 – Jan21; P denotes Period).

- In P4, substantially elevated NH_3 concentrations were recorded at all 8 sites on the bog between October and December 2018. This was attributed to a pollution incidence (details unknown). Data from this period was therefore excluded from comparisons with P0.

- Following population of the poultry housing, NH_3 concentrations along the transect showed an increase at the location closest to the housing (30 m; mean = 3.5 µg m^{-3}, *n* = 5, P4 excluded (8.3 µg m^{-3})), with similar concentrations at both 173 m (mean = 3.5 µg m^{-3}, *n* = 5, P4 excluded (7.7 µg m^{-3})) and 275 m (mean = 3.2 µg m^{-3}, *n* = 5, P4 excluded (7.3 µg m^{-3})). This declined to a smaller mean concentration of 2.1 µg m^{-3} (*n* = 5, P4 excluded (5.7 µg m^{-3})) at the end of the transect (638 m), similar to the pre-population mean concentration of 2.3 µg m^{-3}.

- The small gradient in NH_3 concentrations along the transect in the populated periods (P1 – P6, P4 excluded) suggests that the highest concentrations in the elevated plume emitted from the 16 m high chimney stack is missed by NH_3 measurements closer to the poultry houses that are made at 1.5 m above ground.

- The effects of building downwash are expected to carry some of the emitted plume closer to ground level further along the transect. This effect may have contributed to the larger mean concentrations of 5.0 µg m^{-3} at 173 m (Site 2) in P3 (Sep17 - Jan18). However, spikes in NH_3 concentrations occurred in September (10 µg m^{-3}) and October 2017 (6.0 µg m^{-3}) when manure spreading would normally take place, so the larger concentrations at 173 m location may also be affected by nearby farming emissions from other activities, in addition to emission from the poultry houses.

- An indicative “background” site (Site 8) was established approx. 1.6 km to the southeast of the poultry farm. Mean NH_3 concentrations at this background site were 1.1 µg m^{-3} for pre- (P0: Sep14 - Jan15) and 1.2 µg m^{-3} post-population (mean of P1 – P6, *n* = 5, P4 (3.0 µg m^{-3}) excluded).

- The highest NH_3 concentrations were measured at Site 6, with a pre-population (P0: Sep14 - Jan15) mean of 4.5 µg m^{-3}. Similar concentrations were observed post-population (mean of P1 – P6, excluding P4 = 4.3 µg m^{-3} (range = 2.4 – 5.1 µg m^{-3}; *n* = 5). This is located 320 m north of the poultry houses, and 250 m NE of a pig farm, Site 6 is therefore likely to be affected by emissions from close proximity to the upwind pig farm, with contributions from near source enhancement by the poultry farm.

Changes in NH_3 during non-operational period of poultry farm in 2020

- In mid-January 2020, the poultry houses were emptied and then cleaned, with the cleaning process completed by 7 February 2020. The houses were then non-operational for 8.5 months, until 19/20 October 2020, when they were re-stocked.

- NH_3 concentrations in 2020 were compared with earlier years (2015 – 2019) in a separate report (Tang et al., 2021b).

Trends in NH_3 concentrations

- Between October and December 2018 substantially elevated NH_3 concentrations were recorded at all 8 sites on the bog. This may have been due to a pollution incident (details unknown).
- The increase in NH_3 concentrations from the extended pollution episode were of sufficient magnitude to be clearly visible in the 2018 annual mean concentrations. For example, the 2018 mean concentration at Site 8 was 2.7 µg m^{-3}, compared with a mean of 1.7 µg m^{-3} from 2015 to 2020 (range = 1.5 – 1.9 µg m^{-3}, *n* = 5, 2018 excluded)

- Annual mean concentrations at Sites 1 – 5 along the transect have increased since 2015, on average by 38 % at Site 1, 15 % at Sites 2 and 3, 5 % at Site 4, and 26 % at Site 5 (2016 – 2020, 2018 excluded). This provided a clear indication of the significance of the contribution of the poultry farm and any other changes in the landscape to elevated NH_3 concentrations across the bog within that period.

- Seasonal trends at all sites show the smallest concentrations in winter and largest concentrations in spring and autumn, coinciding with the usual periods of livestock slurry/manure applications to fields in the area. An exception was observed in the late autumn/winter of 2018 (October-December), with substantially elevated concentrations due to an extended pollution episode.

Comparison with Critical Levels of NH_3 concentrations

- The current "Critical Levels" (CLe) of NH_3 concentrations were adopted in 2007, of 1 µg m^{-3} and 3 µg m^{-3} annual mean for the protection of lichens-bryophytes and vegetation (higher plants), respectively (UNECE 2007). They replaced the previous single CLe value of 8 µg m^{-3} (annual mean).

- The CLe of annual mean NH_3 concentrations of 1 µg m^{-3} for protection of lichens and bryophytes was exceeded at all 8 sites.

- All sites, except Sites 5 and 8, exceeded the CLe of annual mean NH_3 concentrations of 3 µg m^{-3} for the protection of all other sensitive vegetation (higher plants).

- Data from the 8 sites captured high variability in NH_3 concentrations across the bog. Sites in closer proximity to the SW edge were exposed to larger concentrations compared with sites that are further away. This highlights the pressures from myriad emission sources on sensitive receptors that are located in agricultural landscapes.

2. Introduction

Atmospheric ammonia (NH_3) gas concentrations have been measured continuously at eight fixed locations across Ballynahone Bog, since monitoring began in September 2014 (Stephens et al., 2018). The monitoring programme was initiated in response to the establishment of a new poultry farm at the southwest edge of Ballynahone Bog in the summer of 2014 (Tang et al., 2015).

Ballynahone Bog Nature Reserve is a protected site, with designation as an Area of Special Scientific Interest (ASSI), Special Area of Conservation (SAC) and Ramsar status. This site is also one of the largest areas of intact active raised bog in Northern Ireland, hosting rare sphagnum mosses and bog rosemary, as well as a variety of protected bird species and other flora and fauna of particular conservation interest (The Wildlife Trusts, 2015).

NH_3 emitted from the poultry farm is advected over the bog by prevailing south-westerly winds in this area. This presents a potential risk to sensitive vegetation on the bog through exposure to elevated NH_3 concentrations and to increased deposition and accumulation of nitrogen in the soil and vegetation. It is widely recognised that the effects of eutrophication and acidification from NH_3 can potentially lead to loss of conservation value for statutory conservation sites due to ecosystem change and loss of biodiversity (DEFRA, 2002).

This report provides a summary of the NH_3 concentration data obtained for the period from September 2014 to June 2022. The following data analyses were also carried out to:

1) Compare concentrations in the periods before (Sep 2014 and Jan 2015) and after the new poultry farm entered operation.
2) Assess source attribution from new poultry farm.
3) Assess source attribution from pig farm.
4) Examine seasonal trends in NH_3 concentrations.
5) Compare annual mean monitored NH_3 concentrations on the bog with UNECE Critical Levels (CLe) of NH_3 concentrations for the protection of vegetation and ecosystem functioning: 1 µg m^{-3} and 3 µg m^{-3} annual mean for the protection of lichens-bryophytes and vegetation, respectively (UNECE 2007).

3. Method

3.1 Ammonia monitoring sites

The poultry installation is situated on the southwest edge of Ballynahone Bog (Figure 1). Eight NH_3 monitoring locations were established in September 2014 by personnel from the Ulster Wildlife Trust (now Ulster Wildlife), to provide a detailed spatial assessment across the bog. Further site information and coordinates are provided in Appendix 1.

- Sites 1 to 5 = NE transect (30, 173, 275, 418 and 638 m) across the Bog, downwind of new poultry housing.
- Site 6 = 320 n NNW of Site 1 (250 m NE of pig farm).
- Site 7 = 265 m ESE of Site 1, to compare with Site 6.
- Site 8 = "Background" site, furthest away from identified sources, to provide an indicative background concentration for the bog.

Figure 1: Ammonia monitoring on Ballynahone Bog. Purple markers indicate placement of ammonia monitoring sites (Sites 1 – 8). Two new poultry houses are located to the southwest of Site 1. An existing pig farm is also visible on the map, situated 250 m to the southwest of Site 6.

Five monitoring locations (Sites 1 – 5) form a local-scale transect across the bog in the approximate direction of the predominant prevailing wind direction (south-westerly). Three additional monitoring locations were installed, one on each side of the established trajectory (Sites 6 and 7) and one location to provide indicative "background" (Site 8) ammonia concentrations away from any immediate sources. It is noted that there is a pig farm present to the west of the study area. This is located close to the SAC boundary, to the southwest of Site 6. Emissions from this pre-existing installation are likely to influence NH_3 concentrations, both before and after population of the new poultry house.

3.2 Poultry Installation Information

The poultry installation has a planning condition limiting stocking numbers to 17,600 broiler breeders for the site. The housing has a chimney stack with a height of approximately 16 m. Population of the two poultry houses began on the 23rd of January 2015 and reached 75% of total capacity on the 3rd of February 2015.

In mid-January 2020, the poultry houses were emptied and then cleaned, with the cleaning process completed by 7 February 2020. The houses were then non-operational for 8.5 months, until 19/20 October 2020, when they were re-stocked.

3.3 Meteorology

Wind direction data provide a valuable insight for inferring the sources of high NH_3 concentrations measured at Ballynahone Bog. In the report by Williams et al. (2021), detailed analysis was undertaken and presented on whether wind patterns from Lough Fea station (the more suitable of the nearby meteorological stations) could be used to gap-fill the on-site Davis weather station wind data for the most recent years (2019-2020). Meteorological data that are representative for the bog are required for any local scale modelling for the landscape surrounding the bog, and to generate multi-year time series of wind direction data at Ballynahone Bog dating back to September 2014. With a new Campbell automatic weather station (AWS) operational at Site 3 on Ballynahone Bog since 1st October 2020, further analysis and interpretation of NH_3 concentration patterns in combination with weather data have been carried out (Williams et al. 2022).

3.4 Ammonia Monitoring Method

3.4.1 UKCEH ALPHA® Samplers

Atmospheric NH_3 gas concentrations were monitored using the UKCEH high sensitivity ALPHA® passive sampler, shown in Figure 2 (Tang et al., 2001). Monitoring is on a monthly frequency since September 2014, with continuous time-integrated sampling over each period. This is cost-efficient for providing annual mean concentrations for comparisons with UNECE Critical levels of NH_3 concentrations, with sufficient resolution to analyse seasonal patterns in the data.

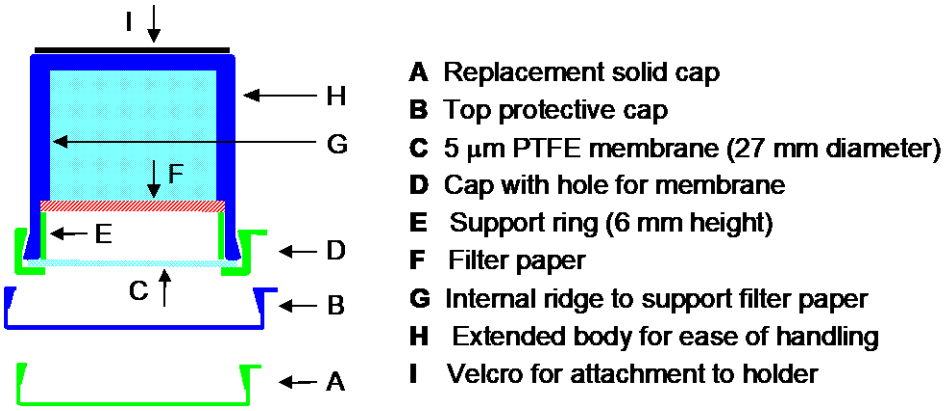

Figure 2: Outline diagram of a single UKCEH ALPHA® sampler.

3.4.2 Preparation of samplers

ALPHA® samplers are prepared in accordance with standard UKCEH protocols (Tang et al. 2019), using filter circles impregnated with 6 mg of citric acid. Replicate samplers (triplicate) are prepared for each site and placed inside a sealed container, together with replacement solid caps that are used to replace the membrane and membrane caps at the end of the monthly sampling period.

3.4.3 Exposure of samplers

Figure 3: UKCEH ALPHA® sampler shelter on a post

ALPHA® samplers are attached by Velcro to an aerodynamically shaped support (upturned plant saucer) on a post at about 1.5 m height above ground or vegetation (Figure 3). The sampling height of 1.5 m above ground is standard, providing a representative NH_3 concentration in the atmosphere. Plastic bird spikes are mounted on the top of the support to deter birds from perching. Replicate (three) samples are used at each site in order to provide an estimate of measurement precision for the air concentration of NH_3.

ALPHA® sampling sites were set up by a member of staff from Ulster Wildlife, in correspondence with experienced personnel at UKCEH. Following site establishment and commencement of the first monitoring period, sites have been visited on a monthly

basis by an Ulster Wildlife representative trained to carry out the required monthly changeover of samples. A recording card is used by the site operator to record dates and times of the sample changes at each site, together with relevant local information (e.g. agricultural activities taking place in the vicinity such as. slurry spreading), during the month or at the time of visit.

3.4.4 Chemical Analysis

Exposed samples are stored in a cold room at 4 °C until analysis. The citric acid-impregnated filter circles from the exposed ALPHA® samplers are extracted into deionised water and analysed for aqueous ammonium (NH_4^+) on the AMFIA (Ammonia Flow Injection Analysis) system (Wyers et al., 1993) at the chemical laboratory of UKCEH Edinburgh. This analysis method is based on selective dialysis of ammonium across a membrane at high pH with subsequent analysis of conductivity (Tang et al., 2018). Since June 2018, analysis is carried out on a new SEAL AA3 Flow Injection Colorimetry system. The SEAL analytical method and standard operating procedures (SOP) for determination of aqueous ammonium used at Edinburgh is the same as that implemented by the UKAS accredited laboratory at UKCEH Lancaster for the UK National Ammonia Monitoring Network (Conolly et al., 2016) and a new ammonia monitoring network in Northern Ireland funded by DAERA (Tang et al., 2021).

3.4.5 Calculations of air concentrations

The amount of NH_3 collected (Q, μg) on an ALPHA® sampler due to air sampling is given by:

$$Q = (Ce - Cb) * v * (\frac{17}{18}) \quad (1)$$

- C_e is the liquid concentration of an exposed sample (µg NH_4^+ ml^{-1}),
- c_b is the liquid concentration of a blank sample (µg NH_4^+ ml^{-1}), and
- v is the liquid volume of the extraction solution (ml).

The air concentration (χ_a) of NH_3 (µg NH_3 m^{-3}) is determined as:

$$\chi_a = \frac{Q}{V} \quad (2)$$

- V is the effective volume of air sampled by ALPHA® sampler over the prescribed period (V, m^3), which may be found by:

$$V = UR_{NH_3} * t \quad (3)$$

- UR_{NH3} is the field calibrated uptake rate for ALPHA® sampler NH_3 measurement by the UKCEH Edinburgh laboratory = 0.003241315 m^3 hr^{-1} (e.g. Martin et al., 2019, Tang et al., 2001), and
- t is sampling duration (hours, hr).

3.4.6 QAQC

The accuracy of the AMFIA and SEAL AA3 systems for determination of ammonium ions in aqueous solution is assured by participation in international laboratory

proficiency schemes (e.g. WMO-GAW Laboratory Intercomparison Program; http://www.qasac-americas.org/lab_ic.html).

The replicate ALPHA® samplers used for each measurement (triplicate samplers in this study) should, when performing well, agree to within 15 % (coefficient of variation, CV). Large discrepancies are most likely due to contamination of samples, or other factors that affect the performance of the samplers. The average reproducibility of replicate samples in the field has been better than 10 % (CV) and the detection limit (x3 standard deviation of blanks) was 0.03 μg m^3 for a monthly exposure period, indicating that the sites and measurements are operating very well.

4. Results and Discussion

4.1 NH_3 pre- and post- population of poultry houses

The first five months of NH_3 measurement between September 2014 and January 2015 were made before the poultry houses were populated. This “pre-population” period (P0) is used as the reference baseline, prior to stocking and operation of the poultry houses (Table 1). Seven periods of “post-population” NH_3 data from 2015 to January 2022 with the corresponding months are summarised in

Table 2 and compared with the "pre-population" period in Figure 4. The percentage change in concentrations for all "post-population periods" (P1 to P7), relative to the reference P0 period, are shown for all sites in Figure 5.

To avoid any differences due to seasonal variations in NH_3 concentrations (e.g. from influence of weather and local agricultural practices, such as manure spreading), pre-population mean NH_3 concentrations (P0: Sep2014 - Jan2015) are compared with 7 years of post-population mean data from the corresponding months:

- P1 = Sep15 - Jan16
- P2 = Sep16 - Jan17
- P3 = Sep17 - Jan18
- P4 = Sep18 – Jan19
- P5 = Sep19 – Jan20
- P6 = Sep20 – Jan21
- P7 = Sep21 – Jan22

The matching of the same months for comparison in each period avoids differences due to seasonal variations in NH_3 concentrations (see Sect.**Error! Reference source not found.**). For example, NH_3 concentrations are generally smallest in the winter months when cold, wet weather reduces emissions, and larger in the warmer, drier months of summer when these conditions promote volatilisation of NH_3. In spring and autumn, peaks in NH_3 concentrations often occur, when manure and slurry application to fields usually takes place (Tang et al., 2018).

Table 1: Monitored mean NH_3 concentrations at each site from September 2014 to January 2015 (P0: pre-population of poultry houses).

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Sep-14	4.88	3.72	6.48	3.76	4.40	3.88	2.97	ND
Oct-14	2.44	2.50	2.50	2.25	2.01	5.21	ND	1.89
Nov-14	1.44	1.53	1.90	1.65	1.38	3.33	1.46	0.84
Dec-14	1.46	1.61	1.85	1.70	ND	6.05	1.35	0.92
Jan-15	1.49	1.73	1.69	1.48	1.22	3.95	1.18	0.69
P0: Mean 14/15	**2.34**	**2.22**	**2.88**	**2.17**	**2.25**	**4.48**	**1.74**	**1.08**

Note: ND = No Data.

Table 2: Monitored mean NH_3 concentrations at all sites for the seven periods (P1 to P7) from matched months with the pre-population period (Table 1).

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Sep-15	4.20	4.49	4.27	3.63	3.11	6.10	3.41	1.41
Oct-15	5.40	3.82	ND	4.02	2.99	5.91	3.26	1.94
Nov-15	ND	1.65	1.47	5.75	0.99	4.83	1.15	0.72
Dec-15	1.79	2.93	2.65	1.75	1.49	3.97	1.34	0.66
Jan-16	2.44	3.69	3.42	2.30	1.73	4.67	2.14	0.83
P1: Mean 15/16	**3.46**	**3.32**	**2.95**	**3.49**	**2.06**	**5.10**	**2.26**	**1.11**
Sep-16	5.34	3.76	3.68	3.19	2.79	5.93	3.38	1.78
Oct-16	3.03	2.72	3.08	2.72	2.30	4.74	2.45	1.45
Nov-16	2.29	2.14	2.90	2.34	1.94	5.38	2.14	1.57
Dec-16	2.17	2.10	3.20	2.39	2.37	4.11	2.47	1.18
Jan-17	2.26	2.79	4.04	2.51	2.13	3.93	2.46	1.53
P2: Mean 16/17	**3.02**	**2.70**	**3.38**	**2.63**	**2.31**	**4.82**	**2.58**	**1.50**
Sep-17	6.33	10.03	5.05	3.16	2.21	6.15	3.80	1.12
Oct-17	4.62	6.02	4.37	3.54	2.94	5.98	4.39	2.04
[a]Nov-17	3.01	3.29	2.95	1.81	1.54	3.68	2.06	0.69
[a]Dec-17	3.01	3.29	2.95	1.81	1.54	3.68	2.06	0.69
Jan-18	1.81	2.36	1.67	1.31	1.25	3.87	1.60	0.90
P3: Mean 17/18	**3.75**	**5.00**	**3.40**	**2.33**	**1.90**	**4.67**	**2.78**	**1.09**
Sep-18	5.48	6.19	5.49	3.88	3.31	6.95	3.70	1.47
Oct-18	9.64	10.6	9.16	7.29	6.49	13.4	9.29	3.98
Nov-18	8.18	7.75	9.25	7.60	7.71	13.3	6.82	4.38
Dec-18	14.4	11.2	10.1	6.42	7.85	10.8	7.07	3.66
Jan-19	3.97	2.51	2.58	ND	3.10	3.80	3.06	1.34
P4: Mean 18/19	**8.32**	**7.65**	**7.32**	**6.30**	**5.69**	**9.64**	**5.99**	**2.97**
Sep-19	ND	ND	ND	ND	ND	ND	ND	ND
Oct-19	4.32	4.31	3.79	2.98	2.71	4.79	3.19	1.40
Nov-19	1.98	1.98	1.61	1.49	1.56	2.63	1.84	0.83
Dec-19	4.32	4.79	4.00	2.72	2.36	5.20	3.16	0.95
Jan-20	4.70	2.94	2.88	2.19	1.92	4.36	2.04	0.97
P5: Mean 19/20	**3.83**	**3.50**	**3.07**	**2.34**	**2.14**	**4.24**	**2.56**	**1.04**
Sep-20	1.24	1.22	4.17	2.92	ND	ND	1.68	2.59
[b]Oct-20	4.51	3.47	3.40	2.82	2.41	1.31	2.64	1.34
[b]Nov-20	4.51	3.47	3.40	2.82	2.41	1.31	2.64	1.34
Dec-20	3.12	4.29	2.81	2.24	1.84	2.72	2.25	0.94
Jan-21	3.18	3.25	3.31	2.26	1.77	4.43	2.60	0.96
P6: Mean 20/21	**3.31**	**3.14**	**3.42**	**2.61**	**2.11**	**2.44**	**2.36**	**1.43**
Sep-21	4.42	3.09	3.43	3.39	3.04	5.34	3.23	1.51
Oct-21	3.47	2.71	2.95	2.66	2.42	5.04	5.15	2.04
Nov-21	2.69	2.54	2.27	1.99	1.80	3.82	2.51	1.16
Dec-21	2.34	2.54	2.33	1.89	1.54	3.32	1.71	0.77
Jan-22	3.22	4.06	3.47	2.58	1.96	4.55	2.5	1.06
P7: Mean 21/22	**3.23**	**2.99**	**2.89**	**2.50**	**2.24**	**4.41**	**2.49**	**1.31**
Mean (P1 – P7) *n* = 7	**4.13**	**4.04**	**3.78**	**3.17**	**2.62**	**5.05**	**3.08**	**1.49**
Mean (exc. P4) *n* = 6	**3.45**	**3.44**	**3.19**	**2.65**	**2.11**	**4.28**	**2.59**	**1.25**

ND = No Data. Samples were lost or not fit for analysis due to contamination, or other issues.
[a]Nov-17 and [a]Dec-17[a] = November 2017 samples exposed for 2 months (09/11/17 – 21/12/17).
[b]Oct-20 and [b]Nov-20 = October 2020 samples exposed for 2 months (24/09/20 – 25/11/20)

In the pre-population period (P0), NH_3 concentrations were fairly homogeneous along the transect, between Site 1 at the start (30 m; mean = 2.3 µg m^{-3}; range = 1.4 – 4.9 µg m^{-3}), and Site 5 at the end of transect (638 m; mean = 2.3 µg m^{-3}; range = 1.2 – 4.4 µg m^{-3}) (Table 1, Figure 4). Larger concentrations at Site 3 along the transect (275 m; mean = 2.9 µg m^{-3}, range = 1.7 – 6.5 µg m^{-3}) (Table 1) indicate potential influence of local NH_3 emissions at this location, possibly from the nearby pig farm that is upwind of this location. Smallest concentrations were seen at the background Site 8 that is furthest from potential sources (mean = 1.2 µg m^{-3}; range = 0.7 – 1.9 µg m^{-3}).

Site 6 closer to the pig farm (250 m downwind of pig farm) provided the largest mean NH_3 concentrations in P0 (Table 1) and also in subsequent periods 2 – 5 (

Table 2), showing very clearly the influence of the pig farm. Seasonal differences in concentrations were also observed across the Sep-Jan comparison periods. While land-spreading emissions in autumn are most likely to have contributed to Sep/Oct peaks in NH_3 concentrations at all sites, larger concentrations at for all other months at Site 6 points to emissions from the pig farm affecting this site. In the most recent period (P6), the mean concentrations at Site 6 had declined quite substantially and was even smaller than measurements at the start (P0). The concentrations at Site 6 was similar to Site 7, which strongly suggest changes at the pig farm. It is of interest to see if concentrations have remained low in 2021/2022.

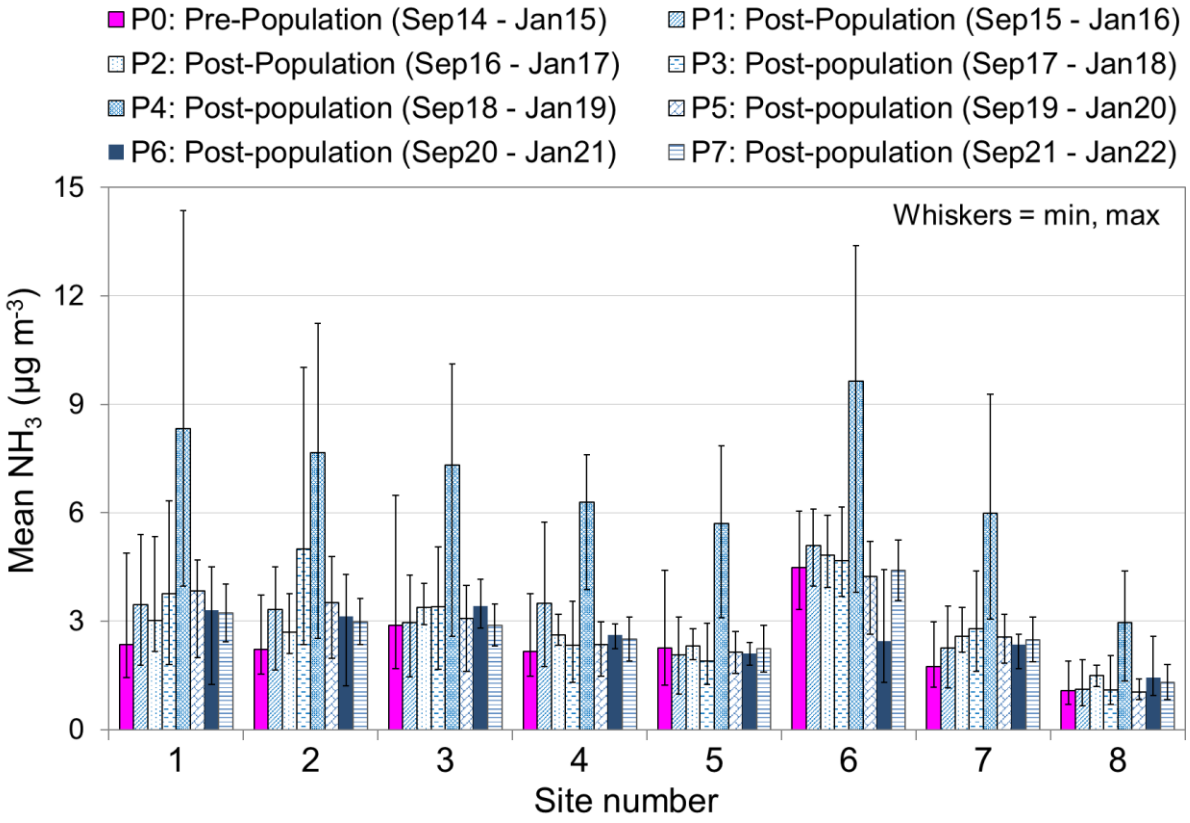

Figure 4: Monitored mean NH_3 concentration at each site, pre-population (Sep14-Jan15) and post-population (2015 - 2022; 7 periods) of the new poultry houses. Whiskers show the range (minimum and maximum) of monitored concentrations in each period.

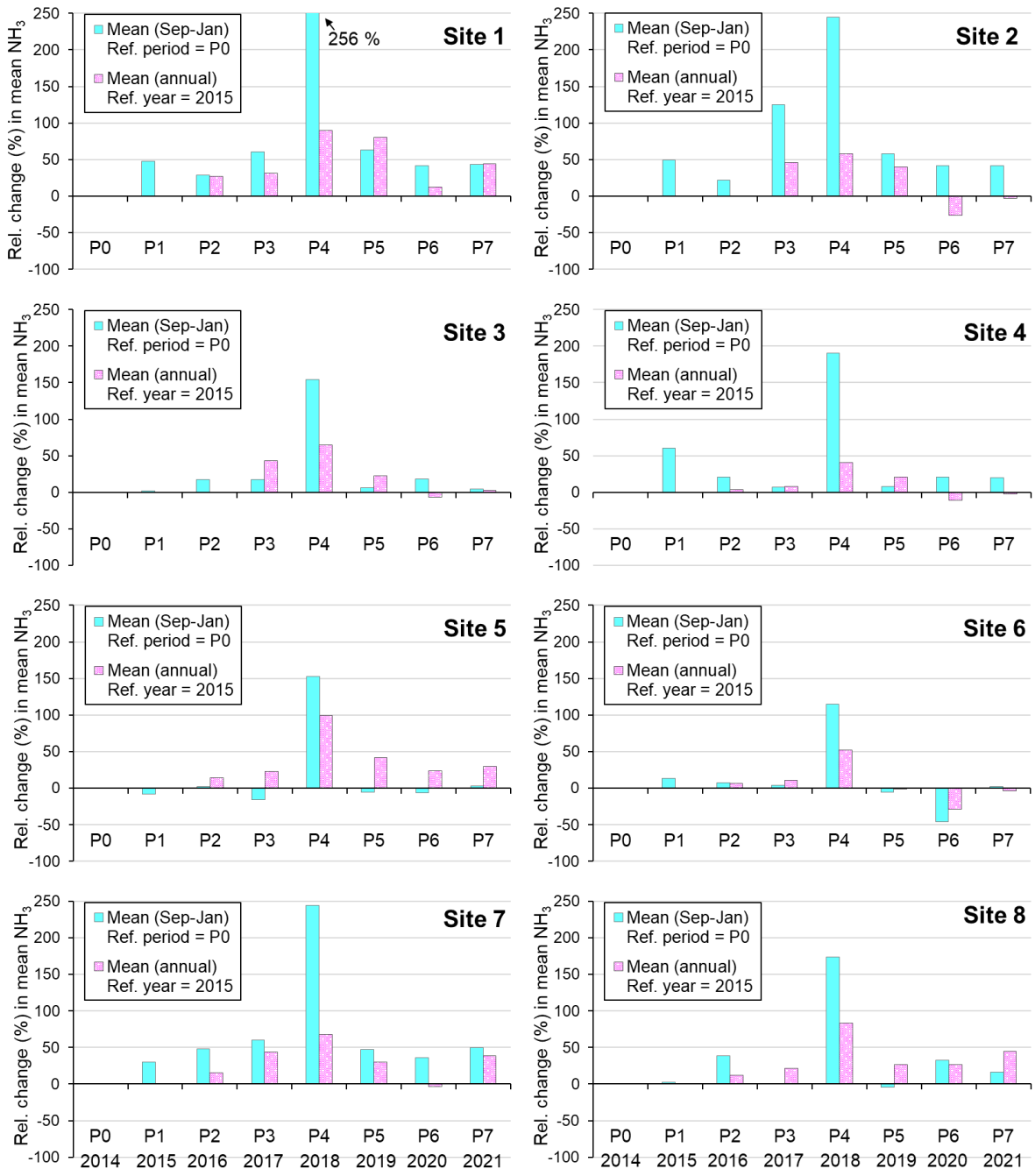

Figure 5: Trends in % relative change in mean monitored NH_3 concentrations since stocking and operation of new poultry houses at Ballynahone Bog in 2014. Two averaging periods were considered: i) 5-month mean (Sep-Jan): reference period = P0 "pre-population" period (mean of Sep14 – Jan15) and ii) annual mean (reference year = 2015). P1 = Sep14-Jan15, P2 = Sep15-Jan16, P3 = Sep16-Jan17, P4 = Sep17-Jan18, P5 = Sep18-Jan19, P6 = Sep19-Jan20, P7 = Sep20-Jan21.

Period 4:

Period 4 (P4: Sep 18 – Jan 19) was different from other years, with significantly elevated NH_3 concentrations at all sites (

Table 2, Figure 4). This is illustrated in Figure 5, where the percentage changes in mean NH_3 concentrations are plotted, relative to the "pre-population" reference period (P0). Data above the zero line indicate an increase in mean NH_3 concentrations. Conversely, data below the zero line indicate a decrease relative to the "pre-population" period. This shows, for example, that NH_3 concentrations at the background Site 8 were twice as high in period 4 (mean = 3.0 µg m^{-3}), compared with the other five "post-population" periods (mean = 1.0 – 1.5 µg m^{-3}, *n* = 5) (

Table 2). Investigations by the local site operator indicated that illegal spreading of slurry on the bog may have occurred over that period.

When period 4 data are excluded, increases in NH_3 concentrations were still observed at Sites 1 – 4 along the NE transect (Figure 4, Figure 5).The largest increase of 59 % occurred at Site 2 (mean = 3.5 µg m^{-3} (*n* = 5), *cf*. P0 = 2.2 µg m^{-3}), followed by Site 1 with an increase of 48 % (mean = 3.5 µg m^{-3} (n = 5), *cf*. P0 = 2.3 µg m^{-3}). Although this appears to suggest possible enhancement of NH_3 concentrations from the poultry farm established in 2014, it has to be noted that there is only one period of pre-population data available as the baseline.

Site 6:

At Site 6, the mean concentrations were similar between all periods (Figure 4, Figure 5). This suggests the presence of another local source influencing this location. As this was the case for both the pre- and post-population measurements, the high concentration is unlikely to be from the poultry farm. Smells from the nearby pig farm were noted for this location, which points to the pig farm as the likely emission source influencing this location. By contrast, Site 7 on the opposite side of the transect from Site 6 showed an increase (30 – 60 %, P4 excluded) in concentrations (Figure 4, Figure 5). This points to a possible influence of poultry emissions on Site 7, since this is downwind of the new poultry houses.

Background Site:

An indicative “background” site was established approx. 1.6 km to the southeast of the poultry farm. Mean NH_3 concentrations at this site were 1.1 µg m^{-3} for pre- (Sep14 - Jan15) and 1.2 µg m^{-3} post-population (mean of 6 years, with matched months, P4 excluded), respectively.

Transect:

Further comparisons of NH_3 concentrations along the NE transect, before and after population of the poultry housing, were made in Figure 6 and Figure 7. Following population of the poultry housing, NH_3 concentrations along the transect showed an increase at the location closest to the housing (30 m; mean = 4.3 µg m^{-3}, *n* = 6), with similar concentrations at both 173 m (mean = 4.2 µg m^{-3}, *n* = 6) and 275 m (mean = 3.9 µg m^{-3}, *n* = 6). This declined to a smaller mean concentration of 2.7 µg m^{-3} (*n* = 6) at the end of the transect (638 m), similar to the pre-population mean concentration of 2.3 µg m^{-3}.

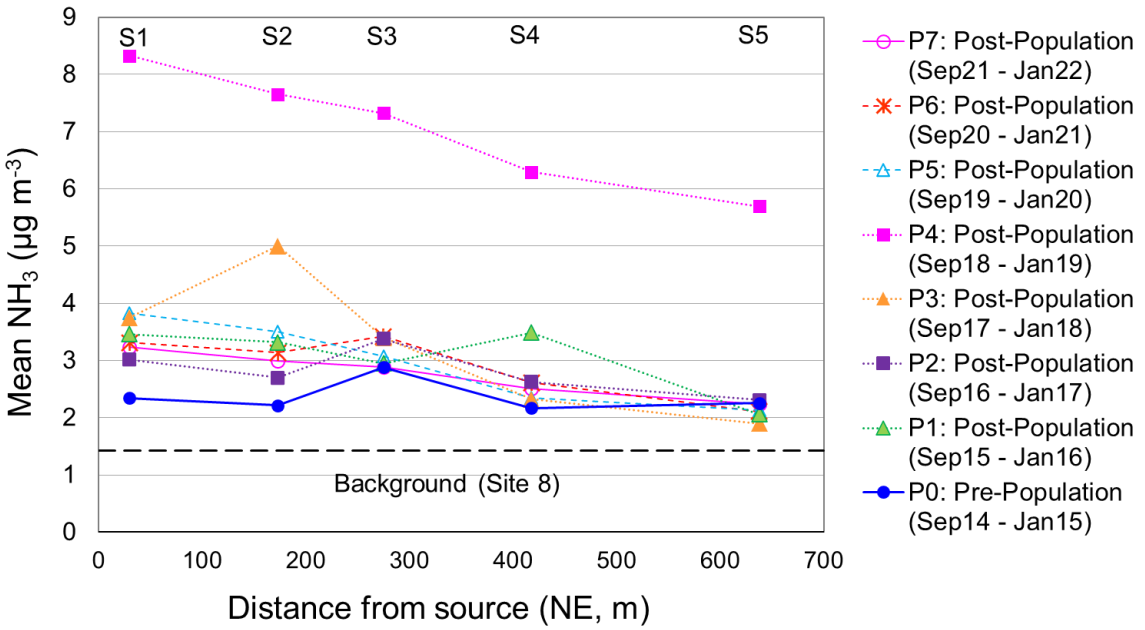

Figure 6: Monitored mean NH_3 concentrations, pre-population (P0) and post-population (P1 to P7) at the five monitoring sites (Sites 1 – 5) along the SW-NE transect. The averaged NH_3 concentrations from Site 8 for P1 to P7 is also plotted to show the indicative "background" NH_3 concentration for the site.

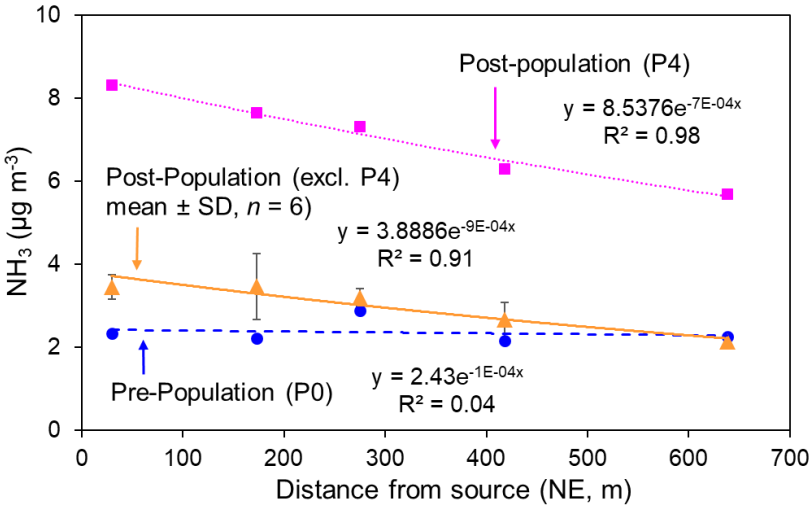

Figure 7: Monitored mean NH_3 concentrations, pre-population (P0: Sep14-Jan15) and post-population (mean of 6 periods, P4 excluded) along SW-NE transect downwind of poultry farm. P4 is plotted as a separate line, as this was an unusual period, affected by an extended pollution episode across the entire site.

The anomalously high concentrations in period 4 can clearly be distinguished from all other periods (Figure 6, Figure 7). Disregarding Period 4, the NE transect showed an enhancement of NH_3 concentrations at the two sites closest to the poultry housing (Sites 1 and 2) (Figure 6, Figure 7). The increases in concentrations at Sites 1 and 2 were about 1 µg m^{-3} on average. This suggests that the largest concentrations in the elevated NH_3 plume emitted from the 16 m chimney stack are missed by measurements that are made at 1.5 m above ground. The increased emission height resulted in smaller ground-level NH_3 concentrations in the immediate vicinity than would occur from, for example, naturally ventilated poultry sheds (e.g. Pitcairn et al., 1998, Tang et al., 2005). Additional measurements at different heights above ground along the transect would be necessary to quantify the vertical concentration profile. Similar results were observed in a study elsewhere in Northern Ireland where a ridge fan ventilated poultry house with similar bird stocking rates provided lower NH_3 concentrations in the immediate vicinity than a naturally ventilated poultry house (Tang et al. 2005).

Depending on the meteorology, the effects of building downwash may be expected to carry some of the emitted plume closer to ground level. This effect could have contributed to the larger mean concentrations of 5.0 µg m^{-3} at Site 2 (173 m; Period 3: Sep17 - Jan18) (Figure 6,

Table 2). However, spikes in NH_3 concentrations occurred in September 2017 (10 µg m^{-3}) and October 2017 (6.0 µg m^{-3}) when manure spreading normally takes place, so the larger concentrations at the 173 m location could also be affected by emissions from other nearby farming activities.

4.2 Trends in annual NH_3 concentrations

Annual mean monitored NH_3 concentration data from all sites between 2014 and 2022 are compared in Figure 8 to Figure 9. Monthly and annually averaged NH_3 data are provided in

Table 3 to Table 8. Full details of exposure information and air concentration measurements for each site are presented in Appendix 6.2.

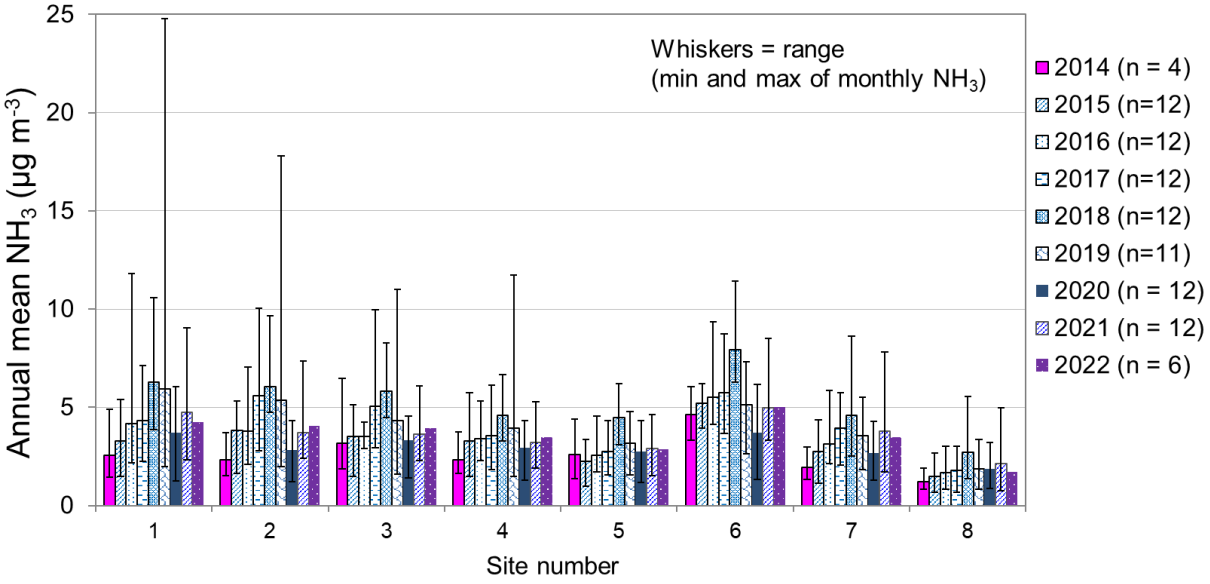

Figure 8: Summary graph comparing annual mean NH_3 concentrations at all sites between September 2014 and June 2022. 2014 and 2022 are incomplete years, with measurements starting in September 2014 and ending in June 2022.

2014 mean data were from 4 months only (September to December) and is shown for illustrative purpose only and is not intended for comparing with annual mean data from 2015 to 2021. 2018 stands out as the year with the highest NH_3 concentrations at all sites (Figure 8, Figure 9). The largest annual mean concentrations in 2018 was due to an extended pollution episode over the last 3 months (see Sect. 4.1) which was of sufficient magnitude to produce substantially elevated annual mean concentrations, compared with other years (2015 – 2021).

March 2019 also saw very high concentrations at Sites 1 (25 µg m^{-3}) to 4 (12 µg m^{-3}) along the NE transect (Table 6). The peak in concentrations occurred in one month only (March 2019), so that the 2019 annual mean concentrations were smaller than 2018 at Sites 1 – 4, but are larger than all previous years. Disregarding 2018, annual mean NH_3 concentrations have increased since 2015 at Sites 1 - 4 along the NE transect (Figure 8, Figure 10) and also at Site 7 (Figure 8) that are downwind of the new poultry installation.

Annual mean concentrations in 2020, with the exception of Sites 5 and 8 (furthest from the influence of the poultry farm) were smaller than previous years (2015 – 2018) and in 2021 and 2022. In 2020, the poultry houses were emptied and cleaned, and were

non-operational for 8.5 months. A detailed assessment of NH_3 data from 2020, compared with earlier years (2015 – 2019), is provided in a separate report (Tang et al., 2021b).

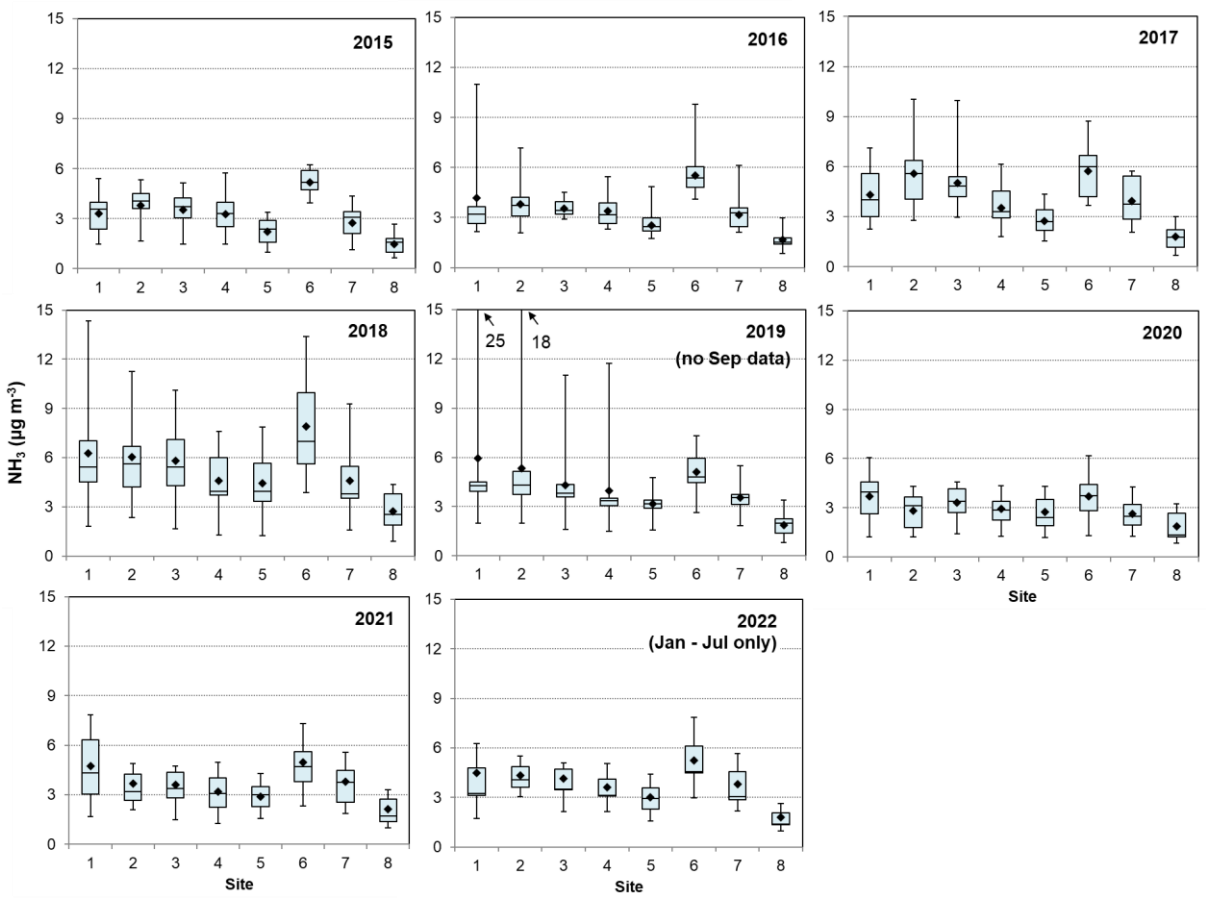

Figure 9: Annual mean monitored mean NH_3 concentrations for 2015 to 2022 (2022 = 7 months of data only) at each site. The diamonds in the boxplots show the mean, with grey box indicating the median and interquartile range, while the whiskers show the range (minimum and maximum).

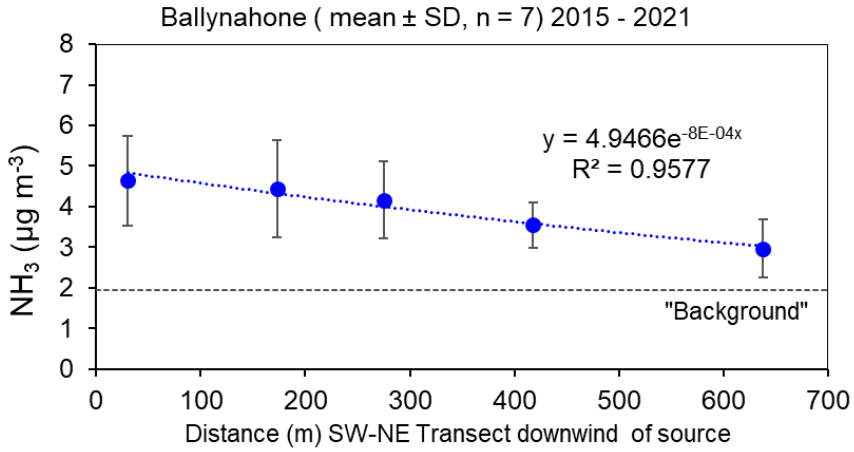

Figure 10: Profile in annually averaged NH_3 concentrations along transect (SW-NE: Sites 1 - 5) downwind of poultry farm. Each data point represents the mean ± SD of 7 years of data (2015 – 2021). The "background" concentrations provided by Site 8 is plotted on the graph as a dotted line, to show enhancement of NH_3 concentrations above background at the other sites.

The smallest NH_3 concentrations were measured at the background Site 8, with annual mean concentration of 2.7 µg m^{-3} in 2018, and between 1.5 to 1.9 µg m^{-3} for other years. Site 5 at the end of the NE transect showed the next smallest NH_3 concentrations that are also consistent between years (2.2 to 3.2 µg m^{-3}; 2018 = 4.5 µg m^{-3}). This site is located furthest from the influence of the poultry houses and from the pig farm.

The largest annual mean concentrations were observed at Site 6 (Figure 8). They are likely to be influenced by NH_3 emissions from the local pig farm, located upwind of this site. Frequent field records of strong smell coming from the direction of the pig farm at this site provided corroborating evidence. With the exception of 2018 (7.9 µg m^{-3}), annual mean concentrations at this site showed little change between 2015 (5.2 µg m^{-3}) and 2019 (5.1 µg m^{-3}).

The Critical Level (CLe) of annual mean NH_3 concentrations of 1 µg m^{-3} for protection of lichens-bryophytes were exceeded at all sites. All sites, except Site 8, also exceeded the CLe of annual mean concentrations of 3 µg m^{-3} for the protection of higher vegetation.

Table 3: Monitored monthly and annually averaged NH_3 concentrations at the 8 Ballynahone Bog sites in 2015.

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Jan-15	1.49	1.73	1.69	1.48	1.22	3.95	1.18	0.69
Feb-15	3.57	3.98	3.71	2.95	2.39	5.71	2.95	1.75
Mar-15	4.07	4.77	4.69	4.14	-	6.22	3.70	2.67
Apr-15	3.73	4.38	4.20	3.57	2.82	5.22	3.41	1.77
May-15	3.34	4.62	3.97	2.37	1.72	4.45	3.20	1.09
June-15	3.91	5.32	5.13	3.98	3.37	5.88	4.35	2.01
July-15	2.44	4.12	3.48	2.58	2.01	4.96	2.40	1.80
Aug-15	2.33	3.99	3.57	3.05	2.49	5.18	2.50	1.28
Sep-15	4.20	4.49	4.27	3.63	3.11	6.10	3.41	1.41
Oct-15	5.40	3.82	-	4.02	2.99	5.91	3.26	1.94
Nov-15	-	1.65	1.47	5.75	0.99	4.83	1.15	0.72
Dec-15	1.79	2.93	2.65	1.75	1.49	3.97	1.34	0.66
Mean of 12 months	**3.30**	**3.82**	**3.53**	**3.27**	**2.23**	**5.20**	**2.74**	**1.48**
Time-weighted annual mean, 2015	**3.32**	**3.86**	**3.59**	**3.24**	**2.33**	**5.26**	**2.79**	**1.50**

Table 4: Monitored monthly and annually averaged NH3 concentrations at the 8 Ballynahone Bog sites in 2016.

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Jan-16	2.44	3.69	3.42	2.30	1.73	4.67	2.14	0.83
Feb-16	3.22	3.75	-	3.60	2.07	4.99	3.29	1.46
Mar-16	11.8	7.04	-	5.32	4.57	9.34	5.86	3.01
Apr-16	3.58	3.79	3.72	3.26	2.54	4.90	3.39	1.87
May-16	2.83	3.47	3.43	4.09	2.73	-	3.26	2.37
June-16	-	-	-	5.14	2.25	5.43	2.82	1.33
July-16	5.84	4.82	4.26	3.18	2.66	5.70	3.33	1.49
Aug-16	3.43	4.36	4.05	3.09	2.62	5.53	3.27	1.58
Sep-16	5.34	3.76	3.68	3.19	2.79	5.93	3.38	1.78
Oct-16	3.03	2.72	3.08	2.72	2.30	4.74	2.45	1.45
Nov-16	2.29	2.14	2.90	2.34	1.94	5.38	2.14	1.57
Dec-16	2.17	2.10	3.20	2.39	2.37	4.11	2.47	1.18
Mean of 12 months	**4.18**	**3.78**	**3.53**	**3.38**	**2.55**	**5.52**	**3.15**	**1.66**
Time-weighted annual mean, 2016	**4.39**	**3.88**	**3.55**	**3.42**	**2.59**	**5.60**	**3.21**	**1.68**

Table 5: Monitored monthly and annually averaged NH_3 concentrations at the 8 Ballynahone Bog sites in 2017.

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Jan-17	2.26	2.79	4.04	2.51	2.13	3.93	2.46	1.53
Feb-17	3.39	4.82	4.84	3.26	2.76	-	3.37	1.94
Mar-17	7.13	7.58	-	6.13	4.34	8.73	5.39	3.02
Apr-17	6.35	5.58	9.96	4.62	3.57	7.19	5.73	3.00
May-17	4.73	6.12	5.63	4.72	3.67	7.45	5.55	2.66
Jun-17	5.34	6.59	5.93	4.53	3.36	6.06	5.64	2.08
Jul-17	3.12	5.35	4.58	3.06	2.26	4.47	3.69	1.64
Aug-17	2.66	-	5.15	3.32	2.62	5.90	3.01	1.17
Sep-17	6.33	10.0	5.05	3.17	2.21	6.15	3.80	1.12
Oct-17	4.62	6.02	4.37	3.54	2.94	5.98	4.39	2.04
Nov-17	3.01	3.29	2.95	1.81	1.54	3.68	2.06	0.69
Dec-17	3.01	3.29	2.95	1.81	1.54	3.68	2.06	0.69
Mean of 12 months	**4.33**	**5.59**	**5.04**	**3.54**	**2.75**	**5.75**	**3.93**	**1.80**
Time-weighted annual mean, 2017	**4.40**	**5.69**	**5.09**	**3.55**	**2.74**	**5.76**	**3.98**	**1.83**

- An event appears to have occurred in March and a strong smell was noted. There was no information on the source of this strong smell.
- Nov+Dec = 2 month exposure.
- The poultry farm was cleared at the end of 2017.

Table 6: Monitored monthly and annually averaged NH3 concentrations at the 8 Ballynahone Bog sites in 2018.

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Jan-18	1.81	2.36	1.67	1.31	1.25	3.87	1.60	0.90
Feb-18	3.49	3.64	3.57	2.76	2.40	4.91	2.80	1.79
Mar-18	6.41	3.95	4.52	3.96	3.97	5.53	3.86	2.93
Apr-18	4.49	4.29	4.94	3.74	3.33	5.88	3.76	2.54
May-18	5.42	5.07	3.62	-	4.43	-	4.23	-
Jun-18	6.63	6.33	6.41	5.56	5.38	-	5.05	3.95
Jul-18	4.54	4.74	5.41	3.71	3.49	7.06	3.50	2.25
Aug-18	4.77	6.26	5.64	4.37	3.92	7.57	3.52	2.03
Sep-18	5.48	6.19	5.49	3.88	3.31	6.95	3.70	1.47
Oct-18	9.64	10.6	9.16	7.29	6.49	13.4	9.29	3.98
Nov-18	8.18	7.75	9.25	7.60	7.71	13.3	6.82	4.38
Dec-18	14.4	11.2	10.1	6.42	7.85	10.8	7.07	3.66
Mean of 12 months	**6.27**	**6.03**	**5.82**	**4.60**	**4.46**	**7.92**	**4.60**	**2.72**
Time-weighted annual mean, 2018	**6.01**	**5.82**	**5.67**	**4.61**	**4.37**	**7.79**	**4.54**	**2.66**

- Site 3: strong smell from direction of pig farm was noted by site operator when collecting in August samples.
- Temporary sheep enclosure near sampling site 1 from Sep-Dec18.
- Unusually high concentrations measured between Oct to Dec 2018.

Table 7: Monitored monthly and annually averaged NH3 concentrations at the 8 Ballynahone Bog sites in 2019.

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Jan-19	3.97	2.51	2.58	-	3.10	3.80	3.06	1.34
Feb-19	4.10	4.28	3.67	3.61	3.09	5.98	3.82	2.31
Mar-19	24.8	17.8	11.0	11.7	3.96	7.30	4.87	2.42
Apr-19	3.89	3.60	3.83	3.40	3.28	4.79	3.54	3.38
May-19	4.66	3.86	3.48	3.30	3.19	4.50	3.66	2.23
Jun-19	3.53	5.48	4.53	3.34	3.53	4.39	2.85	1.52
Jul-19	4.27	4.62	4.17	3.43	4.77	5.94	3.61	2.21
Aug-19	5.60	5.57	4.90	3.52	3.29	6.99	5.50	2.00
Sep-19	-	-	-	-	-	-	-	-
Oct-19	4.32	4.31	3.79	2.98	2.71	4.79	3.19	1.40
Nov-19	1.98	1.98	1.61	1.49	1.56	2.63	1.84	0.83
Dec-19	4.32	4.79	4.00	2.72	2.36	5.20	3.16	0.95
Mean of 12 months	**5.95**	**5.34**	**4.32**	**3.95**	**3.17**	**5.12**	**3.55**	**1.87**
Time-weighted annual mean, 2019	**6.28**	**5.49**	**4.40**	**4.06**	**3.19**	**5.15**	**3.53**	**1.88**

- Note: Sep = all exposed samples lost in the post while in transit to the laboratory

Table 8: Monitored monthly and annually averaged NH3 concentrations at the 8 Ballynahone Bog sites in 2020.

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Jan-20	4.70	2.94	2.88	2.19	1.92	4.36	2.04	0.97
Feb-20	2.36	1.29	1.39	1.28	1.19	3.06	1.28	0.85
Mar-20	6.06	4.31	4.56	4.34	4.32	6.16	4.29	3.22
Apr-20	6.06	4.31	4.56	4.34	4.32	6.16	4.29	3.22
May-20	4.50	3.28	3.85	3.64	3.53	4.45	3.75	2.87
Jun-20	3.44	1.95	2.06	3.32	2.90	3.62	3.00	1.37
Jul-20	2.72	2.23	2.44	2.25	-	3.83	2.28	1.30
Aug-20	1.24	1.22	4.17	2.92	-	-	1.68	2.59
Sep-20	1.24	1.22	4.17	2.92	-	-	1.68	2.59
Oct-20	4.51	3.47	3.40	2.82	2.41	1.31	2.64	1.34
Nov-20	4.51	3.47	3.40	2.82	2.41	1.31	2.64	1.34
Dec-20	3.12	4.29	2.81	2.24	1.84	2.72	2.25	0.94
Mean of 12 months	**3.70**	**2.83**	**3.31**	**2.92**	**2.76**	**3.70**	**2.65**	**1.88**
Time-weighted annual mean, 2020	**3.79**	**2.97**	**3.33**	**3.01**	**2.90**	**3.66**	**2.80**	**1.88**

- Note: Mar+Apr, Aug+Sep, Oct+Nov = 2 month exposures.

Table 9: Monitored monthly and annually averaged NH_3 concentrations at the 8 Ballynahone Bog sites in 2021.

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Jan-21	3.18	3.25	3.31	2.26	1.77	4.43	2.60	0.96
Feb-21	2.58	2.40	2.43	2.16	2.16	3.66	2.25	1.59
Mar-21	6.68	5.15	5.00	3.96	3.83	6.55	4.51	3.00
Apr-21	6.23	4.27	4.62	4.34	3.36	6.41	4.98	3.87
May-21	4.26	3.10	3.20	2.97	2.48	3.77	3.76	1.89
Jun-21	9.06	7.35	6.09	5.28	4.63	8.50	7.80	4.99
Jul-21	5.37	4.26	4.27	4.25	3.61	5.01	4.42	2.67
Aug-21	6.80	3.78	3.50	3.22	2.99	4.01	3.97	1.65
Sep-21	4.42	3.09	3.43	3.39	3.04	5.34	3.23	1.51
Oct-21	3.47	2.71	2.95	2.66	2.42	5.04	-	1.78
Nov-21	2.69	2.54	2.27	1.99	-	3.82	2.51	0.99
Dec-21	2.34	2.54	2.33	1.89	1.54	3.32	1.71	0.77
Mean of 12 months	**4.76**	**3.70**	**3.62**	**3.20**	**2.89**	**4.99**	**3.79**	**2.14**
Time-weighted annual mean, 2021	**4.77**	**3.71**	**3.59**	**3.17**	**2.92**	**4.90**	**3.75**	**2.10**

Table 10: Monitored monthly and annually averaged NH_3 concentrations at the 8 Ballynahone Bog sites in 2022.

Exposure Month	Measured Mean Ammonia Concentrations (µg NH_3 m^{-3})							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Jan-22	3.22	4.06	3.47	2.58	1.96	4.55	2.5	1.06
Feb-22	3.13	3.36	3.2	3.06	3.45	4.17	2.67	1.26
Mar-22	9.10	5.34	6.04	5.26	4.33	6.85	6.12	3.42
Apr-22	3.13	3.61	3.49	3.13	2.29	4.48	3.06	1.40
May-22	3.13	3.61	3.49	3.13	2.29	4.48	3.06	1.40
Jun-22	3.68	4.40	4.01	3.69	2.93	5.53	3.42	1.76
Mean of 7 months	**4.47**	**4.35**	**4.16**	**3.63**	**3.00**	**5.25**	**3.79**	**1.81**
Time-weighted annual mean, 2022	**5.35**	**5.20**	**4.91**	**4.19**	**3.51**	**6.17**	**4.57**	**2.14**

- Note: Jun + Jul = 2 month exposures.

4.3 Temporal Trends

4.3.1 Annual Seasonal Cycles

The site-averaged annual seasonal cycles in NH_3 concentrations from September 2014 to July 2022 are compared in Figure 11. Similar trends are observed for most years, with smallest concentrations in the cooler, wetter winter months (November to January, Figure 12). 2018 was an exceptional year, with substantially elevated NH_3 concentrations between October and December 2018 (Figure 11), due to a pollution episode (details unknown).

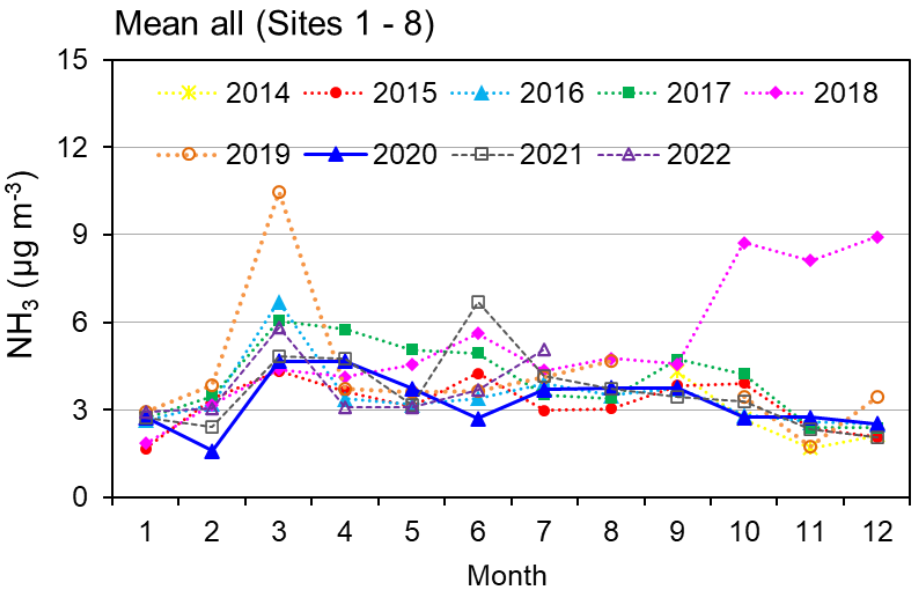

Figure 11: Annual seasonal cycles in NH_3 concentration from 2014 to 2022 at Ballynahone Bog. Each data point represents the mean of monthly measurements of all 8 sites for each year.

The annual spring peaks in March, larger than the autumn peaks in September, coincided with the main period of manure application being in spring. Larger concentrations were also generally seen in the summer than in the winter, due to warmer and drier conditions in the summer months (Figure 12) promoting volatilization

of NH_3 from surfaces. NH_3 emissions resulting mostly from agriculture are strongly influenced by climatic interactions. As a rule of thumb, NH_3 volatilization potentially almost double for every 5°C increase in temperature, according to solubility and dissociation thermodynamics (Sutton et al., 2013).

In February 2020, NH_3 concentrations were noticeably much smaller than other years. While the mean temperature for February 2020 was within the normal range for Northern Ireland (Figure 12**Error! Reference source not found.**), this was an exceptionally wet month, with twice as much rain as normal (223 mm *cf*. 10-year mean of 120 mm (2014-2022) (Figure 12).

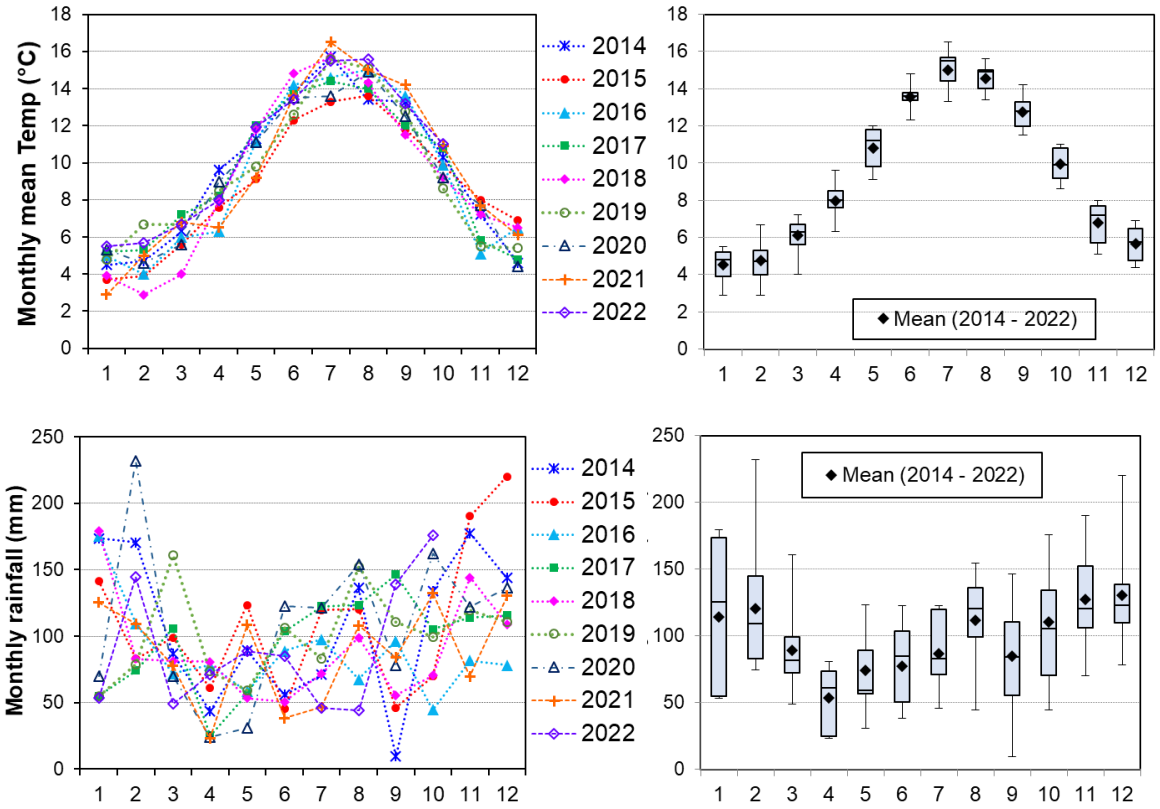

Figure 12: 9-year averaged seasonal cycles in temperature (top panel) and rainfall (bottom panel) (2014 to Oct 2022) in Northern Ireland (https://www.metoffice.gov.uk/pub/ data/weather/uk/climate/datasets/, accessed 18/11/2022). The diamonds in the boxplots show the mean, with the grey boxes indicating the median and interquartile range, while the whiskers show the range (minimum and maximum). Please note this is national data, and not data from on-site met station. September 2014 was an exceptionally dry month (9.5 mm *cf.* 9-year mean = 85 mm). November (190 mm *cf*. 8-year mean = 127mm) and December 2015 (220 mm *cf*. 8-year mean = 131 mm) were very wet months. February and June 2020 also had above average rainfall. February 2020 = 145 mm cf. 9-year mean = 121 mm and June 2020 = 123 mm *cf*. 9-year mean = 77 mm.

4.3.2 Seasonal trends at individual sites

The mean annual seasonal cycle for each of the 8 monitoring sites on the bog are compared in Figure 13 and Figure 14. This shows similar seasonal profiles between sites, with smallest concentrations in the winter and highest in March, but varying in

magnitude of concentrations. Since manure is most often spread in spring and autumn, this effect is revealed in peaks of concentrations during these seasons. 2018 was an unusual year, with elevated concentrations between October and December 2018, as already discussed in Sect. **Error! Reference source not found.**.

Elevated concentrations in the summer months are likely driven by increased volatilization of NH_3 (e.g. high-density grazing livestock) in warmer summer temperatures. February 2020 was unusually wet, and slurry spreading activity would have been delayed. This is reflected by smaller than normal NH_3 concentrations at all sites in February 2020.

At the background Site 8, the winter minima (mean = 1.3 µg m^{-3}) were 4 times smaller than the most polluted Site 6 (5.2 µg m^{-3}). The influence of spring and autumn manure spreading is also evident at this site, with small peaks in concentrations observed in the seasonal profile matching these periods (Figure 13).

A very large peak in NH_3 can also be seen in March 2019 at Sites 1 – 4 along the transect away from the poultry farm. The concentration was largest at Site 1 (25 µg m^{-3}) and declined by half to 12 µg m^{-3} at Site 4. This suggests influence from the poultry housing, and possible influence by manure spreading in fields upwind of the transect.

Site 1 (30 m downwind of poultry housing) had the most pronounced spring peak, with very large variability in concentrations in the March peak (mean = 10 µg m^{-3}, range = 4 – 25 µg m^{-3}).

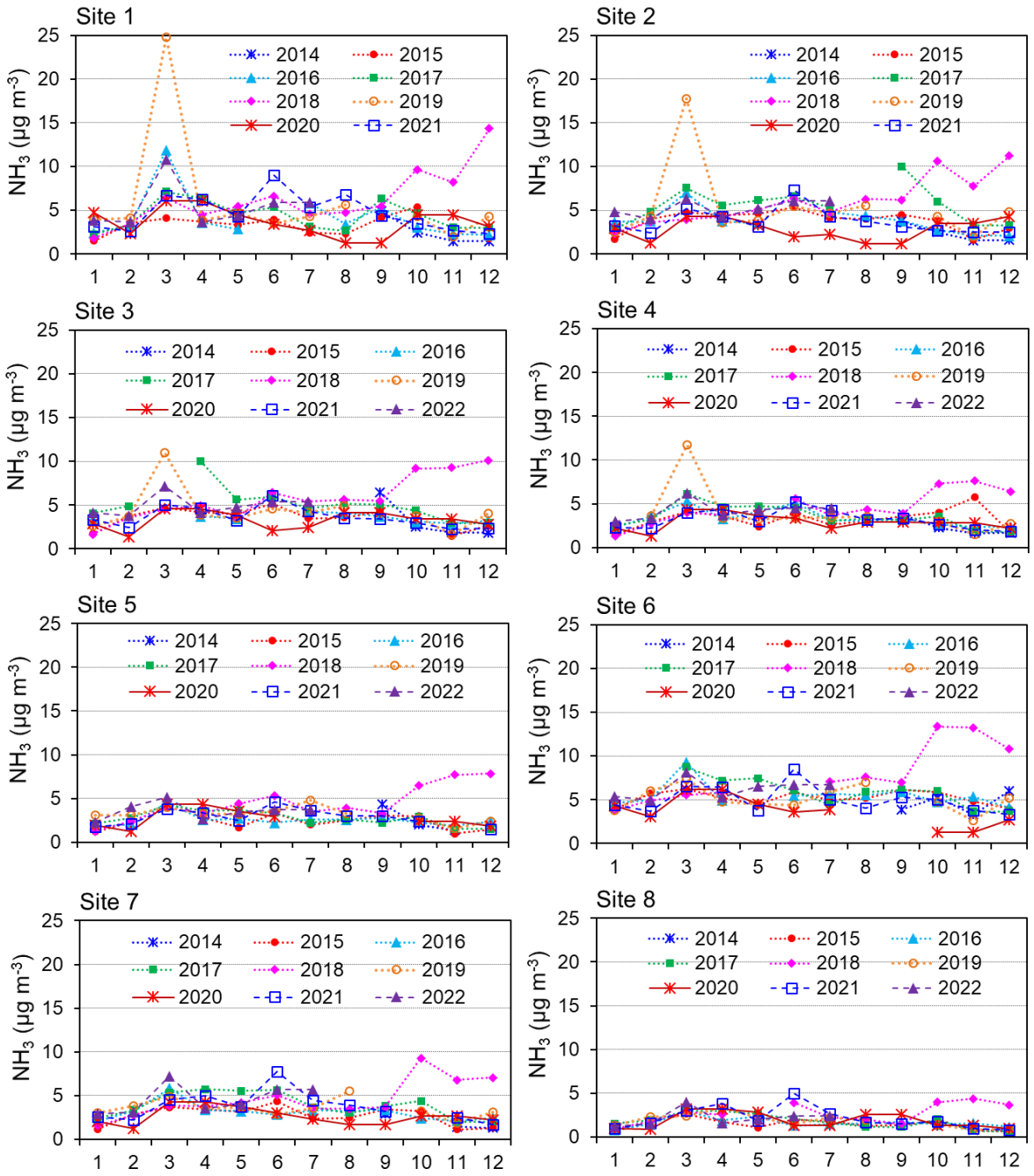

Figure 13: Annual seasonal cycles in atmospheric NH_3 gas concentrations (2014 to 2022) at each of the eight Ballynahone Bog sites. All graphs are plotted on the same scale to allow comparisons of magnitude of concentrations between sites.

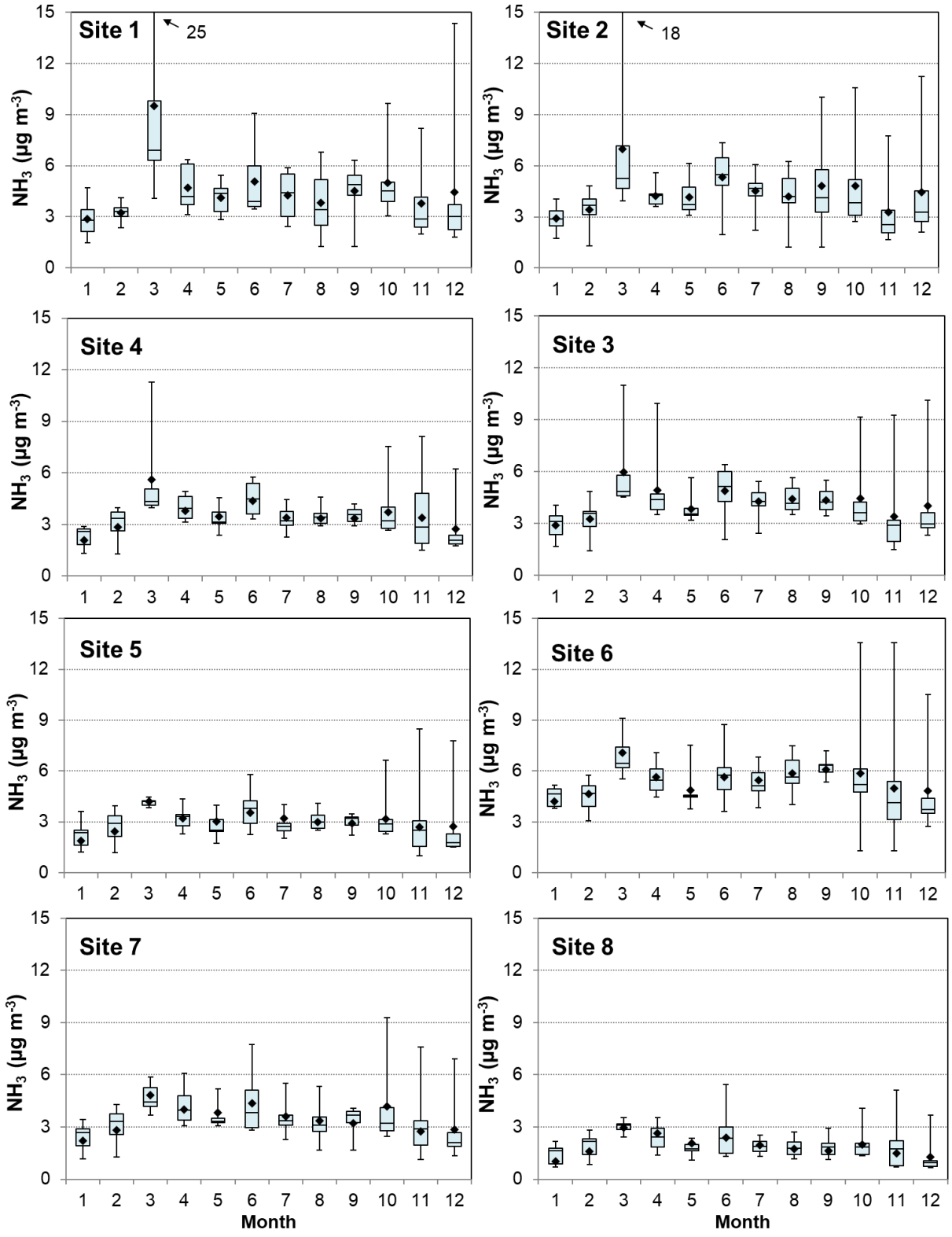

Figure 14: 7-year averaged seasonal cycle in atmospheric NH_3 gas concentration at the eight monitoring sites (Sites 1 to 8) in the Ballynahone Bog study area. The diamonds in the boxplots show the mean (2015 – 2021, *n* = 7), with the grey boxes indicating the median and interquartile range, while the whiskers show the range (minimum and maximum).

5. Conclusion

5.1 Impact of the poultry farm on NH_3 concentrations

The period before population of the poultry housing (P0: September 2014 – January 2015) is the reference baseline. NH_3 concentrations in P0 showed little variations along the transect away from the poultry farm. Similar concentrations were observed at Site 1 at the beginning (30 m; mean = 2.3 µg m^{-3}; range = 1.4 – 4.9 µg m^{-3}) and Site 5 at the end of transect (638 m; mean = 2.3 µg m^{-3}; range = 1.2 – 4.4 µg m^{-3}). Larger concentrations at Site 3 along the transect (275 m; mean = 2.9 µg m^{-3}; range = 1.7 – 6.5 µg m^{-3}) indicate potential influence of local NH_3 emissions at this location (sources unknown). The highest monitored concentrations at Site 6 (mean = 4.5 µg m^{-3}; range = 3.3 – 6.1 µg m^{-3}) suggests that this location is potentially influenced by emissions from the upwind pig farm 250 m away. Smallest concentrations were seen at the background Site 8 (mean = 1.1 µg m^{-3}; range = 0.7 – 1.9 µg m^{-3}).

- P0 was compared with 6 years of post-population data (P1 – P6: 2015 – 2021) from the corresponding months of each year, as P0 only covered September-January. The comparison using only the matched months avoids any bias due to seasonal variations in NH_3 concentrations (e.g. from influence of weather and local agricultural practices, such as manure spreading).
- P4 (Sep 18 – Jan 19) was affected by an extended pollution episode across the bog during October to December 2018, with significantly elevated NH_3 concentrations at all sites, compared with all other periods. The mean concentrations for P4 were on average 217 % (Site 2) to 271 % (Site 5) larger than the mean of the other five "post-population" periods (Site 2: P4 mean = 7.7 µg m^{-3} *cf.* mean of 5 periods = 4.2 µg m^{-3}; Site 5: P4 mean = 5.7 µg m^{-3} *cf.* mean of 5 periods = 2.1 µg m^{-3}). Background Site 8 was also affected, with a mean concentration of 3.0 µg m^{-3} in P4, compared with a mean concentration of 1.2 µg m^{-3} from the other 5 periods.
- When P4 is excluded from analysis, all sites across the bog, except Sites 5 and 6, increased in mean NH_3 concentrations, compared with the baseline P0.
- The increase in mean NH_3 concentrations at the two sites closest to the poultry housing was by 1.1 µg m^{-3} (Site 1) and 1.3 µg m^{-3} (Site 2), on average.
- Sites 1 and 2 provided similar concentrations (mean = 3.5 µg m^{-3}, n = 5). This declined to a mean concentration of 2.1 µg m^{-3} (n = 5) at the end of the transect (Site 5, 638 m). An exponential decay curve fitted to the transect data (Sites 1 to 5) provided R^2 value of 0.94 (P4 excluded). This supports the hypothesis that the poultry farm is a local emission source contributing to elevated NH_3 levels

across the bog, with NH_3 concentrations decreasing with increasing distance from the farm.

- At the end of the transect (Site 5, 638 m), the mean concentration of 2.1 µg m^{-3} (*n* = 5, P4 excluded) was comparable to the pre-population mean concentration of 2.3 µg m^{-3}. This suggests that the influence of the poultry farm is strongest at the first four points of the transect.

- The small enhancement in NH_3 concentrations at Sites 1 and 2, and in particular the similar concentrations between the 2 sites, suggests that the largest concentrations in the elevated NH_3 plume emitted from the 16 m tall chimney stack were largely missed by measurements made at 1.5 m above ground. Depending on the meteorology, the effects of building downwash may be expected to carry some of the emitted plume closer to ground level, which led to small enhancement in ground level NH_3 concentrations.

- The increased emission height therefore resulted in smaller ground-level NH_3 concentrations in the immediate vicinity than would occur from poultry sheds with emissions closer to the ground, e.g. with side-ventilation. This in turn will provide lower NH_3 dry deposition downwind of the poultry housing, but with a larger fraction of the emitted NH_3 contributing to longer-range air pollutant transport.

- The largest NH3 concentrations were measured at Site 6 (320 m north of the poultry farm and 250 NE of pig farm) (4.3 ± 1.1 µg m-3 (mean ± SD, n = 5), P4 excluded). This is similar to the P0 mean concentration of 4.5 µg m-3. Site 6 is therefore assumed to be mostly affected by emissions from the nearby pig farm, with near source enhancement from the poultry farm when the wind is blowing from the south.

- By contrast, Site 7 on the opposite (eastern) side of the transect from Site 6 showed an increase in mean concentrations by 0.8 µg m^{-3} (mean = 2.5 ± 0.20 µg m^{-3} (mean ± SD, *n* = 5), P4 excluded). This points to a possible influence of poultry emissions on Site 7, since this is downwind of the poultry houses.
- The smallest concentrations (1.2 ± 0.22 µg m^{-3} (annual mean ± SD), *n* = 5, P4 excluded) occurred at the background Site 8 (~ 1.6 km to the east of the poultry housing). The NH_3 concentrations, while relatively small compared with the other sites on the bog, are typical of a site in an agricultural landscape, influenced by intensive livestock farming and land-spreading emissions in the area.

5.2 Trends in annual mean NH_3 concentrations

- Annual mean NH_3 concentrations increased at all sites (exception = Site 6) between 2016 and 2019, relative to 2015.
- In 2020, the poultry houses were emptied and cleaned, and were then non-operational for 8.5 months between 7 February and 20 October 2020. A detailed assessment of NH_3 data from 2020, compared with earlier years (2015 – 2019) and with 2021, is provided in a separate report (Tang et al., 2022b).
- Annual mean concentrations in 2020 at all sites (exception = Sites x and 8) were similar to 2015 first year of operation of farm), but smaller than other years (2016 – 2019 and also 2021).
- Substantially elevated annual mean concentrations in 2018 may be attributed to an extended pollution episode with significantly increased NH_3 concentrations between October and December 2018 at all monitoring sites.
- All sites, including the background site in the study were in exceedance of the annual critical level of 1 µg m^{-3} relevant for lichen-bryophyte-dominated ecosystems.
- All sites, with the exception of the background site and the site furthest from the poultry housing along the transect (638 m) exceed the critical level of annual mean NH_3 concentrations of 3 µg m^{-3} for the protection of higher vegetation.

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8. Appendices

8.1 Appendix 1. Site locations

Five monitoring locations form a transect across the bog in the approximate most frequent wind trajectory:

Site Name	Grid Ref	Lat	Long	*Distance from northern boundary of poultry farm
Site 1	IH8491897969	54.82251	-6.67945	30m
Site 2	IH8502998053	54.82325	-6.6777	173m
Site 3	IH8512898087	54.82354	-6.67615	275m
Site 4	IH8524798162	54.82419	-6.67428	418m
Site 5	IH8546798226	54.82473	-6.67084	638m

Note: updated GPS readings were taken and provided by Andy Crory (30th November 2018).
**The two new poultry houses are located 40 m south of boundary. Distance of Site 1 = 30 m + 40 m = 70 m from edge of poultry housing. The tall chimney stacks are on the northern end of each of the houses nearest the boundary with Ballynahone Bog.*

Two additional monitoring locations were installed (Site 6 and 7), one on each side of the established transect and one location to sample ambient NH_3 concentrations:

Site Name	Grid Ref	Lat	Long	Distance from poultry house
Site 6	IH8486198282	54.82533	-6.68025	320m (to the North)
Site 7	IH8517497903	54.82188	-6.67549	285m (to the South)
Site 8	IH8650197305	54.81628	-6.65503	Approx.1.6 km to the East

Please note that New GPS readings were taken and provided by Andy Crory (30th November 2018). Table updated.

Poultry house coordinates on each corner: House 1

Lat	Long
54.82227	-6.67954
54.82220	-6.67934
54.82145	-6.68005
54.82152	-6.68025

Poultry house coordinates on each corner: House 2

Lat	Long
54.82216	-6.67923
54.82210	-6.67902
54.82130	-6.67979
54.82136	-6.68000

8.2 Appendix 1. Data tables

Please note that 2022 data included in the analysis are provisional, unratified data.

Site 1

	Period							ppm NH_4^+ in 3 ml extract						NH_3 ($\mu g\ m^{-3}$)	
Site	**Year**	**Month**	**DATE OUT**	**TIME OUT**	**DATE IN**	**TIME IN**	**Time (Hrs)**	**ALPHA 1**	**ALPHA 2**	**ALPHA 3**	**mean**	**% CV**	**BLANK**	**Calibrated[1]**	**Comments**
1	2014	**9**	12/09/14	12:25	01/10/14	13:00	456.6	2.394	2.407	3.015	2.605	13.6	0.056	**4.88**	Easterly wind, no birds, no smell.
1	2014	**10**	01/10/14	13:00	03/11/14	12:40	791.7	2.247	2.231	2.294	2.257	1.5	0.051	**2.44**	Southwesterly wind, no smell.
1	2014	**11**	03/11/14	12:40	02/12/14	11:40	695.0	1.233	1.227	1.153	1.204	3.7	0.056	**1.44**	Light south westerly wind
1	2014	**12**	02/12/14	11:40	08/01/15	11:30	887.8	1.537	1.508	1.587	1.544	2.6	0.065	**1.46**	
1	2015	**1**	08/01/15	11:30	03/02/15	11:50	624.3	1.185	1.11	1.037	1.111	6.7	0.048	**1.49**	On day of collection chicken houses are 75% full. North wind.
1	2015	**2**	03/02/15	11:50	05/03/15	11:43	719.9	3.245	2.921	2.793	2.986	7.8	0.050	**3.57**	
1	2015	**3**	05/03/15	11:43	31/03/15	13:50	626.1	2.851	3.045	2.973	2.956	3.3	0.040	**4.07**	Light S. Wind, No smell
1	2015	**4**	31/03/15	13:50	06/05/15	12:00	862.2	3.620	3.875	3.696	3.730	3.5	0.051	**3.73**	Very Windy
1	2015	**5**	06/05/15	12:00	02/06/15	11:25	647.4	2.468	2.411	2.65	2.510	5.0	0.037	**3.34**	no smell/ light rain
1	2015	**6**	02/06/15	11:25	08/07/15	12:30	865.1	3.984	3.818	4.006	3.936	2.6	0.070	**3.91**	light wind, overcast, rain showers
1	2015	**7**	08/07/15	12:30	05/08/15	12:10	671.7	1.897	1.938	1.910	1.915	1.1	0.041	**2.44**	Smell around chicken houses and from pig farm
1	2015	**8**	05/08/15	12:10	04/09/15	11:30	719.3	2.080	0.969*	1.889	1.985	6.8	0.070	**2.33**	Smell from pig farm. *1 outlier rejected
1	2015	**9**	04/09/15	11:30	08/10/15	12:20	816.8	3.683	4.254	3.983	3.973	7.2	0.048	**4.20**	

1	2015	**10**	08/10/15	12:20	09/11/15	13:30	769.2	5.554	4.660	4.175	4.796	14.6	0.041	**5.40**	
1	2015	**11**	09/11/15	13:30	02/12/15	11:30	550.0	-	-	-	-	-	0.046	**-**	Strong smell from pig farm. Winds westerly.
1	2015	**12**	02/12/15	11:30	12/01/16	11:30	984.0	2.000	2.094	2.092	2.062	2.6	0.050	**1.79**	Strong smell from pig farm, NW winds.
1	2016	**1**	12/01/16	11:30	09/02/16	11:45	672.3	1.982	1.906	1.910	1.933	2.2	0.056	**2.44**	
1	2016	**2**	09/02/16	11:45	10/03/16	11:00	719.3	2.623	2.761	2.717	2.700	2.6	0.051	**3.22**	
1	2016	**3**	10/03/16	11:00	13/04/16	10:50	815.8	10.796	11.224	11.254	11.091	2.3	0.056	**11.82**	
1	2016	**4**	13/04/16	10:50	12/05/16	11:00	696.2	3.037	2.887	2.775	2.900	4.5	0.049	**3.58**	
1	2016	**5**	13/05/16	11:00	09/06/16	12:00	649.0	2.194	2.250	1.997	2.147	6.2	0.048	**2.83**	
1	2016	**6**	09/06/16	12:00	07/07/16	13:40	673.7	0.096	0.071	0.066	0.078	20.7	0.045	***0.04**	Blank values. Low outlier - rejected
1	2016	**7**	07/07/16	13:40	09/08/16	13:20	791.7	5.391	5.276	5.492	5.386	2.0	0.095	**5.84**	
1	2016	**8**	09/08/16	13:20	07/09/16	13:40	696.3	2.791	2.768	2.938	2.832	3.3	0.098	**3.43**	
1	2016	**9**	07/09/16	13:40	11/10/16	12:05	814.4	5.093	5.001	5.089	5.061	1.0	0.085	**5.34**	
1	2016	**10**	11/10/16	12:05	11/11/16	12:00	743.9	2.504	2.721	2.677	2.634	4.4	0.053	**3.03**	
1	2016	**11**	11/11/16	12:00	06/12/16	13:00	601.0	1.697	1.706	1.613	1.672	3.1	0.095	**2.29**	
1	2016	**12**	06/12/16	13:00	11/01/17	13:40	864.7	2.341	2.218	2.177	2.245	3.8	0.101	**2.17**	chicken houses not populated Nov/ Dec
1	2017	**1**	11/01/17	13:40	13/02/17	11:30	789.8	2.157	2.179	2.198	2.178	0.9	0.139	**2.26**	
1	2017	**2**	13/02/17	11:30	06/03/17	12:55	505.4	2.020	*2.868	2.087	2.054	2.3	0.091	**3.39**	house repopulated. *1 outlier rejected
1	2017	**3**	06/03/17	12:55	05/04/17	12:20	719.4	6.003	-	-	6.003		0.137	**7.13**	2 samplers missing
1	2017	**4**	05/04/17	12:20	09/05/17	11:45	815.4	5.718	6.046	6.183	5.982	4.0	0.063	**6.35**	
1	2017	**5**	09/05/17	11:45	06/06/17	12:45	673.1	3.742	3.730	3.654	3.708	1.3	0.067	**4.73**	
1	2017	**6**	06/06/17	12:45	07/07/17	12:00	743.3	4.398	4.786	4.665	4.616	4.3	0.077	**5.34**	
1	2017	**7**	07/07/17	12:00	15/08/17	11:40	935.7	3.599	3.366	3.286	3.417	4.8	0.081	**3.12**	
1	2017	**8**	15/08/17	11:40	05/09/17	12:15	504.6	1.638	1.640	1.631	1.636	0.3	0.103	**2.66**	
1	2017	**9**	05/09/17	12:15	12/10/17	14:35	890.3	6.339	6.145	7.296	6.593	9.3	0.151	**6.33**	
1	2017	**10**	12/10/17	14:35	09/11/17	12:15	669.7	3.703	3.678	3.636	3.672	0.9	0.136	**4.62**	
1	2017	**11**	09/11/17	12:15	21/12/17	11:35	1007.3	4.089	2.956	3.596	3.547	16.0	0.084	**3.01**	2 month exposure

1	2017		See Nov	-	-	-	-	-	-	-	-	-	-	**3.01**	2 month exposure
1	2018	**1**	21/12/17	11:35	24/01/18	11:59	816.4	*2.292	1.737	1.811	1.774	2.9	0.088	**1.81**	sampler 1 rejected - contaminated
1	2018	**2**	24/01/18	12:00	26/02/18	11:32	791.5	3.352	3.151	3.140	3.214	3.7	0.055	**3.49**	
1	2018	**3**	26/02/18	11:32	21/03/18	10:54	551.4	4.027	4.214	4.081	4.107	2.3	0.065	**6.41**	
1	2018	**4**	21/03/18	10:52	26/04/18	11:47	864.9	4.794	4.519	4.243	4.519	6.1	0.079	**4.49**	
1	2018	**5**	26/04/18	11:49	29/05/18	14:02	794.2	5.127	4.994	4.789	4.970	3.4	0.045	**5.42**	
1	2018	**6**	29/05/18	14:03	25/06/18	14:17	648.2	4.927	5.004	5.124	5.018	2.0	0.102	**6.63**	
1	2018	**7**	25/06/18	14:17	31/07/18	13:20	863.1	5.045	4.485	4.270	4.600	8.7	0.120	**4.54**	
1	2018	**8**	31/07/18	13:20	22/08/18	11:26	526.1	2.935	2.948	-	2.942	0.3	0.072	**4.77**	
1	2018	**9**	22/08/18	11:27	25/09/18	12:20	816.9	5.331	5.351	5.161	5.281	2.0	0.162	**5.48**	temporary sheep enclosure near samplers
1	2018	**10**	25/09/18	12:20	26/10/18	10:00	741.7	8.757	7.807	8.796	8.453	6.6	0.275	**9.64**	temporary sheep enclosure near samplers
1	2018	**11**	26/10/18	10:00	29/11/18	10:46	816.8	7.492	8.082	*30.52	7.787	5.4	0.146	**8.18**	Sampler 3 rejected: suspect sampler or sampling issue
1	2018	**12**	29/11/18	10:46	19/12/18	12:00	481.2	8.382	7.510	8.401	8.097	6.3	0.198	**14.35**	
1	2019	**1**	19/12/18	12:00	28/01/19	14:20	962.3	5.117	3.934	4.428	4.493	13.2	0.120	**3.97**	%CV>10%
1	2019	**2**	28/01/19	14:22	25/02/19	11:58	669.6	3.225	3.173	3.168	3.189	1.0	0.050	**4.10**	
1	2019	**3**	25/02/19	11:58	01/04/19	11:34	839.6	19.755	28.011	*0.069	23.883	24.4	0.083	**24.78**	Ba3 rejected (low outlier). Poor replication
1	2019	**4**	01/04/19	11:36	30/04/19	11:17	695.7	3.144	3.335	2.876	3.118	7.4	0.027	**3.89**	
1	2019	**5**	30/04/19	11:17	29/05/19	13:00	697.7	3.414	3.906	3.912	3.744	7.6	0.025	**4.66**	strong smell at western end of transect, slurry spreading in nearby fields south of bog. 3 Cows, a bull and 30 sheep in field next to chicken house.

1	2019	**6**	29/05/19	13:00	25/06/19	11:40	646.7	2.821	2.593	2.742	2.719	4.3	0.106	**3.53**	
1	2019	**7**	25/06/19	11:50	31/07/19	11:14	863.4	4.346	4.213	4.280	4.280	1.5	0.066	**4.27**	cow observed licking the station
1	2019	**8**	31/07/19	11:15	28/08/19	10:59	671.7	4.325	4.464	*3.129	4.395	2.2	0.088	**5.60**	Sampler 3 rejected: suspect sampler or sampling issue
1	2019	**9**	-	-	-	-	-	-	-	-	-	-	-	-	lost in post
1	2019	**10**	30/09/19	14:19	31/10/19	13:13	742.9	3.686	*0.634	3.963	3.824	5.1	0.150	**4.32**	*1 outlier rejected
1	2019	**11**	31/10/19	13:14	28/11/19	10:57	669.7	1.841	1.486	1.629	1.652	10.8	0.135	**1.98**	
1	2019	**12**	28/11/19	10:59	18/12/19	12:10	481.2	2.721	2.240	2.399	2.453	10.0	0.075	**4.32**	
1	2020	**1**	18/12/19	12:10	28/01/20	12:10	984.0	5.314	5.450	5.291	5.352	1.6	0.064	**4.70**	
1	2020	**2**	28/01/20	12:10	26/02/20	13:38	697.5	1.902	2.047	1.917	1.955	4.1	0.073	**2.36**	
1	2020	**3**	26/02/20	13:38	30/04/20	12:00	1533.4	10.743	10.958	10.437	10.713	2.4	0.092	**6.06**	2 month exposure
1	2020	**4**	see Mar											**6.06**	2 month exposure
1	2020	**5**	30/04/20	12:00	11/06/20	11:00	1007.0	5.338	5.118	5.349	5.268	2.5	0.089	**4.50**	
1	2020	**6**	11/06/20	11:00	09/07/20	17:20	678.3	2.940	2.538	2.723	2.734	7.4	0.068	**3.44**	
1	2020	**7**	09/07/20	17:20	13/08/20	14:00	836.7	2.832	2.555	2.610	2.666	5.5	0.061	**2.72**	
1	2020	**8**	13/08/20	14:00	24/09/20	14:49	1008.8	1.619	1.436	1.534	1.530	6.0	0.097	**1.24**	2 month exposure
1	2020	**9**	see Aug	-	-	-	-	-	-	-	-	-	-	**1.24**	2 month exposure
1	2020	**10**	24/09/20	14:49	25/11/20	13:30	1487.7	7.602	7.926	7.642	7.723	2.3	0.048	**4.51**	2 month exposure
1	2020	**11**	see Oct	-	-	-	-	-	-	-	-	-	-	**4.51**	2 month exposure
1	2020	**12**	25/11/20	13:30	05/01/21	14:00	984.5	3.606	3.747	3.456	3.603	4.0	0.089	**3.12**	
1	2021	**1**	05/01/21	14:00	26/01/21	14:30	504.5	2.022	1.876	1.866	1.921	4.5	0.087	**3.18**	
1	2021	**2**	26/1/2021	14:30	2/3/2021	14:45	840.3	2.564	2.447	2.669	2.560	4.3	0.076	**2.58**	
1	2021	**3**	2/3/2021	15:15	11/4/2021	13:30	957.3	7.941	-	6.812	7.377	10.8	0.061	**6.68**	
1	2021	**4**	11/4/2021	13:30	27/4/2021	13:20	383.8	2.973	2.814	2.812	2.866	3.2	0.130	**6.23**	
1	2021	**5**	27/4/2021	13:20	7/6/2021	14:00	984.7	5.295	4.654	4.724	4.891	7.2	0.093	**4.26**	
1	2021	**6**	7/6/2021	15:00	6/7/2021	15:30	696.5	7.098	7.309	7.668	7.358	3.9	0.142	**9.06**	
1	2021	**7**	6/7/2021	15:30	3/8/2021	14:30	671.0	4.283	4.217	4.224	4.241	0.9	0.120	**5.37**	

1	2021	**8**	3/8/2021	14:30	7/9/2021	13:30	839.0	6.499	6.899	6.580	6.659	3.2	0.137	**6.80**	
1	2021	**9**	7/9/2021	13:30	11/10/2021	14:00	816.5	4.135	4.104	4.420	4.220	4.1	0.089	**4.42**	
1	2021	**10**	11/10/2021	14:00	3/11/2021	14:30	553.5	2.327	2.181	2.381	2.296	4.5	0.097	**3.47**	
1	2021	**11**	3/11/2021	14:30	7/12/2021	13:10	814.7	2.592	2.613	2.645	2.617	1.0	0.107	**2.69**	
1	2021	**12**	7/12/2021	13:10	11/1/2022	13:30	840.3	2.408	2.237	2.638	2.428	8.3	0.183	**2.34**	
1	2022	**1**	11/1/2022	13:30	15/2/2022	13:35	840.1	3.911	3.777	3.743	3.810	2.3	0.146	**3.22**	
1	2022	**2**	15/2/2022	13:35	14/3/2022	13:30	647.9	2.955	2.871	2.795	2.874	2.8	0.125	**3.13**	Wong cap, very wet
1	2022	**3**	14/3/2022	13:30	12/4/2022	12:15	693.8	8.839	8.531	8.722	8.697	1.8	0.138	**9.1**	
1	2022	**4**	12/4/2022	12:15	23/5/2022	12:10	983.9	4.256	4.409	4.215	4.293	2.4	0.142	**3.13**	Late return in Aug
1	2022	**5**	23/5/2022	12:10	16/6/2022	10:00	573.8	2.925	3.038	3.061	3.008	2.4	0.149	**3.13**	Late return in Aug
1	2022	**6**	16/6/2022	10:00	16/8/2022	12:15	1466.3	10.111	9.755	10.036	9.967	1.9	0.117	**3.68**	

Site 2

	Period							ppm NH_4^+ in 3 ml extract						NH_3 ($\mu g\ m^{-3}$)	
Site	**Year**	**Month**	**DATE OUT**	**TIME OUT**	**DATE IN**	**TIME IN**	**Time (Hrs)**	**ALPHA 1**	**ALPHA 2**	**ALPHA 3**	**mean**	**% CV**	**BLANK**	**Calibrated[1]**	**Comments**
2	2014	**9**	12/09/14	12:45	01/10/14	12:35	455.8	2.007	2.032	1.948	1.996	2.2	0.056	**3.72**	Easterly wind, no birds, no smell.
2	2014	**10**	01/10/14	12:35	03/11/14	12:30	791.9	2.320	2.314	*0.762	2.317	0.2	0.051	**2.50**	Southwesterly wind, no smell. On of three samplers recovered from the ground * outlier rejected.
2	2014	**11**	03/11/14	12:30	02/12/14	12:34	696.1	1.283	1.325	1.223	1.277	4.0	0.056	**1.53**	Light south westerly wind
2	2014	**12**	02/12/14	12:34	08/01/15	12:35	888.0	1.723	1.809	1.569	1.700	7.2	0.065	**1.61**	
2	2015	**1**	08/01/15	12:35	03/02/15	12:48	624.2	1.356	1.167	1.323	1.282	7.9	0.048	**1.73**	
2	2015	**2**	03/02/15	12:48	05/03/15	12:49	720.0	3.467	3.326	3.186	3.326	4.2	0.050	**3.98**	
2	2015	**3**	05/03/15	12:49	31/03/15	13:10	624.4	3.48	3.275	3.58	3.445	4.5	0.040	**4.77**	Light S. Wind, Smell detected, source unclear
2	2015	**4**	31/03/15	13:10	06/05/15	12:20	863.2	4.2	4.526	4.406	4.377	3.8	0.051	**4.38**	Very Windy
2	2015	**5**	06/05/15	12:20	02/06/15	11:40	647.3	3.499	3.616	3.266	3.460	5.1	0.037	**4.62**	
2	2015	**6**	02/06/15	11:40	08/07/15	13:40	866.0	5.296	5.383	*0.076	5.340	1.2	0.070	**5.32**	*1 outlier rejected
2	2015	**7**	08/07/15	13:40	05/08/15	12:20	670.7	*8.454	3.035	3.375	3.205	7.5	0.041	**4.12**	*1 outlier rejected
2	2015	**8**	05/08/15	12:20	04/09/15	12:00	719.7	3.366	3.358	3.345	3.356	0.3	0.070	**3.99**	
2	2015	**9**	04/09/15	12:00	08/10/15	12:30	816.5	4.258	4.216	4.264	4.246	0.6	0.048	**4.49**	
2	2015	**10**	08/10/15	12:30	09/11/15	12:30	768.0	3.42	3.481	3.285	3.395	3.0	0.041	**3.82**	
2	2015	**11**	09/11/15	12:30	02/12/15	12:00	551.5	*1.458	1.143	1.035	1.089	7.0	0.046	**1.65**	Strong smell from pig farm. Winds westerly. Sampler 1 rejected: filte dirty and wet
2	2015	**12**	02/12/15	15:00	12/01/16	12:10	981.2	3.401	3.107	3.500	3.336	6.1	0.050	**2.93**	Strong smell from pig farm, NW winds.
2	2016	**1**	12/01/16	12:10	09/02/16	12:45	672.6	2.960	2.876	2.849	2.895	2.0	0.056	**3.69**	
2	2016	**2**	09/02/16	12:45	10/03/16	11:30	718.8	3.204	3.325	2.863	3.131	7.7	0.051	**3.75**	
2	2016	**3**	10/03/16	11:30	13/04/16	11:20	815.8	6.478	6.890	6.497	6.622	3.5	0.056	**7.04**	
2	2016	**4**	13/04/16	11:20	12/05/16	11:20	696.0	2.981	3.097	3.121	3.066	2.4	0.049	**3.79**	
2	2016	**5**	13/05/16	11:20	09/06/16	12:00	648.7	2.606	2.629	2.641	2.625	0.7	0.048	**3.47**	
2	2016	**6**	09/06/16	12:00	07/07/16	12:35	672.6	0.077	0.070	0.068	0.072	6.6	0.045	***0.04**	Blank values. Low outlier - reject
2	2016	**7**	07/07/16	12:35	09/08/16	12:05	791.5	4.298	4.595	4.478	4.457	3.4	0.095	**4.82**	
2	2016	**8**	09/08/16	12:05	07/09/16	13:20	697.3	3.765	3.433	3.522	3.573	4.8	0.098	**4.36**	
2	2016	**9**	07/09/16	13:20	11/10/16	12:30	815.2	3.656	3.667	3.458	3.594	3.3	0.085	**3.76**	
2	2016	**10**	11/10/16	12:30	11/11/16	12:00	743.5	2.503	2.205	2.387	2.365	6.4	0.053	**2.72**	
2	2016	**11**	11/11/16	12:00	06/12/16	12:00	600.0	1.512	1.699	1.482	1.564	7.5	0.095	**2.14**	

2	2016	**12**	06/12/16	12:00	11/01/17	12:10	864.2	2.433	2.146	1.947	2.175	11.2	0.101	**2.10**	chicken houses not populated No Dec
2	2017	**1**	11/01/17	12:10	13/02/17	12:00	791.8	2.394	2.946	-	2.670	14.6	0.139	**2.79**	sampler 3 found on ground: not analysed
2	2017	**2**	13/02/17	12:00	06/03/17	14:20	506.3	2.755	3.157	2.733	2.882	8.3	0.091	**4.82**	house repopulated
2	2017	**3**	06/03/17	14:20	05/04/17	12:45	718.4	6.441	6.149	6.501	6.364	3.0	0.137	**7.58**	
2	2017	**4**	05/04/17	12:45	09/05/17	11:45	815.0	5.248	5.092	5.441	5.260	3.3	0.063	**5.57**	
2	2017	**5**	09/05/17	11:45	06/06/17	13:00	673.3	4.729	5.036	4.585	4.783	4.8	0.067	**6.12**	
2	2017	**6**	06/06/17	13:00	07/07/17	12:45	743.8	5.650	5.617	5.777	5.681	1.5	0.077	**6.59**	
2	2017	**7**	07/07/17	12:45	15/08/17	12:45	936.0	5.675	6.157	5.591	5.808	5.3	0.081	**5.35**	
2	2017	**8**	15/08/17	12:45	05/09/17	12:40	503.9	0.270	0.089	0.108	0.156	63.9	0.103	***0.09**	Blank values. Low outlier - reject
2	2017	**9**	05/09/17	12:40	12/10/17	14:00	889.3	10.672	10.180	10.210	10.354	2.7	0.151	**10.03**	
2	2017	**10**	12/10/17	14:00	09/11/17	12:50	670.8	4.530	4.766	4.978	4.758	4.7	0.136	**6.02**	
2	2017	**11**	09/11/17	12:50	21/12/17	12:16	1007.4	3.975	3.924	3.737	3.879	3.2	0.084	**3.29**	2 month exposure
2	2017	**12**	See Nov	-	-	-	-	-	-	-	-	-	-	**3.29**	
2	2018	**1**	21/12/17	12:18	24/01/18	13:17	817.0	2.168	2.501	2.212	2.294	7.9	0.088	**2.36**	
2	2018	**2**	24/01/18	14:59	26/02/18	12:11	789.2	3.271	3.204	3.553	3.343	5.5	0.055	**3.64**	
2	2018	**3**	26/02/18	12:11	21/03/18	11:32	551.4	2.641	2.358	2.667	2.555	6.7	0.065	**3.95**	
2	2018	**4**	21/03/18	11:31	26/04/18	12:24	864.9	4.414	4.083	4.478	4.325	4.9	0.079	**4.29**	
2	2018	**5**	26/04/18	12:26	29/05/18	15:01	794.6	4.416	4.516	5.014	4.649	6.9	0.045	**5.07**	
2	2018	**6**	29/05/18	15:01	25/06/18	15:11	648.2	4.793	-	-	4.793	-	0.102	**6.33**	2 samplers missing on return from site
2	2018	**7**	25/06/18	15:11	31/07/18	11:55	860.7	5.052	4.636	4.671	4.786	4.8	0.120	**4.74**	
2	2018	**8**	31/07/18	11:55	22/08/18	12:12	528.3	3.803	3.848	3.906	3.852	1.3	0.072	**6.26**	
2	2018	**9**	22/08/18	12:13	25/09/18	11:40	815.5	5.955	5.936	5.926	5.939	0.3	0.162	**6.19**	
2	2018	**10**	25/09/18	11:40	26/10/18	09:15	741.6	8.996	9.712	9.058	9.255	4.3	0.275	**10.59**	
2	2018	**11**	26/10/18	09:15	29/11/18	11:50	818.6	8.132	7.152	6.918	7.401	8.7	0.146	**7.75**	
2	2018	**12**	29/11/18	11:50	19/12/18	11:15	479.4	7.359	5.628	6.093	6.360	14.1	0.198	**11.24**	%CV>10%
2	2019	**1**	19/12/18	11:15	28/01/19	15:15	964.0	2.992	2.791	*4.170	2.892	4.9	0.120	**2.51**	Sampler 3 rejected: suspect sampler or sampling issue
2	2019	**2**	28/01/19	15:16	25/02/19	12:34	669.3	2.865	3.534	3.576	3.325	12.0	0.050	**4.28**	
2	2019	**3**	25/02/19	12:34	01/04/19	12:26	839.9	22.706	11.057	17.739	17.167	34.0	0.083	**17.78**	Poor replication
2	2019	**4**	01/04/19	12:28	30/04/19	12:22	695.9	3.005	2.904	2.763	2.891	4.2	0.027	**3.60**	
2	2019	**5**	30/04/19	12:22	29/05/19	11:50	695.5	3.158	2.904	3.222	3.095	5.4	0.025	**3.86**	
2	2019	**6**	29/05/19	11:50	25/06/19	13:50	650.0	4.270	4.104	4.162	4.179	2.0	0.106	**5.48**	
2	2019	**7**	25/06/19	14:00	31/07/19	12:10	862.2	4.527	4.600	4.740	4.623	2.3	0.066	**4.62**	additional bird spikes added
2	2019	**8**	31/07/19	12:12	28/08/19	11:51	671.7	4.114	4.280	4.710	4.368	7.0	0.088	**5.57**	
2	2019	**9**	-	-	-	-	-	-	-	-	-	-	-	-	lost in post

2	2019	**10**	30/09/19	15:20	31/10/19	11:29	740.2	3.924	3.934	3.545	3.801	5.8	0.150	**4.31**	
2	2019	**11**	31/10/19	11:30	28/11/19	12:33	673.1	1.396	1.603	1.976	1.659	17.7	0.135	**1.98**	%CV > 15%
2	2019	**12**	28/11/19	12:34	18/12/19	11:40	479.1	2.619	2.762	2.723	2.701	2.7	0.075	**4.79**	
2	2020	**1**	18/12/19	11:40	28/01/20	11:35	983.9	3.327	3.317	3.469	3.371	2.5	0.064	**2.94**	
2	2020	**2**	28/01/20	11:35	26/02/20	12:00	696.4	1.134	1.004	1.156	1.098	7.5	0.073	**1.29**	
2	2020	**3**	26/2/20	12:00	30/04/20	12:00	1535.0	7.323	7.983	-	7.653	6.1	0.092	**4.31**	2 month exposure
2	2020	**4**	see Mar	-	-	-	-	-	-	-	-	-	-	**4.31**	
2	2020	**5**	30/04/20	12:00	11/06/20	12:00	1008.0	3.825	3.849	3.939	3.871	1.6	0.089	**3.28**	
2	2020	**6**	11/06/20	12:00	09/07/20	16:45	676.8	1.563	1.539	1.620	1.574	2.6	0.068	**1.95**	
2	2020	**7**	09/07/20	16:45	13/08/20	12:35	835.8	2.217	-	2.160	2.189	1.8	0.061	**2.23**	
2	2020	**8**	13/08/20	12:35	24/09/20	13:10	1008.6	1.534	1.470	1.504	1.503	2.1	0.097	**1.22**	2 month exposure
2	2020	**9**	see Aug	-	-	-	-	-	-	-	-	-	-	**1.22**	
2	2020	**10**	24/09/20	13:10	25/11/20	13:00	1488.8	*11.595	5.838	6.078	5.958	2.8	0.048	**3.47**	2 month exposure. One outlier removed
2	2020	**11**	See Oct	-	-	-	-	-	-	-	-	-	-	**3.47**	
2	2020	**12**	25/11/20	14:00	05/01/21	13:00	983.0	4.699	5.103	4.932	4.911	4.1	0.089	**4.29**	
2	2021	**1**	05/01/21	13:00	26/01/21	12:30	503.5	1.900	2.029	1.952	1.960	3.3	0.087	**3.25**	
2	2021	**2**	26/1/2021	13:00	2/3/2021	13:00	840.0	-	2.341	2.424	2.383	2.5	0.076	**2.40**	
2	2021	**3**	2/3/2021	13:00	11/4/2021	12:30	958.5	5.323	5.490	6.297	5.703	9.1	0.061	**5.15**	
2	2021	**4**	11/4/2021	12:30	27/4/2021	13:00	384.5	1.929	1.916	2.177	2.007	7.3	0.130	**4.27**	
2	2021	**5**	27/4/2021	13:00	7/6/2021	12:45	983.8	3.891	3.437	3.428	3.585	7.4	0.093	**3.10**	
2	2021	**6**	7/6/2021	15:15	6/7/2021	15:45	696.5	6.404	5.544	6.038	5.995	7.2	0.142	**7.35**	
2	2021	**7**	6/7/2021	15:45	3/8/2021	14:40	670.9	3.309	3.473	3.384	3.389	2.4	0.120	**4.26**	
2	2021	**8**	3/8/2021	14:40	7/9/2021	13:40	839.0	3.514	4.114	3.660	3.763	8.3	0.137	**3.78**	
2	2021	**9**	7/9/2021	13:40	11/10/2021	12:20	814.7	2.948	2.866	3.104	2.973	4.1	0.089	**3.09**	
2	2021	**10**	11/10/2021	12:20	3/11/2021	12:50	553.5	1.831	1.729	1.880	1.813	4.2	0.097	**2.71**	
2	2021	**11**	3/11/2021	12:50	7/12/2021	13:40	816.8	2.201	2.696	2.538	2.478	10.2	0.107	**2.54**	wrong cap, wet filter
2	2021	**12**	7/12/2021	13:40	11/1/2022	13:00	839.3	2.730	2.506	2.618	2.618	4.3	0.183	**2.54**	
2	2022	**1**	11/1/2022	13:00	15/2/2022	13:35	840.6	*0.249	5.228	4.293	4.761	13.9	0.146	**4.06**	Wrong Cap, very Wet. One outlier removed
2	2022	**2**	15/2/2022	13:35	14/3/2022	13:40	648.1	*0.914	2.984	3.167	3.076	4.2	0.125	**3.36**	Wrong Cap, very Wet. One outlier removed
2	2022	**3**	14/3/2022	13:40	12/4/2022	12:30	693.8	5.165	5.009	5.306	5.160	2.9	0.138	**5.34**	
2	2022	**4**	12/4/2022	12:30	23/5/2022	12:30	984.0	4.956	4.739	5.106	4.934	3.7	0.142	**3.61**	
2	2022	**5**	23/5/2022	12:30	16/6/2022	10:15	573.8	3.601	3.680	3.426	3.569	3.6	0.149	**3.61**	
2	2022	**6**	16/6/2022	10:15	16/8/2022	12:00	1465.8	9.823	9.991	10.979	10.264	6.1	0.117	**4.4**	

Site 3

								ppm NH_4^+ in 3 ml extract						NH_3 ($\mu g\ m^{-3}$)	
Site	**Year**	**Month**	**DATE OUT**	**TIME OUT**	**DATE IN**	**TIME IN**	**Time (Hrs)**	**ALPHA 1**	**ALPHA 2**	**ALPHA 3**	**mean**	**% CV**	**BLANK**	**Calibrated[1]**	**Comments**
3	2014	**9**	12/09/14	13:00	01/10/14	12:15	455.3	3.461	3.402	3.421	3.428	0.9	0.056	**6.48**	Easterly wind, no birds, no smell.
3	2014	**10**	01/10/14	12:15	03/11/14	13:00	792.8	2.318	-	-	2.318	-	0.051	**2.50**	Southwesterly wind, no smell. Two of three samplers recovered from the ground.
3	2014	**11**	03/11/14	13:00	02/12/14	12:29	695.5	1.541	1.556	1.600	1.566	2.0	0.056	**1.90**	Light SW'ly wind
3	2014	**12**	02/12/14	12:29	08/01/15	12:25	887.9	1.878	1.942	2.009	1.943	3.4	0.065	**1.85**	
3	2015	**1**	08/01/15	12:25	03/02/15	12:45	624.3	1.27	1.256	1.236	1.254	1.4	0.048	**1.69**	Bird faeces on post
3	2015	**2**	03/02/15	12:45	05/03/15	12:42	720.0	3.125	3.052	3.149	3.109	1.6	0.050	**3.71**	Bird faeces on post
3	2015	**3**	05/03/15	12:42	31/03/15	13:00	624.3	3.431	3.338	3.399	3.389	1.4	0.040	**4.69**	Light S. Wind, No smell
3	2015	**4**	31/03/15	13:00	06/05/15	12:20	863.3	4.152	4.246	4.187	4.195	1.1	0.051	**4.20**	Very Windy
3	2015	**5**	06/05/15	12:20	02/06/15	11:50	647.5	2.994	2.918	3.026	2.979	1.9	0.037	**3.97**	
3	2015	**6**	02/06/15	11:50	08/07/15	13:20	865.5	5.118	5.225	5.105	5.149	1.3	0.070	**5.13**	
3	2015	**7**	08/07/15	13:20	05/08/15	12:40	671.3	2.588	2.639	2.923	2.717	6.6	0.041	**3.48**	
3	2015	**8**	05/08/15	12:40	04/09/15	11:50	719.2	3.118	3.019	2.872	3.003	4.1	0.070	**3.57**	
3	2015	**9**	04/09/15	11:50	08/10/15	12:45	816.9	4.053	3.914	4.134	4.034	2.8	0.048	**4.27**	
3	2015	**10**	08/10/15	12:45	09/11/15	12:40	767.9	0.094	0.143	0.072	0.103	35.3	0.041	***0.07**	Low outlier - rejected
3	2015	**11**	09/11/15	12:40	02/12/15	12:50	552.2	*2.326	0.936	1.007	0.972	5.2	0.046	**1.47**	Strong smell from pig farm. Winds westerly. *rejected – suspect contamination

3	2015	**12**	02/12/15	12:50	12/01/16	12:30	983.7	2.985	3.105	3.017	3.036	2.0	0.050	**2.65**	Strong smell from pig farm, NW winds.
3	2016	**1**	12/01/16	12:30	09/02/16	13:20	672.8	2.638	2.740	*2.305	2.689	2.7	0.056	**3.42**	sampler 3: no lid on sampler - rejected
3	2016	**2**	09/02/16	13:20	10/03/16	11:45	718.4	0.054	0.097	0.074	0.075	28.7	0.051	***0.03**	Mar16 label. Unexposed sample returned by mistake?
3	2016	**3**	10/03/16	11:45	13/04/16	11:45	816.0	-	-	-	-	-	0.056	**-**	all 3 missing
3	2016	**4**	13/04/16	11:45	12/05/16	11:50	696.1	2.919	3.203	2.900	3.008	5.7	0.049	**3.72**	
3	2016	**5**	13/05/16	11:50	09/06/16	12:00	648.2	2.688	2.454	2.634	2.592	4.7	0.048	**3.43**	
3	2016	**6**	09/06/16	12:00	07/07/16	12:00	672.0	0.046	0.061	0.059	0.055	14.7	0.045	***0.01**	Blank values. Low outlier - rejected
3	2016	**7**	07/07/16	12:00	09/08/16	11:45	791.8	3.810	4.031	4.030	3.957	3.2	0.095	**4.26**	
3	2016	**8**	09/08/16	11:45	07/09/16	12:40	696.9	3.330	3.341	3.317	3.329	0.4	0.098	**4.05**	
3	2016	**9**	07/09/16	12:40	11/10/16	12:40	816.0	3.524	3.517	3.524	3.522	0.1	0.085	**3.68**	
3	2016	**10**	11/10/16	12:40	11/11/16	12:00	743.3	2.990	2.573	2.446	2.670	10.7	0.053	**3.08**	
3	2016	**11**	11/11/16	12:00	06/12/16	12:15	600.3	2.081	1.919	2.264	2.088	8.3	0.095	**2.90**	
3	2016	**12**	06/12/16	12:15	11/01/17	12:40	864.4	3.739	3.090	2.972	3.267	12.6	0.101	**3.20**	chicken houses not populated Nov/ Dec
3	2017	**1**	11/01/17	12:40	13/02/17	12:35	791.9	4.624	3.653	3.127	3.801	20.0	0.139	**4.04**	
3	2017	**2**	13/02/17	12:35	06/03/17	14:00	505.4	2.879	2.845	2.950	2.891	1.9	0.091	**4.84**	house repopulated
3	2017	**3**	06/03/17	14:00	05/04/17	13:05	719.1	-	-	-	nd		0.137	**-**	samples missing
3	2017	**4**	05/04/17	13:05	09/05/17	11:45	814.7	8.052	10.035	9.957	9.348	12.0	0.063	**9.96**	
3	2017	**5**	09/05/17	11:45	06/06/17	13:40	674.0	4.312	4.452	4.466	4.410	1.9	0.067	**5.63**	
3	2017	**6**	06/06/17	13:40	07/07/17	13:00	743.3	4.897	5.005	5.458	5.120	5.8	0.077	**5.93**	
3	2017	**7**	07/07/17	13:00	15/08/17	12:20	935.3	4.878	5.079	-	4.979	2.9	0.081	**4.58**	2 samplers
3	2017	**8**	15/08/17	12:20	05/09/17	13:20	505.0	2.999	2.932	3.305	3.079	6.5	0.103	**5.15**	
3	2017	**9**	05/09/17	13:20	12/10/17	14:20	889.0	4.795	5.909	5.151	5.285	10.8	0.151	**5.05**	
3	2017	**10**	12/10/17	14:20	09/11/17	13:00	670.7	*5.689	3.488	-	3.488	-	0.136	**4.37**	Ba3 missing and *Ba 1 wet (rejected)
3	2017	**11**	09/11/17	13:00	21/12/17	12:36	1007.6	*5.467	3.372	3.597	3.485	4.6	0.084	**2.95**	

3	2017	**12**	See Nov	-	-	-	-	-	-	-	-	-	-	2.95	2 month exposure. *1 outlier removed
3	2018	**1**	21/12/17	12:38	24/01/18	13:10	816.5	1.408	1.731	1.806	1.648	12.8	0.088	**1.67**	
3	2018	**2**	24/01/18	13:12	26/02/18	12:06	790.9	3.353	3.251	3.263	3.289	1.7	0.055	**3.57**	
3	2018	**3**	26/02/18	12:06	21/03/18	11:27	551.4	2.782	3.045	2.914	2.914	4.5	0.065	**4.52**	
3	2018	**4**	21/03/18	11:26	26/04/18	12:19	864.9	5.003	5.068	4.814	4.962	2.7	0.079	**4.94**	
3	2018	**5**	26/04/18	12:21	29/05/18	14:50	794.5	*0.010	3.467	3.203	3.335	5.6	0.045	**3.62**	Ba1 rejected – low outlier
3	2018	**6**	29/05/18	14:50	25/06/18	15:02	648.2	4.852	-	-	4.852	-	0.102	**6.41**	2 samplers missing
3	2018	**7**	25/06/18	15:02	31/07/18	11:45	860.7	5.883	5.032	5.421	5.445	7.8	0.120	**5.41**	
3	2018	**8**	31/07/18	11:45	22/08/18	12:07	528.4	3.439	3.651	3.343	3.478	4.5	0.072	**5.64**	strong smell from direction of pig farm
3	2018	**9**	22/08/18	12:08	25/09/18	11:25	815.3	5.394	4.989	5.473	5.285	4.9	0.162	**5.49**	
3	2018	**10**	25/09/18	11:25	26/10/18	09:05	741.7	7.983	8.180	7.977	8.046	1.4	0.275	**9.16**	
3	2018	**11**	26/10/18	09:05	29/11/18	11:40	818.6	8.873	8.745	-	8.809	1.0	0.146	**9.25**	
3	2018	**12**	29/11/18	11:40	19/12/18	11:05	479.4	5.819	5.678	*7.518	5.748	1.7	0.198	**10.12**	*Ba3 oultier rejected:
3	2019	**1**	19/12/18	11:05	28/01/19	14:59	963.9	3.054	2.881	-	2.967	4.1	0.120	**2.58**	
3	2019	**2**	28/01/19	15:00	25/02/19	12:30	669.5	2.863	-	-	2.863	-	0.050	**3.67**	
3	2019	**3**	25/02/19	12:30	01/04/19	12:05	839.6	5.626	10.061	16.251	10.646	50.1	0.083	**11.00**	Poor replication
3	2019	**4**	01/04/19	12:07	30/04/19	12:14	696.1	2.925	3.027	3.268	3.073	5.7	0.027	**3.83**	
3	2019	**5**	30/04/19	12:14	29/05/19	11:40	695.4	2.881	2.701	2.805	2.796	3.2	0.025	**3.48**	
3	2019	**6**	29/05/19	11:40	25/06/19	12:55	649.3	3.353	3.329	3.738	3.473	6.6	0.106	**4.53**	
3	2019	**7**	25/06/19	13:20	31/07/19	12:03	862.7	4.222	4.051	4.258	4.177	2.6	0.066	**4.17**	
3	2019	**8**	31/07/19	12:05	28/08/19	11:46	671.7	3.810	3.599	4.149	3.852	7.2	0.088	**4.90**	
3	2019	**9**	-	-	-	-	-	-	-	-	-	-	-	-	lost in post
3	2019	**10**	30/09/19	15:15	31/10/19	11:24	740.2	3.030	3.759	3.295	3.362	11.0	0.150	**3.79**	
3	2019	**11**	31/10/19	11:26	28/11/19	12:27	673.0	1.376	1.408	1.349	1.377	2.1	0.135	**1.61**	
3	2019	**12**	28/11/19	12:28	18/12/19	11:50	479.4	2.367	2.177	2.259	2.268	4.2	0.075	**4.00**	
3	2020	**1**	18/12/19	11:50	28/01/20	11:35	983.8	3.500	3.361	3.063	3.308	6.7	0.064	**2.88**	
3	2020	**2**	28/01/20	11:35	26/02/20	11:56	696.4	1.194	1.185	1.171	1.183	1.0	0.073	**1.39**	
3	2020	**3**	26/02/20	11:56	30/04/20	12:00	1535.1	8.487	7.750	8.063	8.100	4.6	0.092	4.56	2 month exposure
3	2020	**4**	See Mar	-	-	-	-	-	-	-	-	-	-	4.56	
3	2020	**5**	30/04/20	12:00	11/06/20	12:15	1008.3	4.465	4.697	4.438	4.533	3.1	0.089	**3.85**	

3	2020	**6**	11/06/20	12:15	09/07/20	16:30	676.3	1.711	1.615	-	1.663	4.1	0.068	**2.06**	Ba 3 not returned
3	2020	**7**	9/07/20	16:30	13/08/20	12:30	836.0	2.442	2.411	2.325	2.393	2.5	0.061	**2.44**	
3	2020	**8**	13/08/20	12:30	24/09/20	13:06	1008.6	4.920	4.917	4.872	4.903	0.5	0.097	**4.17**	2 month exposure
3	2020	**9**	See Aug	-	-	-	-	-	-	-	-	-	-	**4.17**	
3	2020	**10**	24/09/20	13:06	25/11/20	12:20	1488.2	5.832	5.782	5.917	5.844	1.2	0.048	**3.40**	2 month exposure
3	2020	**11**	See Oct	-	-	-	-	-	-	-	-	-	-	**3.40**	
3	2020	**12**	25/11/20	13:30	05/01/21	12:30	983.0	3.384	3.135	3.236	3.252	3.9	0.089	**2.81**	
3	2021	**1**	05/01/21	12:30	26/01/21	12:30	504.0	1.972	1.971	2.048	1.997	2.2	0.087	**3.31**	
3	2021	**2**	26/1/2021	12:30	2/3/2021	12:30	840.0	2.330	2.528	2.381	2.413	4.3	0.076	**2.43**	
3	2021	**3**	2/3/2021	12:30	11/4/2021	11:30	958.0	5.347	5.728	5.545	5.540	3.4	0.061	**5.00**	
3	2021	**4**	11/4/2021	11:30	27/4/2021	12:30	385.0	2.318	2.065	2.112	2.165	6.2	0.130	**4.62**	
3	2021	**5**	27/4/2021	12:30	7/6/2021	12:30	984.0	-	3.793	3.592	3.693	3.8	0.093	**3.20**	
3	2021	**6**	7/6/2021	13:00	6/7/2021	15:20	698.3	4.944	5.031	5.044	5.006	1.1	0.142	**6.09**	
3	2021	**7**	6/7/2021	15:20	3/8/2021	14:10	670.8	3.525	3.300	3.372	3.399	3.4	0.120	**4.27**	
3	2021	**8**	3/8/2021	14:10	7/9/2021	13:10	839.0	3.459	3.451	3.573	3.494	2.0	0.137	**3.50**	
3	2021	**9**	7/9/2021	13:10	11/10/2021	11:40	814.5	3.302	3.217	3.324	3.281	1.7	0.089	**3.43**	
3	2021	**10**	11/10/2021	11:40	3/11/2021	13:00	554.3	2.084	2.030	1.797	1.970	7.7	0.097	**2.95**	
3	2021	**11**	3/11/2021	13:00	7/12/2021	13:05	816.1	2.179	2.264	2.238	2.227	2.0	0.107	**2.27**	
3	2021	**12**	7/12/2021	13:05	11/1/2022	12:00	838.9	2.382	2.452	-	2.417	2.0	0.183	**2.33**	
3	2022	**1**	11/1/2022	12:00	15/2/2022	12:50	840.8	3.767	3.969	4.539	4.092	9.8	0.146	**3.47**	
3	2022	**2**	15/2/2022	12:50	14/3/2022	13:00	648.2	2.859	2.947	3.005	2.937	2.5	0.125	**3.2**	
3	2022	**3**	14/3/2022	13:00	12/4/2022	11:15	693.3	5.369	5.850	6.227	5.815	7.4	0.138	**6.04**	
3	2022	**4**	12/4/2022	11:15	23/5/2022	11:50	984.6	4.438	5.175	4.737	4.783	7.7	0.142	**3.49**	
3	2022	**5**	23/5/2022	11:50	16/6/2022	08:40	572.8	3.366	3.336	3.088	3.263	4.7	0.149	**3.49**	
3	2022	**6**	16/6/2022	08:40	16/8/2022	11:10	1466.5	8.911	8.985	9.671	9.189	4.6	0.117	**4.01**	

Site 4

								ppm NH_4^+ in 3 ml extract						NH_3 (µg m^{-3})	
Site	**Year**	**Month**	**DATE OUT**	**TIME OUT**	**DATE IN**	**TIME IN**	**Time (Hrs)**	**ALPHA 1**	**ALPHA 2**	**ALPHA 3**	**mean**	**% CV**	**BLANK**	**Calibrated[1]**	**Comments**
4	2014	**9**	12/09/14	13:15	01/10/14	12:00	454.8	1.971	2.052	2.018	2.014	2.0	0.056	**3.76**	Easterly wind, no birds, no smell.
4	2014	**10**	01/10/14	12:00	03/11/14	13:10	793.2	2.077	2.069	2.141	2.096	1.9	0.051	**2.25**	Southwesterly wind, no smell.
4	2014	**11**	03/11/14	13:10	02/12/14	12:22	695.2	1.382	1.403	1.326	1.370	2.9	0.056	**1.65**	Light south westerly wind
4	2014	**12**	02/12/14	12:22	08/01/15	12:10	887.8	1.754	1.827	*0.533	1.791	2.9	0.065	**1.70**	*wet - rejected
4	2015	**1**	08/01/15	12:10	03/02/15	12:35	624.4	1.005	1.112	1.196	1.104	8.7	0.048	**1.48**	Bird faeces on sampler post
4	2015	**2**	03/02/15	12:35	05/03/15	12:35	720.0	2.381	2.569	2.482	2.477	3.8	0.050	**2.95**	Bird faeces on post
4	2015	**3**	05/03/15	12:35	31/03/15	12:55	624.3	2.899	3.469	2.632	3.000	14.3	0.040	**4.14**	Light S. Wind, No smell
4	2015	**4**	31/03/15	12:55	06/05/15	12:30	863.6	3.528	3.629	3.563	3.573	1.4	0.051	**3.57**	Very Windy
4	2015	**5**	06/05/15	12:30	02/06/15	12:00	647.5	1.815	1.771	1.823	1.803	1.6	0.037	**2.38**	
4	2015	**6**	02/06/15	12:00	08/07/15	13:10	865.2	3.904	3.981	4.152	4.012	3.2	0.070	**3.98**	
4	2015	**7**	08/07/15	13:10	05/08/15	12:55	671.8	2.056	2.078	1.934	2.023	3.8	0.041	**2.58**	
4	2015	**8**	05/08/15	12:55	04/09/15	12:20	719.4	2.389	2.456	2.883	2.576	10.4	0.070	**3.05**	
4	2015	**9**	04/09/15	12:20	08/10/15	13:00	816.7	3.257	3.546	3.51	3.438	4.6	0.048	**3.63**	
4	2015	**10**	08/10/15	13:00	09/11/15	12:50	767.8	3.432	3.628	3.652	3.571	3.4	0.041	**4.02**	
4	2015	**11**	09/11/15	12:50	02/12/15	13:00	552.2	*0.751	3.584	3.767	3.676	3.5	0.046	**5.75**	Strong smell from pig farm. Winds westerly. Sampler 1 rejected – filter dirty and wet

4	2015	**12**	02/12/15	13:00	12/01/16	12:50	983.8	*0.328	2.054	1.977	2.016	2.7	0.050	**1.75**	Strong smell from pig farm, NW winds. Sampler 1 rejected - filter dirty and wet
4	2016	**1**	12/01/16	12:50	09/02/16	13:30	672.7	1.849	1.788	1.832	1.823	1.7	0.056	**2.30**	
4	2016	**2**	09/02/16	13:30	10/03/16	12:00	718.5	3.141	3.048	2.845	3.011	5.0	0.051	**3.60**	
4	2016	**3**	10/03/16	12:00	13/04/16	12:05	816.1	*7.059	4.930	5.114	5.022	2.6	0.056	**5.32**	
4	2016	**4**	13/04/16	12:05	12/05/16	12:20	696.3	2.580	2.587	2.772	2.647	4.1	0.049	**3.26**	
4	2016	**5**	13/05/16	12:20	09/06/16	12:00	647.7	3.242	2.948	3.042	3.077	4.9	0.048	**4.09**	
4	2016	**6**	09/06/16	12:00	07/07/16	11:45	671.8	*1.886	4.249	3.737	3.993	9.1	0.045	**5.14**	
4	2016	**7**	07/07/16	11:45	09/08/16	11:35	791.8	2.993	2.968	2.972	2.978	0.5	0.095	**3.18**	
4	2016	**8**	09/08/16	11:35	07/09/16	12:20	696.8	2.556	2.550	2.579	2.562	0.6	0.098	**3.09**	
4	2016	**9**	07/09/16	12:20	11/10/16	13:00	816.7	2.966	3.049	3.169	3.061	3.3	0.085	**3.19**	
4	2016	**10**	11/10/16	13:00	11/11/16	12:00	743.0	2.423	2.354	2.306	2.361	2.5	0.053	**2.72**	
4	2016	**11**	11/11/16	12:00	06/12/16	12:25	600.4	1.757	1.697	1.645	1.700	3.3	0.095	**2.34**	
4	2016	**12**	06/12/16	12:25	11/01/17	12:55	864.5	2.344	*5.973	2.581	2.463	6.8	0.101	**2.39**	chicken houses not populated Nov/ Dec, 2 samplers not re capped and filters damp.
4	2017	**1**	11/01/17	12:55	13/02/17	12:20	791.4	2.635	2.249	2.360	2.415	8.2	0.139	**2.51**	
4	2017	**2**	13/02/17	12:20	06/03/17	14:20	506.0	1.961	1.942	2.032	1.978	2.4	0.091	**3.26**	house repopulated
4	2017	**3**	06/03/17	14:20	05/04/17	13:15	718.9	4.917	4.924	5.698	5.180	8.7	0.137	**6.13**	
4	2017	**4**	05/04/17	13:15	09/05/17	11:45	814.5	4.629	4.197	4.272	4.366	5.3	0.063	**4.62**	
4	2017	**5**	09/05/17	11:45	06/06/17	13:50	674.2	3.781	3.738	3.610	3.710	2.4	0.067	**4.72**	
4	2017	**6**	06/06/17	13:50	07/07/17	12:45	742.9	3.643	3.824	4.317	3.928	8.9	0.077	**4.53**	
4	2017	**7**	07/07/17	12:45	15/08/17	12:10	935.4	3.732	3.087	3.255	3.358	10.0	0.081	**3.06**	
4	2017	**8**	15/08/17	12:10	05/09/17	13:00	504.8	2.095	1.943	2.025	2.021	3.8	0.103	**3.32**	
4	2017	**9**	05/09/17	13:00	12/10/17	14:15	889.3	3.465	3.276	-	3.371	4.0	0.151	**3.17**	1 sample missing
4	2017	**10**	12/10/17	14:15	09/11/17	12:50	670.6	2.854	2.859	2.845	2.853	0.2	0.136	**3.54**	
4	2017	**11**	09/11/17	12:50	21/12/17	12:43	1007.9	2.172	2.292	2.045	2.170	5.7	0.084	**1.81**	

4	2017	**12**	See Nov	-	-	-	-	-	-	-	-	-	-	1.81	2 month exposure
4	2018	**1**	21/12/17	12:45	24/01/18	13:03	816.3	1.342	1.205	1.377	1.308	6.9	0.088	**1.31**	
4	2018	**2**	24/01/18	13:04	26/02/18	11:58	790.9	2.607	2.467	2.570	2.548	2.8	0.055	**2.76**	
4	2018	**3**	26/02/18	11:58	21/03/18	11:23	551.4	2.623	2.396	2.668	2.562	5.7	0.065	**3.96**	
4	2018	**4**	21/03/18	11:22	26/04/18	12:14	864.9	3.594	3.417	4.321	3.777	12.7	0.079	**3.74**	
4	2018	**5**	26/04/18	12:15	29/05/18	14:45	794.5	-	-	-	-	-	0.045	**-**	samples lost
4	2018	**6**	29/05/18	14:45	25/06/18	14:57	648.2	4.226	4.221	-	4.224	0.1	0.102	**5.56**	1 sampler missing
4	2018	**7**	25/06/18	14:57	31/07/18	11:35	860.6	3.681	3.768	3.858	3.769	2.4	0.120	**3.71**	
4	2018	**8**	31/07/18	11:35	22/08/18	12:00	528.4	2.724	2.685	2.728	2.712	0.9	0.072	**4.37**	
4	2018	**9**	22/08/18	12:02	25/09/18	11:15	815.2	3.946	3.771	3.613	3.777	4.4	0.162	**3.88**	
4	2018	**10**	25/09/18	11:15	26/10/18	08:55	741.7	5.670	6.305	7.415	6.463	13.7	0.275	**7.29**	
4	2018	**11**	26/10/18	08:55	29/11/18	11:30	818.6	6.873	7.298	7.606	7.259	5.1	0.146	**7.60**	
4	2018	**12**	29/11/18	11:30	19/12/18	11:00	479.5	3.991	3.444	-	3.718	10.4	0.198	**6.42**	
4	2019	**1**	19/12/18	11:00	28/01/19	14:55	-	-	-	-	-	-	0.120	**-**	all samplers missing
4	2019	**2**	28/01/19	14:55	25/02/19	12:24	669.5	2.816	-	-	2.816	-	0.050	**3.61**	
4	2019	**3**	25/02/19	12:24	01/04/19	11:58	839.6	14.041	8.649	-	11.345	33.6	0.083	**11.73**	Poor replication
4	2019	**4**	01/04/19	12:01	30/04/19	11:55	695.9	2.623	2.807	2.775	2.735	3.6	0.027	**3.40**	
4	2019	**5**	30/04/19	11:55	29/05/19	11:30	695.6	2.586	2.687	2.674	2.649	2.1	0.025	**3.30**	
4	2019	**6**	29/05/19	11:30	25/06/19	12:35	649.1	2.517	2.582	2.668	2.589	2.9	0.106	**3.34**	
4	2019	**7**	25/06/19	12:50	31/07/19	11:52	863.0	3.394	3.352	3.612	3.453	4.0	0.066	**3.43**	
4	2019	**8**	31/07/19	11:53	28/08/19	11:34	671.7	2.637	2.605	3.141	2.794	10.8	0.088	**3.52**	
4	2019	**9**	-	-	-	-	-	-	-	-	-	-	-	-	lost in post
4	2019	**10**	30/09/19	14:58	31/10/19	11:09	740.2	2.372	2.997	2.649	2.673	11.7	0.150	**2.98**	
4	2019	**11**	31/10/19	11:11	28/11/19	11:28	672.3	1.255	1.367	1.210	1.277	6.3	0.135	**1.49**	
4	2019	**12**	28/11/19	11:29	18/12/19	11:40	480.2	1.472	1.630	1.601	1.568	5.4	0.075	**2.72**	
4	2020	**1**	18/12/19	11:40	28/01/20	11:15	983.6	2.348	2.529	2.704	2.527	7.0	0.064	**2.19**	
4	2020	**2**	28/01/20	11:15	26/02/20	11:40	696.4	0.971	1.032	1.266	1.090	14.3	0.073	**1.28**	
4	2020	**3**	26/02/20	11:40	30/04/20	12:00	1535.3	7.617	7.667	7.860	7.715	1.7	0.092	4.34	2 month exposure
4	2020	**4**	see Mar	-	-	-	-	-	-	-	-	-	-	4.34	
4	2020	**5**	30/04/20	12:00	11/06/20	12:25	1008.4	4.203	4.352	4.297	4.284	1.8	0.089	**3.64**	
4	2020	**6**	11/06/20	12:25	09/07/20	16:15	675.8	3.010	2.256	2.637	2.634	14.3	0.068	**3.32**	
4	2020	**7**	09/07/20	16:15	13/08/20	12:10	835.9	2.235	2.127	2.269	2.210	3.4	0.061	**2.25**	

4	2020	**8**	13/08/20	12:10	24/09/20	13:42	1009.5	3.654	3.243	3.516	3.471	6.0	0.097	2.92	2 month exposure
4	2020	**9**	see Aug	-	-	-	-	-	-	-	-	-	-	2.92	
4	2020	**10**	24/09/20	13:42	25/11/20	11:58	1487.3	4.662	5.070	4.812	4.848	4.3	0.048	2.82	2 month exposure
4	2020	**11**	see Oct	-	-	-	-	-	-	-	-	-	-	2.82	
4	2020	**12**	25/11/20	11:58	05/01/21	11:55	984.0	2.615	-	-	2.615	-	0.089	**2.24**	filter very wet
4	2021	**1**	05/01/21	11:55	26/01/21	11:45	1247.8	1.432	1.350	1.391	1.391	2.9	0.087	**2.26**	
4	2021	**2**	26/1/2021	11:45	2/3/2021	11:50	840.1	-	2.228	2.083	2.156	4.8	0.076	**2.16**	wrong cap on
4	2021	**3**	2/3/2021	12:00	11/4/2021	10:40	957.7	4.334	4.470	-	4.402	2.2	0.061	**3.96**	wrong cap, wet
4	2021	**4**	11/4/2021	10:40	27/4/2021	11:55	385.3	1.935	2.151	-	2.043	7.5	0.130	**4.34**	Ba3 sampler missing
4	2021	**5**	27/4/2021	11:55	7/6/2021	12:00	984.1	3.213	3.583	3.509	3.435	5.7	0.093	**2.97**	
4	2021	**6**	7/6/2021	12:45	6/7/2021	15:15	698.5	4.432	4.212	4.433	4.359	2.9	0.142	**5.28**	
4	2021	**7**	6/7/2021	15:15	3/8/2021	14:00	670.8	3.403	3.434	3.294	3.377	2.2	0.120	**4.25**	
4	2021	**8**	3/8/2021	14:00	7/9/2021	13:00	839.0	3.313	3.171	3.185	3.223	2.4	0.137	**3.22**	
4	2021	**9**	7/9/2021	13:00	11/10/2021	11:15	814.3	3.167	3.261	3.313	3.247	2.3	0.089	**3.39**	
4	2021	**10**	11/10/2021	11:15	3/11/2021	11:45	553.5	1.812	1.760	1.769	1.780	1.6	0.097	**2.66**	
4	2021	**11**	3/11/2021	11:45	7/12/2021	12:50	817.1	1.828	2.060	2.021	1.970	6.3	0.107	**1.99**	wrong cap, wet filter, wet filter. 1 sampler on the ground
4	2021	**12**	7/12/2021	12:50	11/1/2022	11:30	838.7	2.083	2.024	1.875	1.994	5.4	0.183	**1.89**	
4	2022	**1**	11/1/2022	11:30	15/2/2022	12:20	840.8	3.261	2.997	2.979	3.079	5.1	0.146	**2.58**	
4	2022	**2**	15/2/2022	12:20	14/3/2022	12:40	648.3	2.129	2.871	2.759	2.586	15.5	0.125	**3.06**	Very Wet. 1 sampler on ground
4	2022	**3**	14/3/2022	12:40	12/4/2022	11:00	693.3	5.040	4.950	5.253	5.081	3.1	0.138	**5.26**	
4	2022	**4**	12/4/2022	11:00	23/5/2022	11:40	984.7	4.191	4.350	4.338	4.293	2.1	0.142	**3.13**	
4	2022	**5**	23/5/2022	11:40	16/6/2022	10:30	574.8	2.946	2.827	3.309	3.027	8.3	0.149	**3.13**	
4	2022	**6**	16/6/2022	10:30	16/8/2022	11:00	1464.5	7.987	7.845	7.302	7.711	4.7	0.117	**3.69**	

Site 5

								ppm NH_4^+ in 3 ml extract						NH_3 ($\mu g\ m^{-3}$)	
Site	**Year**	**Month**	**DATE OUT**	**TIME OUT**	**DATE IN**	**TIME IN**	**Time (Hrs)**	**ALPHA 1**	**ALPHA 2**	**ALPHA 3**	**mean**	**% CV**	**BLANK**	**Calibrated[1]**	**Comments**
5	2014	**9**	12/09/14	13:30	01/10/14	11:55	454.4	2.345	2.362	2.317	2.341	1.0	0.056	**4.40**	Bird dropping on shelter cover, easterly wind, no birds, no smell.
5	2014	**10**	01/10/14	11:55	03/11/14	13:10	793.3	1.870	1.867	1.883	1.873	0.5	0.051	**2.01**	Bird droppings on shelter cover.
5	2014	**11**	03/11/14	13:10	02/12/14	12:12	695.0	1.065	1.121	1.273	1.153	9.3	0.056	**1.38**	Light south westerly wind
5	2014	**12**	02/12/14	12:12	08/01/15	12:00	887.8	-	-	-	-	-	-	-	Samplers not returned
5	2015	**1**	08/01/15	12:00	03/02/15	12:20	624.3	0.857	0.915	0.982	0.918	6.8	0.048	**1.22**	Bird faeces on sampler post
5	2015	**2**	03/02/15	12:20	05/03/15	12:24	720.1	1.988	2.05	2.009	2.016	1.6	0.050	**2.39**	Bird faeces on post
5	2015	**3**	05/03/15	12:24	31/03/15	12:45	624.4	-	-	-	-	-	-	-	Not returned, SW wind
5	2015	**4**	31/03/15	12:45	06/05/15	12:45	864.0	2.83	2.802	2.893	2.842	1.6	0.051	**2.82**	Very Windy
5	2015	**5**	06/05/15	12:45	02/06/15	12:20	647.6	1.282	1.279	1.365	1.309	3.7	0.037	**1.72**	
5	2015	**6**	02/06/15	12:20	08/07/15	13:00	864.7	3.321	3.507	3.385	3.404	2.8	0.070	**3.37**	
5	2015	**7**	08/07/15	13:00	05/08/15	13:10	672.2	1.561	1.617	1.585	1.588	1.8	0.041	**2.01**	
5	2015	**8**	05/08/15	13:10	04/09/15	12:30	719.3	2.108	2.105	2.132	2.115	0.7	0.070	**2.49**	
5	2015	**9**	04/09/15	12:30	08/10/15	12:20	815.8	2.829	3.111	2.897	2.946	5.0	0.048	**3.11**	
5	2015	**10**	08/10/15	12:20	09/11/15	13:00	768.7	2.737	2.587	2.675	2.666	2.8	0.041	**2.99**	
5	2015	**11**	09/11/15	13:00	02/12/15	13:10	552.2	0.675	0.671	0.666	0.671	0.7	0.046	**0.99**	Strong smell from pig farm. Winds westerly.
5	2015	**12**	02/12/15	13:10	12/01/16	12:58	983.8	*0.109	1.645	1.804	1.725	6.5	0.050	**1.49**	Strong smell from pig farm, NW winds. Sampler 1

															rejected - filter dirty and wet
5	2016	**1**	12/01/16	12:58	09/02/16	13:45	672.8	1.330	1.426	1.405	1.387	3.6	0.056	**1.73**	
5	2016	**2**	09/02/16	13:45	10/03/16	12:15	718.5	1.833	1.700	1.727	1.753	4.0	0.051	**2.07**	
5	2016	**3**	10/03/16	12:15	13/04/16	12:20	816.1	4.516	4.406	4.039	4.320	5.8	0.056	**4.57**	
5	2016	**4**	13/04/16	12:20	12/05/16	12:35	696.3	2.117	2.095	1.995	2.069	3.2	0.049	**2.54**	
5	2016	**5**	13/05/16	12:35	09/06/16	12:00	647.4	2.107	2.056	2.052	2.072	1.5	0.048	**2.73**	
5	2016	**6**	09/06/16	12:00	07/07/16	11:30	671.5	1.820	1.707	1.799	1.775	3.4	0.045	**2.25**	
5	2016	**7**	07/07/16	11:30	09/08/16	11:25	791.9	2.414	2.820	2.268	2.501	11.4	0.095	**2.66**	
5	2016	**8**	09/08/16	11:25	07/09/16	12:00	696.6	2.024	2.238	2.284	2.182	6.4	0.098	**2.62**	
5	2016	**9**	07/09/16	12:00	11/10/16	13:10	817.2	2.711	2.647	2.732	2.697	1.6	0.085	**2.79**	
5	2016	**10**	11/10/16	13:10	11/11/16	12:00	742.8	2.019	1.875	2.119	2.004	6.1	0.053	**2.30**	
5	2016	**11**	11/11/16	12:00	06/12/16	12:35	600.6	1.497	1.317	1.471	1.428	6.8	0.095	**1.94**	
5	2016	**12**	06/12/16	12:35	11/01/17	13:10	864.6	2.904	2.276	2.165	2.448	16.3	0.101	**2.37**	chicken houses not populated Nov/ Dec
5	2017	**1**	11/01/17	13:10	13/02/17	12:00	790.8	1.962	2.195	2.033	2.063	5.8	0.139	**2.13**	
5	2017	**2**	13/02/17	12:00	06/03/17	14:40	506.7	*2.054	1.696	1.687	1.692	0.4	0.091	**2.76**	house repopulated. Ba1 outlier removed
5	2017	**3**	06/03/17	14:40	05/04/17	13:35	718.9	3.668	3.718	3.736	3.707	1.0	0.137	**4.34**	
5	2017	**4**	05/04/17	13:35	09/05/17	11:45	814.2	3.331	3.461	3.378	3.390	1.9	0.063	**3.57**	
5	2017	**5**	09/05/17	11:45	06/06/17	14:10	674.5	2.884	3.069	2.741	2.898	5.7	0.067	**3.67**	
5	2017	**6**	06/06/17	14:10	07/07/17	12:30	742.3	3.159	2.784	2.848	2.930	6.8	0.077	**3.36**	
5	2017	**7**	07/07/17	12:30	15/08/17	12:00	935.5	2.489	2.596	2.410	2.498	3.7	0.081	**2.26**	
5	2017	**8**	15/08/17	12:00	05/09/17	12:40	504.7	1.823	1.414	1.601	1.613	12.7	0.103	**2.62**	
5	2017	**9**	05/09/17	12:40	12/10/17	13:40	889.0	2.393	2.398	2.419	2.403	0.6	0.151	**2.22**	
5	2017	**10**	12/10/17	13:40	09/11/17	12:45	671.1	2.284	2.575	2.318	2.392	6.7	0.136	**2.94**	
5	2017	**11**	09/11/17	12:45	21/12/17	12:53	1008.1	1.973	1.806	1.816	1.865	5.0	0.084	**1.54**	2 month exposure
5	2017	**12**	see Nov	-	-	-	-	-	-	-	-	-	-	**1.54**	
5	2018	**1**	21/12/17	12:55	24/01/18	12:50	815.9	1.512	1.002	-	1.257	28.7	0.088	**1.25**	
5	2018	**2**	24/01/18	12:51	26/02/18	11:51	791.0	2.155	2.037	2.475	2.222	10.2	0.055	**2.40**	
5	2018	**3**	26/02/18	11:51	21/03/18	11:17	551.4	2.634	2.692	2.383	2.570	6.4	0.065	**3.97**	
5	2018	**4**	21/03/18	11:16	26/04/18	12:06	864.8	3.279	3.160	3.686	3.375	8.2	0.079	**3.33**	

5	2018	**5**	26/04/18	12:08	29/05/18	14:36	794.5	-	3.971	4.168	4.070	3.4	0.045	**4.43**	
5	2018	**6**	29/05/18	14:36	25/06/18	14:47	648.2	4.089	-	-	4.089	-	0.102	**5.38**	2 samplers missing on return from site
5	2018	**7**	25/06/18	14:47	31/07/18	11:25	860.6	2.957	4.004	3.714	3.558	15.2	0.120	**3.49**	
5	2018	**8**	31/07/18	11:25	22/08/18	11:52	528.5	2.251	2.367	2.712	2.443	9.8	0.072	**3.92**	
5	2018	**9**	22/08/18	11:53	25/09/18	11:05	815.2	3.327	3.254	3.162	3.248	2.6	0.162	**3.31**	
5	2018	**10**	25/09/18	11:05	26/10/18	08:45	741.7	6.369	5.782	5.190	5.781	10.2	0.275	**6.49**	
5	2018	**11**	26/10/18	08:45	29/11/18	11:15	818.5	7.631	7.102	-	7.367	5.1	0.146	**7.71**	
5	2018	**12**	29/11/18	11:15	19/12/18	10:50	479.6	4.722	4.744	4.047	4.505	8.8	0.198	**7.85**	
5	2019	**1**	19/12/18	10:50	28/01/19	14:40	963.8	2.980	4.099	-	3.540	22.3	0.120	**3.10**	%CV>15%
5	2019	**2**	28/01/19	14:42	25/02/19	12:18	669.6	2.415	-	-	2.415	-	0.050	**3.09**	
5	2019	**3**	25/02/19	12:18	01/04/19	11:51	839.6	3.883	3.793	3.978	3.885	2.4	0.083	**3.96**	
5	2019	**4**	01/04/19	11:53	30/04/19	11:44	695.9	2.623	2.651	*3.453	2.637	0.8	0.027	**3.28**	Ba3 rejected: suspect sampler or sampling issue
5	2019	**5**	30/04/19	11:44	29/05/19	11:20	695.6	2.304	2.802	2.573	2.559	9.7	0.025	**3.19**	
5	2019	**6**	29/05/19	11:20	25/06/19	12:15	648.9	2.679	2.604	2.899	2.727	5.6	0.106	**3.53**	
5	2019	**7**	25/06/19	12:30	31/07/19	11:44	863.2	5.003	4.717	4.611	4.777	4.2	0.066	**4.77**	
5	2019	**8**	31/07/19	11:45	28/08/19	11:27	671.7	2.613	2.690	2.550	2.617	2.7	0.088	**3.29**	
5	2019	**9**	-	-	-	-	-	-	-	-	-	-	-	-	lost in post
5	2019	**10**	30/09/19	14:44	31/10/19	11:00	740.3	2.285	2.229	2.811	2.442	13.1	0.150	**2.71**	
5	2019	**11**	31/10/19	11:01	28/11/19	11:20	672.3	1.197	1.369	1.432	1.333	9.1	0.135	**1.56**	
5	2019	**12**	28/11/19	11:21	18/12/19	11:30	480.2	1.272	1.389	1.459	1.373	6.9	0.075	**2.36**	
5	2020	**1**	18/12/19	11:30	28/01/20	11:05	983.6	2.367	2.057	2.231	2.218	7.0	0.064	**1.92**	
5	2020	**2**	28/01/20	11:05	26/02/20	11:33	696.5	0.980	1.067	1.022	1.023	4.3	0.073	**1.19**	
5	2020	**3**	26/02/20	11:33	30/04/20	12:00	1535.5	7.460	7.493	8.110	7.688	4.8	0.092	**4.32**	2 month exposure
5	2020	**4**	see Mar	-	-	-	-	-	-	-	-	-	-	**4.32**	
5	2020	**5**	30/04/20	12:00	11/06/20	12:35	1008.6	4.099	4.139	4.229	4.156	1.6	0.089	**3.53**	
5	2020	**6**	11/06/20	12:35	09/07/20	16:00	675.4	2.109	2.380	2.430	2.306	7.5	0.068	**2.90**	
5	2020	**7**	9/7/2020	16:00	24/09/20	12:33	1844.6	23.90	28.95	-	26.42	13.5	0.061	***12.5**	3 month exposure: High outlier rejected:
5	2020	**8**	see Jul	-	-	-	-	-	-	-	-	-	0.097	***12.5**	
5	2020	**9**	see Jul	-	-	-	-	-	-	-	-	-	-	***12.5**	

															suspect contamination
5	2020	**10**	24/09/20	12:33	25/11/20	11:30	1488.0	4.226	4.290	3.957	4.158	4.3	0.048	2.41	2 month exposure
5	2020	**11**	see Oct											2.41	
5	2020	**12**	25/11/20	11:30	05/01/21	11:30	984.0	2.056	2.295	2.116	2.156	5.8	0.089	**1.84**	
5	2021	**1**	05/01/21	11:30	26/01/2021	11:30	504	1.116	1.155	1.058	1.110	4.4	0.087	**1.77**	
5	2021	**1**	5/1/2021	11:30	26/1/2021	11:30	504.0	1.116	1.155	1.058	1.110	4.4	0.087	**1.77**	
5	2021	**2**	26/1/2021	11:30	2/3/2021	11:30	840.0	1.900	2.224	2.328	2.151	10.4	0.076	**2.16**	
5	2021	**3**	2/3/2021	11:30	11/4/2021	10:00	957.5	4.478	4.041	-	4.260	7.3	0.061	**3.83**	wrong cap, wet
5	2021	**4**	11/4/2021	10:00	27/4/2021	11:40	385.7	1.611	-	-	1.611	-	0.130	**3.36**	Ba3 not exposed (Velcro missing). Ba2 missing
5	2021	**5**	27/4/2021	11:40	7/6/2021	11:45	984.1	2.929	2.870	2.870	2.890	1.2	0.093	**2.48**	
5	2021	**6**	7/6/2021	12:30	6/7/2021	15:06	698.6	3.858	3.923	3.749	3.843	2.3	0.142	**4.63**	
5	2021	**7**	6/7/2021	15:06	3/8/2021	13:50	670.7	2.861	2.901	2.910	2.891	0.9	0.120	**3.61**	
5	2021	**8**	3/8/2021	13:50	7/9/2021	12:45	838.9	3.520	2.710	2.802	3.011	14.7	0.137	**2.99**	
5	2021	**9**	7/9/2021	12:45	11/10/2021	11:00	814.3	2.922	2.894	2.935	2.917	0.7	0.089	**3.04**	
5	2021	**10**	11/10/2021	11:00	3/11/2021	11:25	553.4	1.692	1.608	1.583	1.628	3.5	0.097	**2.42**	
5	2021	**11**	3/11/2021	11:25	7/12/2021	12:40	817.3	*0.149	3.438	-	3.438	-	0.107	***3.56**	Ba3 missing, wrong cap, Water in Ba1, Ba3 on ground. Data rejected as unreliable
5	2021	**12**	7/12/2021	12:40	11/1/2022	11:00	838.3	1.637	1.851	1.477	1.655	11.3	0.183	**1.54**	
5	2021	**1**	5/1/2021	11:30	26/1/2021	11:30	504.0	1.116	1.155	1.058	1.110	4.4	0.087	**1.96**	
5	2022	**1**	11/1/2022	11:00	15/2/2022	11:50	840.8	2.395	2.330	2.406	2.377	1.7	0.146	**3.45**	
5	2022	**2**	15/2/2022	11:50	14/3/2022	12:00	648.2	*0.033	*0.953	3.158	3.158	-	0.125	**4.33**	Ba1 + Ba2 wet, on ground
5	2022	**3**	14/3/2022	12:00	12/4/2022	10:50	693.8	4.707	3.892	4.036	4.212	10.3	0.138	**2.29**	
5	2022	**4**	12/4/2022	10:50	23/5/2022	10:40	983.8	3.159	2.975	3.371	3.168	6.3	0.142	**2.29**	
5	2022	**5**	23/5/2022	10:40	16/6/2022	11:00	576.3	2.363	2.376	2.578	2.439	4.9	0.149	**2.93**	
5	2022	**6**	16/6/2022	11:00	16/8/2022	10:30	1463.5	5.936	7.647	5.549	6.377	17.5	0.117	**1.96**	

Site 6

								ppm NH_4^+ in 3 ml extract						NH_3 ($\mu g\ m^{-3}$)	
Site	**Year**	**Month**	**DATE OUT**	**TIME OUT**	**DATE IN**	**TIME IN**	**Time (Hrs)**	**ALPHA 1**	**ALPHA 2**	**ALPHA 3**	**mean**	**% CV**	**BLANK**	**Calibrated[1]**	**Comments**
6	2014	**9**	12/09/14	13:45	01/10/14	11:45	454.0	2.072	2.115	2.023	2.070	2.2	0.056	**3.88**	Southwest wind, no smell
6	2014	**10**	01/10/14	11:45	03/11/14	13:20	793.6	4.785	-	-	4.785	-	0.051	**5.21**	Southwest wind, no smell. Two of three samplers recovered from the ground.
6	2014	**11**	03/11/14	13:20	02/12/14	12:43	695.4	2.491	2.769	2.845	2.701	6.9	0.056	**3.33**	Light south westerly wind
6	2014	**12**	02/12/14	12:43	08/01/15	12:50	888.1	6.138	6.423	6.075	6.212	3.0	0.065	**6.05**	
6	2015	**1**	08/01/15	12:50	03/02/15	13:00	624.2	2.824	2.946	2.845	2.872	2.3	0.048	**3.95**	
6	2015	**2**	03/02/15	13:00	05/03/15	13:15	720.3	4.887	4.647	4.724	4.753	2.6	0.050	**5.71**	Strong smell
6	2015	**3**	05/03/15	13:15	31/03/15	13:20	624.1	4.543	4.607	4.295	4.482	3.7	0.040	**6.22**	SW wind, no smell
6	2015	**4**	31/03/15	13:20	06/05/15	12:30	863.2	5.174	5.161	5.294	5.210	1.4	0.051	**5.22**	Very Windy
6	2015	**5**	06/05/15	12:30	02/06/15	12:35	648.1	3.553	3.345	3.113	3.337	6.6	0.037	**4.45**	persistent heavy pig smell
6	2015	**6**	02/06/15	12:35	08/07/15	13:20	864.8	5.906	5.934	5.811	5.884	1.1	0.070	**5.88**	persistent heavy pig smell
6	2015	**7**	08/07/15	13:20	05/08/15	13:25	672.1	3.836	4.02	3.708	3.855	4.1	0.041	**4.96**	
6	2015	**8**	05/08/15	13:25	04/09/15	12:20	718.9	4.56	4.133	4.305	4.333	5.0	0.070	**5.18**	
6	2015	**9**	04/09/15	12:20	08/10/15	13:40	817.3	6.283	5.388	5.587	5.753	8.2	0.048	**6.10**	
6	2015	**10**	08/10/15	13:40	09/11/15	13:10	767.5	5.256	5.342	5.103	5.234	2.3	0.041	**5.91**	
6	2015	**11**	09/11/15	13:10	02/12/15	12:15	551.1	3.195	3.065	3.011	3.090	3.1	0.046	**4.83**	Strong smell from pig farm. Winds westerly.

6	2015	**12**	02/12/15	12:15	12/01/16	13:15	985.0	4.432	4.398	4.732	4.521	4.1	0.050	**3.97**	Strong smell from pig farm, NW winds.
6	2016	**1**	12/01/16	13:15	09/02/16	13:00	671.8	3.484	3.802	*2.303	3.643	6.2	0.056	**4.67**	Ba3 rejected: outlier
6	2016	**2**	09/02/16	13:00	10/03/16	12:30	719.5	4.297	4.215	3.970	4.161	4.1	0.051	**4.99**	
6	2016	**3**	10/03/16	12:30	13/04/16	12:30	816.0	8.523	9.114	8.673	8.770	3.5	0.056	**9.34**	
6	2016	**4**	13/04/16	12:30	12/05/16	12:50	696.3	3.977	3.867	4.016	3.953	2.0	0.049	**4.90**	
6	2016	**5**	13/05/16	12:50	09/06/16	12:00	647.2	-	-	-	-	-	0.048	**-**	all 3 samplers missing
6	2016	**6**	09/06/16	12:00	07/07/16	12:20	672.3	*0.035	*0.068	4.225	4.225	-	0.045	**5.44**	Ba1 and Ba 2 rejected
6	2016	**7**	07/07/16	12:20	09/08/16	11:55	791.6	5.043	5.127	5.592	5.254	5.6	0.095	**5.70**	
6	2016	**8**	09/08/16	11:55	07/09/16	13:10	697.3	4.458	4.614	4.453	4.508	2.0	0.098	**5.53**	
6	2016	**9**	07/09/16	13:10	11/10/16	12:30	815.3	5.103	5.931	5.807	5.614	8.0	0.085	**5.93**	
6	2016	**10**	11/10/16	12:30	11/11/16	12:00	743.5	3.732	4.339	4.186	4.086	7.7	0.053	**4.74**	
6	2016	**11**	11/11/16	12:00	06/12/16	12:15	600.3	3.590	3.891	3.885	3.789	4.5	0.095	**5.38**	
6	2016	**12**	06/12/16	12:15	11/01/17	12:30	864.3	4.308	4.066	4.128	4.167	3.0	0.101	**4.11**	chicken houses not populated nov/ dec
6	2017	**1**	11/01/17	12:30	13/02/17	12:15	791.8	3.767	3.645	3.688	3.700	1.7	0.139	**3.93**	
6	2017	**2**	13/02/17	12:15	06/03/17	14:00	505.8	0.278	0.140	0.118	0.179	48.5	0.091	***0.15**	house repopulated. Low outlier - rejected
6	2017	**3**	06/03/17	14:00	05/04/17	12:55	718.9	7.762	7.384	6.805	7.317	6.6	0.137	**8.73**	
6	2017	**4**	05/04/17	12:55	09/05/17	11:45	814.8	6.241	7.063	7.003	6.769	6.8	0.063	**7.19**	
6	2017	**5**	09/05/17	11:45	06/06/17	13:30	673.8	5.569	5.963	5.891	5.808	3.6	0.067	**7.45**	
6	2017	**6**	06/06/17	13:30	07/07/17	13:00	743.5	5.071	5.661	4.954	5.229	7.2	0.077	**6.06**	
6	2017	**7**	07/07/17	13:00	15/08/17	12:30	935.5	4.703	5.172	4.709	4.861	5.5	0.081	**4.47**	
6	2017	**8**	15/08/17	12:30	05/09/17	13:00	504.5	3.576	3.340	3.611	3.509	4.2	0.103	**5.90**	
6	2017	**9**	05/09/17	13:00	12/10/17	14:15	889.3	5.938	6.391	6.900	6.410	7.5	0.151	**6.15**	
6	2017	**10**	12/10/17	14:15	09/11/17	13:05	670.8	4.511	4.634	5.033	4.726	5.8	0.136	**5.98**	
6	2017	**11**	09/11/17	13:05	21/12/17	12:27	1007.4	*3.611	4.312	4.326	4.319	0.2	0.084	**3.68**	1 outlier removed, 2
6	2017	**12**	See nov											**3.68**	

															month exposure
6	2018	**1**	21/12/17	12:05	24/01/18	13:46	817.7	3.788	4.216	3.109	3.704	15.1	0.088	**3.87**	
6	2018	**2**	24/01/18	13:48	26/02/18	12:18	790.5	4.545	4.442	4.485	4.491	1.2	0.055	**4.91**	
6	2018	**3**	26/02/18	12:18	21/03/18	11:39	551.4	3.800	3.407	3.451	3.553	6.1	0.065	**5.53**	
6	2018	**4**	21/03/18	11:38	26/04/18	12:33	864.9	5.856	5.985	5.840	5.894	1.3	0.079	**5.88**	
6	2018	**5**	26/04/18	12:35	29/05/18	16:05	795.5	-	-	-	-	-	0.045	**-**	All samples lost
6	2018	**6**	29/05/18	16:05	25/06/18	15:20	647.3	-	-	-	-	-	0.102	**-**	all samplers missing on return from site
6	2018	**7**	25/06/18	15:32	31/07/18	12:05	860.6	-	7.874	6.260	7.067	16.1	0.120	**7.06**	poor replication
6	2018	**8**	31/07/18	12:05	22/08/18	12:22	528.3	4.420	4.253	5.269	4.647	11.7	0.072	**7.57**	
6	2018	**9**	22/08/18	12:24	25/09/18	11:45	815.4	6.297	7.154	6.485	6.645	6.8	0.162	**6.95**	
6	2018	**10**	25/09/18	11:45	26/10/18	09:25	741.7	11.955	10.995	11.966	11.639	4.8	0.275	**13.39**	
6	2018	**11**	26/10/18	09:25	29/11/18	12:05	818.7	12.502	12.693	12.486	12.560	0.9	0.146	**13.26**	
6	2018	**12**	29/11/18	12:05	19/12/18	11:35	479.5	6.337	5.963	6.027	6.109	3.3	0.198	**10.78**	
6	2019	**1**	19/12/18	11:35	28/01/19	15:07	963.5	4.278	4.338	-	4.308	1.0	0.120	**3.80**	
6	2019	**2**	28/01/19	15:08	25/02/19	12:44	669.6	4.477	4.622	4.784	4.628	3.3	0.050	**5.98**	
6	2019	**3**	25/02/19	12:44	01/04/19	12:39	839.9	7.818	6.735	6.745	7.099	8.8	0.083	**7.30**	
6	2019	**4**	01/04/19	12:40	30/04/19	12:33	695.9	3.794	4.067	3.651	3.837	5.5	0.027	**4.79**	
6	2019	**5**	30/04/19	12:33	29/05/19	12:00	695.5	3.780	3.383	3.654	3.606	5.6	0.025	**4.50**	
6	2019	**6**	29/05/19	12:00	25/06/19	14:00	650.0	*4.527	3.590	3.154	3.372	9.1	0.106	**4.39**	Sampler 3 rejected: suspect sampler or sampling issue
6	2019	**7**	25/06/19	14:15	31/07/19	12:18	862.1	6.184	5.923	5.666	5.925	4.4	0.066	**5.94**	Ba1 on ground, rejected
6	2019	**8**	31/07/19	12:19	28/08/19	11:58	671.7	*4.510	5.757	5.156	5.457	7.8	0.088	**6.99**	Ba1 = v. wet, rejected
6	2019	**9**	-	-	-	-	-	-	-	-	-	-	-	-	lost in post
6	2019	**10**	30/09/19	15:27	31/10/19	11:38	740.2	3.695	4.131	4.778	4.201	13.0	0.150	**4.79**	
6	2019	**11**	31/10/19	11:39	28/11/19	12:40	673.0	2.382	2.056	2.051	2.163	8.8	0.135	**2.63**	

6	2019	**12**	28/11/19	12:41	18/12/19	11:50	479.2	2.807	3.036	2.939	2.927	3.9	0.075	**5.20**	
6	2020	**1**	18/12/19	11:50	28/01/20	11:40	983.8	5.012	4.913	4.974	4.966	1.0	0.064	**4.36**	
6	2020	**2**	28/01/20	11:40	26/02/20	12:08	696.5	2.475	2.520	2.539	2.511	1.3	0.073	**3.06**	
6	2020	**3**	26/02/20	12:08	30/04/20	12:00	1534.9	12.217	9.869	10.626	10.904	11.0	0.092	**6.16**	2 month exposure
6	2020	**4**	see Mar	-	-	-	-	-	-	-	-	-	-	**6.16**	
6	2020	**5**	30/04/20	12:00	11/06/20	12:50	1008.8	5.229	-	-	5.229	-	0.089	**4.45**	
6	2020	**6**	11/06/20	12:50	09/07/20	16:45	675.9	2.915	2.705	2.980	2.867	5.0	0.068	**3.62**	
6	2020	**7**	09/07/20	16:45	13/08/20	12:45	836.0	3.604	3.866	3.703	3.724	3.6	0.061	**3.83**	
6	2020	**8**	13/08/20	12:45	24/09/20	13:07	1008.4	-	-	-	-	-	0.097	-	2 month exposure: All missing
6	2020	**9**	see Aug	-	-	-	-	-	-	-	-	-	-	-	
6	2020	**10**	24/09/20	13:07	25/11/20	11:15	1487.1	2.398	2.155	-	2.277	7.5	0.048	**1.31**	2 month exposure
6	2020	**11**	see Oct	-	-	-	-	-	-	-	-	-	-	**1.31**	
6	2020	**12**	25/11/20	11:15	05/01/21	12:45	985.5	3.168	3.276	3.012	3.152	4.2	0.089	**2.72**	
6	2021	**1**	05/01/21	12:45	26/01/21	13:20	504.6	2.643	2.715	2.573	2.644	2.7	0.087	**4.43**	
6	2021	**2**	26/1/2021	13:20	2/3/2021	11:00	837.7	3.453	3.763	3.522	3.579	4.5	0.076	**3.66**	
6	2021	**3**	2/3/2021	13:00	11/4/2021	13:00	959.0	7.032	7.250	7.470	7.251	3.0	0.061	**6.55**	
6	2021	**4**	11/4/2021	13:00	27/4/2021	13:40	384.7	2.915	2.906	3.034	2.952	2.4	0.130	**6.41**	
6	2021	**5**	27/4/2021	13:40	7/6/2021	13:30	983.8	4.182	4.316	4.519	4.339	3.9	0.093	**3.77**	
6	2021	**6**	7/6/2021	15:00	6/7/2021	16:00	697.0	6.258	6.744	7.744	6.915	11.0	0.142	**8.50**	
6	2021	**7**	6/7/2021	16:00	3/8/2021	15:10	671.2	3.924	3.943	4.041	3.969	1.6	0.120	**5.01**	
6	2021	**8**	3/8/2021	15:10	7/9/2021	14:15	839.1	4.054	4.000	3.903	3.986	1.9	0.137	**4.01**	
6	2021	**9**	7/9/2021	14:15	11/10/2021	14:20	816.1	4.926	5.125	5.162	5.071	2.5	0.089	**5.34**	
6	2021	**10**	11/10/2021	14:20	3/11/2021	14:50	553.5	3.281	3.349	3.232	3.287	1.8	0.097	**5.04**	
6	2021	**11**	3/11/2021	14:50	7/12/2021	13:25	814.6	4.090	3.059	3.851	3.667	14.7	0.107	**3.82**	
6	2021	**12**	7/12/2021	13:25	11/1/2022	10:30	837.1	3.420	3.263	3.394	3.359	2.5	0.183	**3.32**	
6	2022	**1**	11/1/2022	10:30	15/2/2022	13:15	842.8	5.136	4.909	5.961	5.335	10.4	0.146	**4.55**	
6	2022	**2**	15/2/2022	13:15	14/3/2022	14:00	648.8	3.542	3.936	3.894	3.791	5.7	0.125	**4.17**	
6	2022	**3**	14/3/2022	14:00	12/4/2022	11:45	692.8	6.879	6.357	6.470	6.569	4.2	0.138	**6.85**	
6	2022	**4**	12/4/2022	11:45	23/5/2022	12:00	984.3	5.858	5.831	6.589	6.093	7.1	0.142	**4.48**	
6	2022	**5**	23/5/2022	12:00	16/6/2022	09:30	573.5	4.557	4.401	4.392	4.450	2.1	0.149	**4.48**	
6	2022	**6**	16/6/2022	09:30	16/8/2022	09:15	1463.8	10.533	11.196	12.272	11.334	7.7	0.117	**5.53**	

Site 7

								ppm NH_4^+ in 3 ml extract						NH_3 ($\mu g\ m^{-3}$)	
Site	**Year**	**Month**	**DATE OUT**	**TIME OUT**	**DATE IN**	**TIME IN**	**Time (Hrs)**	**ALPHA 1**	**ALPHA 2**	**ALPHA 3**	**mean**	**% CV**	**BLANK**	**Calibrated[1]**	**Comments**
7	2014	**9**	12/09/14	14:00	01/10/14	11:25	453.4	1.601	1.635	1.556	1.597	2.5	0.056	**2.97**	Southwest wind, no smell
7	2014	**10**	01/10/14	11:25	03/11/14	13:20	793.9	***1.546**	-	-	-	-	0.051	**-**	Southwest wind, no smell. All three samplers recovered from the ground.
7	2014	**11**	03/11/14	13:20	02/12/14	13:00	695.7	1.177	1.183	1.299	1.219	5.7	0.056	**1.46**	Light south westerly wind
7	2014	**12**	02/12/14	13:00	08/01/15	13:00	888.0	1.456	1.467	1.375	1.433	3.5	0.065	**1.35**	
7	2015	**1**	08/01/15	13:00	03/02/15	13:15	624.3	0.869	0.918	0.882	0.890	2.9	0.048	**1.18**	
7	2015	**2**	03/02/15	13:15	05/03/15	13:25	720.2	2.568	2.43	2.434	2.477	3.2	0.050	**2.95**	
7	2015	**3**	05/03/15	13:25	31/03/15	13:40	624.3	2.8	2.600	2.636	2.679	4.0	0.040	**3.70**	SW wind, no smell
7	2015	**4**	31/03/15	13:40	06/05/15	12:45	863.1	3.358	3.397	3.491	3.415	2.0	0.051	**3.41**	Very Windy
7	2015	**5**	06/05/15	12:45	02/06/15	12:40	647.9	2.196	2.358	2.68	2.411	10.2	0.037	**3.20**	
7	2015	**6**	02/06/15	12:40	08/07/15	13:00	864.3	4.494	4.199	4.422	4.372	3.5	0.070	**4.35**	
7	2015	**7**	08/07/15	13:00	05/08/15	13:35	672.6	1.781	2.032	1.842	1.885	6.9	0.041	**2.40**	
7	2015	**8**	05/08/15	13:35	04/09/15	11:50	718.3	2.083	0.131*	2.159	2.121	2.5	0.070	**2.50**	Ba2 rejected: low outlier
7	2015	**9**	04/09/15	11:50	08/10/15	14:15	818.4	*5.217	3.102	3.376	3.239	6.0	0.048	**3.41**	Ba1 rejected: contaminated
7	2015	**10**	08/10/15	14:15	09/11/15	13:20	767.1	2.927	3.167	2.617	2.904	9.5	0.041	**3.26**	
7	2015	**11**	09/11/15	13:20	02/12/15	12:30	551.2	0.743	0.808	0.765	0.772	4.3	0.046	**1.15**	Strong smell from pig farm. Winds westerly.
7	2015	**12**	02/12/15	12:30	12/01/16	13:30	985.0	*0.146	1.595	1.515	1.555	3.6	0.050	**1.34**	Strong smell from pig farm, NW winds. Ba1rejected - filter dirty/wet
7	2016	**1**	12/01/16	13:30	09/02/16	12:30	671.0	1.617	1.822	1.645	1.695	6.6	0.056	**2.14**	

7	2016	**2**	09/02/16	12:30	10/03/16	12:45	720.3	2.821	2.754	2.707	2.761	2.1	0.051	**3.29**	
7	2016	**3**	10/03/16	12:45	13/04/16	12:40	815.9	5.291	5.862	5.414	5.522	5.4	0.056	**5.86**	
7	2016	**4**	13/04/16	12:40	12/05/16	13:25	696.8	2.819	2.585	2.854	2.752	5.3	0.049	**3.39**	
7	2016	**5**	13/05/16	13:25	09/06/16	12:00	646.6	2.468	2.438	2.469	2.458	0.7	0.048	**3.26**	
7	2016	**6**	09/06/16	12:00	07/07/16	12:50	672.8	*0.052	2.225	2.208	2.217	0.5	0.045	**2.82**	Ba1 rejected: low outlier
7	2016	**7**	07/07/16	12:50	09/08/16	12:20	791.5	3.133	3.174	3.033	3.113	2.3	0.095	**3.33**	
7	2016	**8**	09/08/16	12:20	07/09/16	13:30	697.2	2.748	2.738	2.626	2.704	2.5	0.098	**3.27**	
7	2016	**9**	07/09/16	13:30	11/10/16	12:45	815.3	3.455	2.993	3.262	3.237	7.2	0.085	**3.38**	
7	2016	**10**	11/10/16	12:45	11/11/16	12:00	743.3	2.207	2.141	2.070	2.139	3.2	0.053	**2.45**	
7	2016	**11**	11/11/16	12:00	06/12/16	12:25	600.4	1.520	1.601	1.576	1.566	2.6	0.095	**2.14**	
7	2016	**12**	06/12/16	12:25	11/01/17	12:00	863.6	2.709	2.511	2.388	2.536	6.4	0.101	**2.47**	chicken houses not populated Nov/ Dec
7	2017	**1**	11/01/17	12:00	13/02/17	12:00	792.0	2.427	2.183	2.500	2.370	7.0	0.139	**2.46**	
7	2017	**2**	13/02/17	12:00	06/03/17	14:40	506.7	2.042	1.878	2.212	2.044	8.2	0.091	**3.37**	house repopulated
7	2017	**3**	06/03/17	14:40	05/04/17	12:35	717.9	4.552	4.908	4.235	4.565	7.4	0.137	**5.39**	
7	2017	**4**	05/04/17	12:35	09/05/17	11:45	815.2	5.715	5.280	5.232	5.409	4.9	0.063	**5.73**	
7	2017	**5**	09/05/17	11:45	06/06/17	13:10	673.5	4.432	4.252	-	4.342	2.9	0.067	**5.55**	1 sampler only
7	2017	**6**	06/06/17	13:10	07/07/17	12:30	743.3	5.050	5.080	4.487	4.872	6.9	0.077	**5.64**	
7	2017	**7**	07/07/17	12:30	15/08/17	13:10	936.7	4.034	-	-	4.034	-	0.081	**3.69**	1 sampler only
7	2017	**8**	15/08/17	13:10	05/09/17	13:20	504.2	1.861	1.877	1.771	1.836	3.1	0.103	**3.01**	
7	2017	**9**	05/09/17	13:20	12/10/17	13:40	888.3	4.276	4.102	3.669	4.016	7.8	0.151	**3.80**	
7	2017	**10**	12/10/17	13:40	09/11/17	12:35	670.9	2.773	4.584	3.149	3.502	27.3	0.136	**4.39**	
7	2017	**11**	09/11/17	12:35	21/12/17	12:03	1007.5	2.259	*1.721	2.650	2.455	11.3	0.084	**2.06**	1 outlier removed, 2 month exposure
7	2017	**12**	See nov											**2.06**	
7	2018	**1**	21/12/17	12:29	24/01/18	14:10	817.7	1.511	1.428	1.827	1.589	13.3	0.088	**1.60**	
7	2018	**2**	24/01/18	14:12	26/02/18	12:29	790.3	2.439	2.809	2.504	2.584	7.6	0.055	**2.80**	
7	2018	**3**	26/02/18	12:29	21/03/18	11:49	551.3	2.540	2.529	2.436	2.502	2.3	0.065	**3.86**	
7	2018	**4**	21/03/18	11:48	26/04/18	12:44	864.9	3.813	3.455	4.121	3.796	8.8	0.079	**3.76**	
7	2018	**5**	26/04/18	12:46	29/05/18	15:14	794.5	3.880	4.223	3.577	3.894	8.3	0.045	**4.23**	
7	2018	**6**	29/05/18	15:14	25/06/18	15:32	648.3	3.846	-	-	3.846	-	0.102	**5.05**	2 samplers missing
7	2018	**7**	25/06/18	15:20	31/07/18	12:25	861.1	3.420	3.718	-	3.569	5.9	0.120	**3.50**	

7	2018	**8**	31/07/18	12:25	22/08/18	13:01	528.6	2.156	2.208	2.237	2.200	1.9	0.072	**3.52**	
7	2018	**9**	22/08/18	13:03	25/09/18	11:55	814.9	3.603	3.718	3.507	3.609	2.9	0.162	**3.70**	
7	2018	**10**	25/09/18	11:55	26/10/18	09:40	741.8	9.058	7.962	7.446	8.155	10.1	0.275	**9.29**	
7	2018	**11**	26/10/18	09:40	29/11/18	12:25	818.8	6.837	6.228	-	6.533	6.6	0.146	**6.82**	
7	2018	**12**	29/11/18	12:25	19/12/18	11:45	479.3	3.731	3.988	4.501	4.074	9.6	0.198	**7.07**	
7	2019	**1**	19/12/18	11:45	28/01/19	15:26	963.7	3.221	3.605	3.669	3.498	6.9	0.120	**3.06**	
7	2019	**2**	28/01/19	15:27	25/02/19	12:55	669.5	2.848	2.701	3.387	2.979	12.1	0.050	**3.82**	
7	2019	**3**	25/02/19	12:56	01/04/19	12:49	839.9	4.257	5.489	4.536	4.761	13.6	0.083	**4.87**	
7	2019	**4**	01/04/19	12:52	30/04/19	12:47	695.9	2.505	2.865	3.154	2.841	11.4	0.027	**3.54**	
7	2019	**5**	30/04/19	12:47	29/05/19	12:20	695.6	3.213	2.796	2.808	2.939	8.1	0.025	**3.66**	
7	2019	**6**	29/05/19	12:20	25/06/19	14:30	650.2	1.989	2.466	2.228	2.228	10.7	0.106	**2.85**	
7	2019	**7**	25/06/19	14:40	31/07/19	12:28	861.8	3.496	3.766	3.599	3.620	3.8	0.066	**3.61**	
7	2019	**8**	31/07/19	12:30	28/08/19	12:08	671.6	4.449	4.362	4.121	4.311	3.9	0.088	**5.50**	
7	2019	**9**	-	-	-	-	-	-	-	-	-	-	-	-	lost in post
7	2019	**10**	30/09/19	15:37	31/10/19	11:52	740.3	2.825	2.805	2.910	2.847	1.9	0.150	**3.19**	
7	2019	**11**	31/10/19	11:53	28/11/19	12:51	673.0	1.508	1.678	1.467	1.551	7.2	0.135	**1.84**	
7	2019	**12**	28/11/19	12:52	18/12/19	11:30	478.6	2.037	1.896	1.491	1.808	15.7	0.075	**3.16**	
7	2020	**1**	18/12/19	11:30	28/01/20	11:55	984.4	2.348	2.215	2.516	2.360	6.4	0.064	**2.04**	
7	2020	**2**	28/01/20	11:55	26/02/20	12:20	696.4	1.162	1.032	1.080	1.091	6.0	0.073	**1.28**	
7	2020	**3**	26/02/20	12:20	30/04/20	12:00	1534.7	7.556	7.575	7.719	7.617	1.2	0.092	**4.29**	2 month exposure
7	2020	**4**	see Mar	-	-	-	-	-	-	-	-	-	-	**4.29**	2 month exposure
7	2020	**5**	30/04/20	12:00	11/06/20	13:00	1009.0	4.261	4.704	4.276	4.414	5.7	0.089	**3.75**	
7	2020	**6**	11/06/20	13:00	09/07/20	17:05	676.1	2.474	2.164	2.524	2.387	8.2	0.068	**3.00**	
7	2020	**7**	09/07/20	17:05	13/08/20	13:00	835.9	2.301	2.268	2.161	2.243	3.3	0.061	**2.28**	
7	2020	**8**	13/08/20	13:00	24/09/20	13:27	1008.5	1.898	2.161	2.040	2.033	6.5	0.097	**1.68**	2 month exposure
7	2020	**9**	see Aug	-	-	-	-	-	-	-	-	-	-	**1.68**	
7	2020	**10**	24/09/20	13:27	25/11/20	13:30	1489.1	4.595	4.464	4.578	4.546	1.6	0.048	**2.64**	2 month exposure
7	2020	**11**	see Oct	-	-	-	-	-	-	-	-	-	-	**2.64**	
7	2020	**12**	25/11/20	13:30	05/01/21	13:00	983.5	2.654	2.493	2.706	2.618	4.2	0.089	**2.25**	
7	2021	**1**	05/01/21	13:00	26/01/21	13:50	504.8	1.610	1.626	1.525	1.587	3.4	0.087	**2.60**	
7	2021	**2**	26/1/2021	13:50	2/3/2021	10:45	836.9	2.191	2.242	2.255	2.229	1.5	0.076	**2.25**	
7	2021	**3**	2/3/2021	13:20	11/4/2021	13:10	958.8	5.063	4.712	5.262	5.012	5.6	0.061	**4.51**	
7	2021	**4**	11/4/2021	13:10	27/4/2021	14:00	384.8	2.246	2.625	2.094	2.322	11.8	0.130	**4.98**	
7	2021	**5**	27/4/2021	14:00	7/6/2021	14:00	984.0	4.215	4.438	-	4.327	3.6	0.093	**3.76**	

7	2021	**6**	7/6/2021	15:20	6/7/2021	16:15	696.9	5.644	6.755	6.682	6.360	9.8	0.142	**7.80**	
7	2021	**7**	6/7/2021	16:15	3/8/2021	15:20	671.1	3.563	3.465	3.511	3.513	1.4	0.120	**4.42**	
7	2021	**8**	3/8/2021	15:20	7/9/2021	14:25	839.1	4.009	3.725	4.109	3.948	5.0	0.137	**3.97**	
7	2021	**9**	7/9/2021	14:25	11/10/2021	14:40	816.3	3.222	3.015	3.069	3.102	3.5	0.089	**3.23**	
7	2021	**10**	11/10/2021	14:45	3/11/2021	15:20	553.6	*1.986	5.458	*2.628	5.458	-	0.097	***8.46**	filter wet, wrong cap on, water in sampler – data rejected as unreliable
7	2021	**11**	3/11/2021	15:20	7/12/2021	14:00	814.7	2.330	2.139	2.874	2.448	15.6	0.107	**2.51**	wrong cap
7	2021	**12**	7/12/2021	14:00	11/1/2022	10:00	836.0	1.972	1.841	1.637	1.817	9.3	0.183	**1.71**	
7	2022	**1**	11/1/2022	10:00	15/2/2022	13:50	843.8	2.822	2.971	3.208	3.000	6.5	0.146	**2.5**	
7	2022	**2**	15/2/2022	13:50	14/3/2022	14:10	648.3	*1.302	2.506	2.439	2.473	1.9	0.125	**2.67**	Ba1 on the ground
7	2022	**3**	14/3/2022	14:10	12/4/2022	12:50	693.7	6.371	5.323	5.982	5.892	9.0	0.138	**6.12**	
7	2022	**4**	12/4/2022	12:50	23/5/2022	12:45	983.9	4.112	4.060	4.447	4.206	5.0	0.142	**3.06**	
7	2022	**5**	23/5/2022	12:45	16/6/2022	09:00	572.3	2.825	2.889	2.695	2.803	3.5	0.149	**3.06**	
7	2022	**6**	16/6/2022	09:00	16/8/2022	09:00	1464.0	9.837	9.503	-	9.670	2.4	0.117	**3.42**	

Site 8

								ppm NH_4^+ in 3 ml extract						NH_3 ($\mu g\ m^{-3}$)	
Site	**Year**	**Month**	**DATE OUT**	**TIME OUT**	**DATE IN**	**TIME IN**	**Time (Hrs)**	**ALPHA 1**	**ALPHA 2**	**ALPHA 3**	**mean**	**% CV**	**BLANK**	**Calibrated[1]**	**Comments**
8	2014	**9**	12/09/14	14:15	01/10/14	11:15	453.0	0.073	0.072	0.078	0.074	4.3	0.056	***0.04**	Unused sample: Treat as Transport Blank
8	2014	**10**	01/10/14	13:20	03/11/14	13:20	792.0	1.762	-	-	1.762	-	0.051	**1.89**	Southwest wind, no smell. Two of tsamples on ground -
8	2014	**11**	03/11/14	13:20	02/12/14	13:56	696.6	0.712	0.743	0.714	0.723	2.4	0.056	**0.84**	Light south westerly wind
8	2014	**12**	02/12/14	13:56	08/01/15	13:20	887.4	1.001	1.024	0.96	0.995	3.3	0.065	**0.92**	
8	2015	**1**	08/01/15	13:20	03/02/15	13:50	624.5	0.6	0.511	0.517	0.543	9.4	0.048	**0.69**	
8	2015	**2**	03/02/15	13:30	05/03/15	14:00	720.5	1.526	1.5	1.455	1.489	2.4	0.050	**1.75**	
8	2015	**3**	05/03/15	14:00	31/03/15	14:05	624.1	1.908	1.971	1.955	1.945	1.7	0.040	**2.67**	SW wind, no smell
8	2015	**4**	31/03/15	14:05	06/05/15	13:15	863.2	1.810	1.771	1.805	1.795	1.2	0.051	**1.77**	Very Windy
8	2015	**5**	06/05/15	13:15	02/06/15	12:00	646.8	0.929	0.825	0.783	0.846	8.9	0.037	**1.09**	
8	2015	**6**	02/06/15	12:40	08/07/15	13:00	864.3	2.022	2.057	2.086	2.055	1.6	0.070	**2.01**	
8	2015	**7**	08/07/15	13:30	05/08/15	14:00	672.5	1.393	1.462	1.414	1.423	2.5	0.041	**1.80**	
8	2015	**8**	05/08/15	14:00	04/09/15	11:50	717.8	1.142	1.148	1.074	1.121	3.7	0.070	**1.28**	Smell from pig farm
8	2015	**9**	04/09/15	13:20	08/10/15	14:30	817.2	1.412	1.401	1.289	1.367	5.0	0.048	**1.41**	
8	2015	**10**	08/10/15	14:30	09/11/15	13:45	767.3	1.625	1.978	1.624	1.742	11.7	0.041	**1.94**	
8	2015	**11**	09/11/15	13:45	02/12/15	14:00	552.3	0.499	0.500	-	0.500	0.1	0.046	**0.72**	Strong smell from pig farm. Winds westerly. Only 2 samples returned
8	2015	**12**	02/12/15	14:00	12/01/16	14:00	984.0	0.792	0.789	0.805	0.795	1.1	0.050	**0.66**	Strong smell from pig

															farm, NW winds.
8	2016	**1**	12/01/16	14:00	09/02/16	14:00	672.0	0.715	0.689	0.674	0.693	3.0	0.056	**0.83**	All 3 samplers: membrane caps not changed
8	2016	**2**	09/02/16	14:00	10/03/16	13:15	719.3	1.244	1.244	1.277	1.255	1.5	0.051	**1.46**	
8	2016	**3**	10/03/16	13:15	13/04/16	13:10	815.9	3.065	2.667	*3.500	2.866	9.8	0.056	**3.01**	Ba3 rejected - contaminated
8	2016	**4**	13/04/16	13:10	12/05/16	14:00	696.8	1.556	1.499	1.569	1.541	2.4	0.049	**1.87**	
8	2016	**5**	13/05/16	14:00	09/06/16	12:00	646.0	1.734	1.969	1.690	1.798	8.3	0.048	**2.37**	
8	2016	**6**	09/06/16	12:00	07/07/16	13:50	673.8	0.991	1.118	1.093	1.067	6.3	0.045	**1.33**	
8	2016	**7**	07/07/16	13:50	09/08/16	13:40	791.8	1.385	1.484	1.459	1.443	3.6	0.095	**1.49**	
8	2016	**8**	09/08/16	13:40	07/09/16	13:50	696.2	1.384	1.348	1.346	1.359	1.6	0.098	**1.58**	
8	2016	**9**	07/09/16	13:50	11/10/16	13:10	815.3	1.842	1.598	1.784	1.741	7.3	0.085	**1.78**	
8	2016	**10**	11/10/16	13:10	11/11/16	12:00	742.8	1.279	1.233	1.333	1.282	3.9	0.053	**1.45**	
8	2016	**11**	11/11/16	12:00	06/12/16	13:30	601.5	1.279	1.068	*0.899	1.174	12.7	0.095	**1.57**	Ba3 rejected – sampler issue
8	2016	**12**	06/12/16	13:30	11/01/17	14:00	864.5	1.251	1.254	1.302	1.269	2.3	0.101	**1.18**	chicken houses not populated Nov/ Dec
8	2017	**1**	11/01/17	14:00	13/02/17	13:00	791.0	1.521	1.531	1.527	1.526	0.3	0.139	**1.53**	
8	2017	**2**	13/02/17	13:00	06/03/17	12:15	503.3	1.283	1.216	1.117	1.205	6.9	0.091	**1.94**	house repopulated
8	2017	**3**	06/03/17	12:15	05/04/17	12:00	719.8	2.539	2.591	2.733	2.621	3.8	0.137	**3.02**	
8	2017	**4**	05/04/17	12:00	09/05/17	11:45	815.8	3.131	2.506	2.953	2.863	11.2	0.063	**3.00**	
8	2017	**5**	09/05/17	11:45	06/06/17	14:30	674.8	2.073	2.202	2.091	2.122	3.3	0.067	**2.66**	
8	2017	**6**	06/06/17	14:30	07/07/17	11:30	741.0	1.922	1.825	1.764	1.837	4.3	0.077	**2.08**	
8	2017	**7**	07/07/17	11:30	15/08/17	13:50	938.3	2.006	1.632	1.884	1.841	10.4	0.081	**1.64**	
8	2017	**8**	15/08/17	13:50	05/09/17	12:00	502.2	0.694	0.877	0.747	0.773	12.2	0.103	**1.17**	
8	2017	**9**	05/09/17	12:00	12/10/17	13:20	889.3	1.278	1.270	1.322	1.290	2.2	0.151	**1.12**	
8	2017	**10**	12/10/17	13:20	09/11/17	11:45	670.4	1.609	1.813	1.673	1.698	6.1	0.136	**2.04**	
8	2017	**11**	09/11/17	11:45	21/12/17	11:25	1007.7	*1.159	0.867	0.896	0.882	2.3	0.084	**0.69**	1 outlier removed. 2
8	2017	**12**	see Nov	-	-	-	-	-	-	-	-	-	-	**0.69**	

															month exposure
	2018	**1**	21/12/17	11:25	24/01/18	11:46	816.4	0.929	0.947	0.902	0.926	2.4	0.088	**0.90**	
8	2018	**2**	24/01/18	11:47	26/02/18	11:20	791.6	1.756	1.758	1.519	1.678	8.2	0.055	**1.79**	
8	2018	**3**	26/02/18	11:20	21/03/18	10:41	551.4	1.845	1.727	2.161	1.911	11.7	0.065	**2.93**	
8	2018	**4**	21/03/18	10:41	26/04/18	11:12	864.5	2.601	2.641	2.530	2.591	2.2	0.079	**2.54**	
8	2018	**5**	26/04/18	11:14	29/05/18	15:41	796.5	-	-	-	-	-	0.045	**-**	samples lost
8	2018	**6**	29/05/18	15:41	25/06/18	14:02	646.4	3.000	2.993	3.073	3.022	1.5	0.102	**3.95**	
8	2018	**7**	25/06/18	14:02	31/07/18	13:46	863.7	2.348	-	-	2.348	-	0.120	**2.25**	
8	2018	**8**	31/07/18	13:46	22/08/18	11:10	525.4	1.302	1.205	1.363	1.290	6.2	0.072	**2.03**	
8	2018	**9**	22/08/18	11:12	25/09/18	12:35	817.4	1.659	1.416	-	1.537	11.2	0.162	**1.47**	
8	2018	**10**	25/09/18	12:35	26/10/18	10:50	742.3	3.876	3.757	3.339	3.657	7.7	0.275	**3.98**	
8	2018	**11**	26/10/18	10:50	29/11/18	12:50	818.0	4.373	4.130	4.236	4.246	2.9	0.146	**4.38**	
8	2018	**12**	29/11/18	12:50	19/12/18	12:20	479.5	2.182	2.089	2.340	2.204	5.8	0.198	**3.66**	
8	2019	**1**	19/12/18	12:20	28/01/19	14:10	961.8	1.615	1.611	1.569	1.598	1.6	0.120	**1.34**	
8	2019	**2**	28/01/19	14:12	25/02/19	11:36	669.4	1.916	1.727	-	1.821	7.3	0.050	**2.31**	
8	2019	**3**	25/02/19	11:36	01/04/19	11:20	839.7	2.393	2.646	2.177	2.405	9.8	0.083	**2.42**	
8	2019	**4**	01/04/19	11:24	30/04/19	10:55	695.5	2.528	2.983	2.640	2.717	8.7	0.027	**3.38**	
8	2019	**5**	30/04/19	10:55	29/05/19	12:00	697.1	1.758	1.851	1.809	1.806	2.6	0.025	**2.23**	
8	2019	**6**	29/05/19	12:30	25/06/19	11:10	646.7	1.268	1.239	1.175	1.227	3.9	0.106	**1.52**	
8	2019	**7**	25/06/19	11:25	31/07/19	11:00	863.6	2.259	2.191	2.282	2.244	2.1	0.066	**2.21**	
8	2019	**8**	31/07/19	11:01	28/08/19	10:23	671.4	1.713	1.533	1.632	1.626	5.5	0.088	**2.00**	
8	2019	**9**	-	-	-	-	-	-	-	-	-	-	-	-	lost in post
8	2019	**10**	30/09/19	14:02	31/10/19	13:25	743.4	1.432	1.300	1.296	1.343	5.8	0.150	**1.40**	
8	2019	**11**	31/10/19	13:26	28/11/19	10:45	669.3	0.882	0.732	0.694	0.769	12.9	0.135	**0.83**	
8	2019	**12**	28/11/19	10:47	18/12/19	12:25	481.6	0.597	0.699	0.505	0.600	16.2	0.075	**0.95**	
8	2020	**1**	18/12/19	12:25	28/01/20	12:20	983.9	1.106	1.102	1.254	1.154	7.5	0.064	**0.97**	
8	2020	**2**	28/01/20	12:20	26/02/20	14:53	698.6	0.832	0.719	0.699	0.750	9.6	0.073	**0.85**	
8	2020	**3**	26/02/20	14:53	30/04/20	12:00	1532.1	5.765	5.782	5.667	5.738	1.1	0.092	**3.22**	2 month exposure
8	2020	**4**	see Mar	-	-	-	-	-	-	-	-	-	-	**3.22**	
8	2020	**5**	30/04/20	12:00	11/06/20	10:15	1006.3	3.393	-	-	3.393	-	0.089	**2.87**	
8	2020	**6**	11/06/20	10:15	09/07/20	15:45	677.5	1.155	1.119	1.106	1.127	2.3	0.068	**1.37**	
8	2020	**7**	09/07/20	15:45	13/08/20	14:20	838.6	1.265	1.318	1.344	1.309	3.1	0.061	**1.30**	
8	2020	**8**	13/08/20	14:20	24/09/20	11:27	1005.1	3.147	3.164	2.901	3.071	4.8	0.097	**2.59**	2 month exposure
8	2020	**9**	see Aug	-	-	-	-	-	-	-	-	-	-	**2.59**	
8	2020	**10**	24/09/20	11:27	25/11/20	15:00	1492.6	2.195	2.685	2.128	2.336	13.0	0.048	**1.34**	2 month exposure
8	2020	**11**	see Oct	-	-	-	-	-	-	-	-	-	-	**1.34**	

8	2020	**12**	25/11/20	15:00	05/01/21	11:00	980.0	1.148	1.146	1.128	1.141	1.0	0.089	**0.94**	

8	2021	**1**	5/1/2021	11:00	26/1/2021	11:00	504.0	0.616	0.676	0.626	0.639	5.0	0.087	**0.96**	
8	2021	**2**	26/1/2021	11:00	2/3/2021	15:00	844.0	1.611	1.593	1.619	1.608	0.8	0.076	**1.59**	
8	2021	**3**	2/3/2021	15:00	11/4/2021	09:30	953.5	3.232	3.315	3.455	3.334	3.4	0.061	**3.00**	
8	2021	**4**	11/4/2021	09:30	27/4/2021	10:30	385.0	-	-	1.835	1.835	-	0.130	**3.87**	Ba1+Ba2 extracts mixed together accidentally during analysis
8	2021	**5**	27/4/2021	10:30	7/6/2021	10:00	983.5	2.364	2.125	2.172	2.220	5.7	0.093	**1.89**	
8	2021	**6**	7/6/2021	16:30	6/7/2021	16:45	696.3	3.927	4.299	-	4.113	6.4	0.142	**4.99**	
8	2021	**7**	6/7/2021	16:45	3/8/2021	15:30	670.8	*0.881	2.013	2.322	2.168	10.1	0.120	**2.67**	
8	2021	**8**	3/8/2021	15:30	7/9/2021	14:30	839.0	1.673	1.878	1.606	1.719	8.2	0.137	**1.65**	
8	2021	**9**	7/9/2021	14:30	11/10/2021	10:30	812.0	1.516	1.491	1.463	1.490	1.8	0.089	**1.51**	
8	2021	**10**	11/10/2021	10:30	3/11/2021	10:40	553.2	1.214	*1.719	1.230	1.222	0.9	0.097	**1.78**	
8	2021	**11**	3/11/2021	10:40	7/12/2021	10:35	815.9	1.029	1.035	*1.497	1.032	0.4	0.107	**0.99**	
8	2021	**12**	7/12/2021	10:40	11/1/2022	09:30	838.8	0.936	0.903	0.927	0.922	1.9	0.183	**0.77**	
8	2022	**1**	11/1/2022	09:30	15/2/2022	10:15	840.8	1.331	1.383	1.324	1.346	2.4	0.146	**1.06**	
8	2022	**2**	15/2/2022	10:15	14/3/2022	14:40	652.4	*0.156	1.342	1.137	1.240	11.7	0.125	**1.26**	Wrong Cap, Very Wet1 sampler on the ground
8	2022	**3**	14/3/2022	14:40	12/4/2022	10:12	690.5	3.140	3.586	3.286	3.337	6.8	0.138	**3.42**	
8	2022	**4**	12/4/2022	10:12	23/5/2022	10:20	984.1	1.806	2.080	2.083	1.990	8.0	0.142	**1.4**	
8	2022	**5**	23/5/2022	10:20	16/6/2022	08:20	574.0	1.515	1.576	1.463	1.518	3.7	0.149	**1.4**	
8	2022	**6**	16/6/2022	08:20	16/8/2022	08:45	1464.4	4.602	4.137	3.673	4.137	11.2	0.117	**1.76**	Wrong Caps

Contact

enquiries@ceh.ac.uk

@UK_CEH

ceh.ac.uk

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Bangor

UK Centre for Ecology & Hydrology
Environment Centre Wales
Deiniol Road
Bangor
Gwynedd
LL57 2UW

+44 (0)1248 374500

Edinburgh

UK Centre for Ecology & Hydrology
Bush Estate
Penicuik
Midlothian
EH26 0QB

+44 (0)131 4454343

Lancaster

UK Centre for Ecology & Hydrology
Lancaster Environment Centre
Library Avenue
Bailrigg
Lancaster
LA1 4AP

+44 (0)1524 595800

Wallingford (Headquarters)

UK Centre for Ecology & Hydrology
Maclean Building
Benson Lane
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

+44 (0)1491 838800

UK Centre for Ecology & Hydrology