

1 **Appendices for:**
2 **Characterising populations living close to intensive farming and**
3 **composting facilities in England**
4

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29 **Appendix A. Materials and methods: Air pollution-related incidents**

30

31 The Environment Agency (EA) logs all events or occurrences in regulated sites that have an
32 environmental and/or operational impact (e.g. which requires EA resources to manage)
33 (Environment Agency, 2016), termed ‘incidents’. Incidents include environmental harm to the
34 air and may impact on human health to the local community. Incidents are brought to the EA’s
35 attention by the public, emergency services, local authorities, other regulators, industry, EA
36 staff and other parties. When an incident occurs, it is logged on the EA’s National Incident
37 Recoding System (NIRS), and is given an event number, along with: (i) the date and time, (ii)
38 the number of notifications (if more than one person reports the same event, this is noted under
39 the first record of the event), (iii) the facility that the incident is related to (may include name
40 of site, permit number and address), (iv) the pollutant and cause type, and (v) an impact
41 category. Data from NIRS relating to incidents from a regulated intensive farming or
42 composting facility in England, with a pollutant recorded as ‘Atmospheric Pollutant and Effects’
43 were obtained for the period 1st January 2011 to 31st December 2017. Incidents are given a
44 score of 1, 2, 3 or 4 according to the potential impact on the environment, actual impact on the
45 environment, and impact on EA resources, using the EA’s Common Incident Classification
46 Scheme (CICS). Briefly, the CICS scores are defined as: (1) major, serious, persistent and/or
47 extensive impacts or effects on the environment, people and/or property; (2) significant impact
48 or effect on the environment, people and/or property; (3) minor or minimal impact or effect on
49 the environment, people and/or property; (4) substantiated incident with no impact, as
50 summarised in more detail in Appendix B (Environment Agency, 2016). Category 1 incidents
51 include major effect on air quality, major damage to nature conservation, serious effect on
52 human health, major effect on amenity values, major impact on property or major damage to
53 agriculture/commerce (e.g. a major containment and control failure, or a fire). Category 4

54 incidents have no impact and are substantiated incidents with no impact to air quality
55 (Appendix B).

56

57 From the NIRS data we calculated; (i) the number of incidents per year, (ii) the number of
58 incidents per CICS score (iii) the average number of incidents per year by the number of sites
59 operating that year to assess whether air pollution from intensive farming and composting
60 facilities are increasing over time. We also calculated (iv) the number of notifications per year,
61 (v) the number of notifications per CICS score, and (vi) the number of notifications per year
62 by the number of sites operating that year, to assess whether there is more public concern
63 surrounding air pollution emissions from these facilities.

64

65 We also describe the socio-demographic characteristics around facilities with a CICS 2 or
66 CICS3 incident attributed to them.

67

68 **Appendix B. The Environment Agency Common Incident Classification**
69 **Scheme (CICS) for scoring environmental incidents**

70

71 The following has been adapted from the Environment Agency (EA) England’s “Incidents and
72 their classification: the Common Incident Classification Scheme (CICS)” (Environment
73 Agency, 2016). It should be noted that incidents are categorised based on the version of the
74 CICS that is current at the time of the incident.

75

76 **CICS Tier 1: Impact on resources**

77

78 **Methodology**

79 Tier 1 classifies the deployment of resources. Identify which of the statements contained in
80 each level definition best describes the resources deployed. Only assess Tier 1 at an area level.
81 Assign the level where the highest selected criterion is listed. For example, an incident resulting
82 in a limited deployment to on site (Level C) but a major deployment to staff the incident room
83 (Level A) will be recorded as a Level A incident.

84

85 **Area major incident**

86 Declare an area major incident if a Level A response is expected to be required. Assess the
87 potential for a Level A response when you are planning how to respond and start to deploy
88 resources. See Operational instruction 123_02 on the management of major incidents for
89 further details on declaring an area, regional or national major incident.

90 **Table B1. CICs Tier 1 classification - Impact on resources.**

Category	Definition	Impact criteria and guidance (one or more definition or criteria are met)
1	Major deployment of resources	<p>A major deployment of resources which results in a severe disruption to normal business and requires an immediate reorganization of priorities and reassignment of staff. This will involve one or more of the following:</p> <p>Major deployment to staff the incident room</p> <ul style="list-style-type: none"> • Drafting in additional staff such as call handlers and staff to support the incident room (whether based in the incident room or elsewhere). • Opening of an area incident room for more than 2 days consecutively and requiring rosters to be put in place. <p>Major deployment on site</p> <ul style="list-style-type: none"> • Greater than four officer’s days (simultaneously or in consecutive shifts) in a 24 hour period. • Maximum use of available resource, within the bounds of the working time directive. • The special mobilization of personnel, plant or other resources at a regional or national level. For example: • extensive use of specialist clean up contractors; • deployment of the Air Quality Cell in response to a major air pollution incident;

-
- mobilisation of staff from other regions (inter-regional support) or military aid;
 - the use of contingency dissemination of flood warnings if normal systems fail.

Major deployment to support multi-agency response

- Deployment of liaison officers to multi-agency co-ordination centres (such as Silver and Gold Command) for more than a day.

Major deployment to manage a high level of media (including social media), public or political interest

- A need to produce a nationally and/or regionally co-ordinated media release in response to national (or extensive local) media interest.
 - The drafting in of additional staff to handle numerous calls from the public and professional partners. As a guide, for single location incidents, more than 20 calls in any one day. For multiple-location incidents (such as flooding), 15 or more calls per hour or more. Consider the nature of the incident and the actual callers (such as, persistent callers).
 - Strategic Managers required to manage a high level of political interest which gives rise to concern by the government or ministers.
-

Only record an incident involving our participation in a UK national response plan (such as the National Response Plan for radiation incidents) or major civil emergency (possibly in support of the emergency services) as Level A if one or more of the above criteria are met. Terrorist events involving radioactive materials are likely to require a Level A response due to the need to manage a high level of media, public and political interest.

Category	Significant	A significant deployment of resources causing a significant disruption to normal business requiring a reorganization of priorities at a local and possibly regional level. This is will involve one or more of the following:
2	deployment of resources	

Significant deployment to staff the incident room

- Opening of an area incident room for less than 2 days consecutively and not requiring rostering of staff to support extended opening.

Significant deployment on site

- Between 1 and 4 officer's day (simultaneously or in consecutive shifts) in a 24-hour period.
- Field work cover provided during silent hours (00:00 to 06:00) but not worked.
- Special mobilization of personnel, plant or other resources at a local and regional level. For example,

clean-up contractors and mobilisation of staff from other areas.

Significant deployment to support multi-agency response

- Deployment of Liaison Officers to multi-agency co-ordination centres (such as Silver and Gold Command) for one day or less.

Significant deployment to manage intermediate level of media (including social media), public or political interest

- A need to manage an intermediate level of media interest, such as a large amount of interest from local newspapers and possibly local television.
- Additional resources required to manage a moderate number of calls from the public. As a guide, for single location incidents, between 5-19 calls in any one day. For multiple-location incidents, between 10-15 calls per hour.
- Strategic Managers required to manage an intermediate level of political interest including concern expressed by a local Councillor.

Category	Limited	The incident is not significantly disruptive to normal business
3	deployment of resources	and does not require the immediate reorganisation of priorities. This will involve one or more of the following:

Limited deployment to manage the incident

- Incident room not opened (Note: The incident room is not considered open when an Area Base Controller is not managing it, for example when the same room is being used for issuing warnings and monitoring weather and river levels only).
- Less than one officer's day in any 24-hour period, but more than 20 minutes spent dealing with the incident.
- For flooding incidents, rostered staff are active for the non-routine monitoring and forecasting of river/sea levels and issuing flood alerts. Most activity is between 06:00 and 23:59, although some activity maybe necessary during silent hours depending on the expected time of flood.

Limited deployment on site

- Site attendance (including attendance at Bronze Control by Operational Liaison Officer) needed but for less than one officer's day in a 24-hour period.
- For flooding incidents, rostered staff are active for the non-routine monitoring, operating and inspecting a small number of assets. Most activity is between 06:00 and 23:59, although some activity maybe necessary during silent hours depending on the expected time of flood.

Limited deployment to support multi-agency response

- No need to deploy liaison officers to multi-agency tactical and strategic co-ordination centres.

Limited deployment to manage low level of media (including social media), or public interest

- Limited resources required to manage a low level of media interest, such as a small amount of interest from local newspapers.
- Limited resources required to manage a low level of public interest. This would involve a small number of calls. For single location incidents, no more than four calls in any one day, for multiple-location less than 5-10 calls per hour.

Category	No deployment of	• No attendance or deployment of resources beyond
4	resources	recording and assessing the incident (may involve a few phone-calls) and completing the incident record.
		• No media or public interest to manage.

91

92 **CICS Tier 2: Impact on the environment**

93

94 **Methodology – type of incident**

95 Tier 2, the environmental impact categorisation, is split into five functional schemes:

- 96 • Environment Management (air, land, water) incidents – for incidents involving water
97 quality, pollution, or physical habitat damage (outside of FCRM remit). Environment
98 Management usually leads.
- 99 • Fisheries incidents – for incidents involving illegal fishing and illegal fish movements,
100 fish disease, fishery management activities and fish kills from non-pollution causes,
101 including low flows and low dissolved oxygen. Fisheries usually leads.
- 102 • Water Resources incidents – for incidents involving the quantity of a water resource.
103 Environment Management usually leads.
- 104 • Waterways incidents – for incidents on a waterway where we are the competent
105 authority for navigation.
- 106 • Flood and Coastal Risk Management incidents – for incidents which involve actual or
107 potential flooding and land drainage works on main rivers or where regional bylaws
108 apply.
- 109 • There is no specific scheme for incidents of interest to biodiversity teams but impacts
110 to ecology must be considered for all incidents by the function leading the response.
111 Use the definitions and criteria provided when categorising the impact to ecology.
112 Fisheries and Biodiversity (F&B) teams must be consulted.

113

114 **Methodology – impact categories**

115 For each functional scheme, the environmental impact categorisation, is split into four
116 categories:

- 117 • Category 1 – major, serious, persistent and/or extensive impact or effect on the
118 environment, people and/or property
- 119 • Category 2 – significant impact or effect on the environment, people and/or property

120 • Category 3 – minor or minimal impact or effect on the environment, people and/or
121 property

122 • Category 4 – substantiated incident with no impact.

123 Assign the impact category corresponding to the highest criteria selected. The potential impact
124 category assigned informs the response time required (refer to incident management service
125 levels).

126

127 **Environment Management (air, land and water) incidents**

128 *Introduction – air, land and water*

129 Incidents within the responsibility of Environment Management must be assigned an impact
130 category for each of the environmental media (air, land and water) affected that are within the
131 Environment Agency’s responsibility or area of business.

132

133 *Impacts within our area of business*

134 Any impact to surface waters or groundwater is within our business. Only assess impact on air
135 and land when it arises from a site, substance or process under the regulation of the
136 Environment Agency. Our responsibilities include:

- 137 • impacts from activities that cause damage to the physical habitat of a water body;
- 138 • spillage or discharge from a facility regulated under the Environmental Permitting
139 (England and Wales) Regulations 2010:
 - 140 ○ installations;
 - 141 ○ mobile plant;
 - 142 ○ waste operation (formerly under Waste Management Licenses);
 - 143 ○ mining waste operation;
 - 144 ○ water discharge activity;

- 145 ○ groundwater activity;
- 146 ○ radioactive substances activity;
- 147 • any activities which are registered as exempt under the Environmental Permitting
- 148 Regulations;
- 149 • amenity issues at regulated sites
- 150 • sites regulated under the Control of Major Accidents and Hazards Regulations;
- 151 • controlled waste (including sewage) and illegal deposit of waste (where it is our
- 152 responsibility under the Flytipping Protocol for England and Wales):
- 153 • any other water quality incidents (including impact of sediment or blue/green algae).

154

155 This methodology applies regardless of whether there are specific conditions relating to the
156 impact attached to the permission.

157

158 *Impacts outside our business*

159 Assign impacts that are not within our area of business as ‘impact not within Environment
160 Agency business’ on NIRS. This option only applies to the environmental media of air and
161 land. For example:

- 162 • A death caused by smoke inhalation at a fire at a site, substance or process that we do
163 not regulate will be assigned as not within Environment Agency business for air.
- 164 • A spillage from a domestic tank (and where the Oil Storage Regulations do not apply)
165 which has resulted in soil contamination will be assigned as not within Environment
166 Agency business for land.
- 167 • Erosion resulting in run-off contaminated with soil when it rains will be assigned as not
168 within Environment Agency business for land.

169

170 *Impacts on human health*

171 It is important to consider and record the impact the incident has on human health (for a site,
172 substance or process we regulate) even though we are not experts in human health.

173

174 Consider the offence caused to human senses. This is particularly important when assessing
175 the impact from noise, dust and odour.

176

177 Consider the possible links between the source, pathway and any human receptors. You will
178 probably need to get advice from the local authority Environmental Health department and / or
179 Public Health England (PHE).

180

181 You must notify PHE of incidents that have a potential or actual Category 1 or 2 impact and
182 where there is likely to be public concern about the health effect or people could be exposed to
183 the hazardous substance. Refer to Operational instruction 134_07 on the notification of
184 pollution incidents affecting human health to PHE.

185

186 *Impact on ecology – consult F&B teams*

187 Refer to impact on ecology and consult area Fisheries and Biodiversity (F&B) teams whenever
188 an incident may have impacted on ecology. Ecological incidents have been categorised by
189 impact to nature conservation for protected sites and species, physical habitat for
190 hydromorphological damage and fish stocks. You must consider any implications under the
191 Environmental Damage Regulations. F&B must consult Analysis and Reporting teams for
192 input on Water Framework Directive impacts.

193

194

195 *Natural phenomenon /forces*

196 Record incidents that can be attributable to natural phenomenon or forces under the appropriate
197 Environment Management (air, land and water) impact scheme.

198 Natural sources include iron deposits on a stream bed and oil films from decaying
199 vegetation/peat. The pollution of water with soil, which is linked to poor land management
200 practices, is not a natural phenomenon. Ensure you select the correct cause on NIRS.

201 Record the death of fish and other aquatic wildlife caused by other natural phenomenon such
202 as low flows, fish disease, and spawning stress under the appropriate Water Resources or
203 Fisheries impact scheme. Refer to Recording dry weather and drought related incidents.

204 In other cases, such as fish kills following algal blooms which may be due to low dissolved
205 oxygen or algal toxin, the function taking the lead in the incident must classify the incident.
206 Refer to Methodology – type of incident.

207

208 **Impact on air**

209 *Definition of air*

210 Air' includes impacts related to air quality, noise, odour, flies and dust/particulate fallout. We
211 are responsible for co-ordinating air quality monitoring and modelling for major air pollution
212 incidents, irrespective of source. For all other incidents, only assess impact on air when it arises
213 from a site, substance or process under the regulation of the Environment Agency.

214

215 Assign impacts that are not within our area of business as 'impact not within Environment
216 Agency business' on NIRS. For example, a death caused by smoke inhalation at a fire at a site,
217 substance or process that we do not regulate. Note: Our operational response for major air
218 pollution incidents is broader than our regulatory remit, and the impact of these incidents on
219 air must be assessed.

220

221 We are responsible for taking action if emissions of noise, dust, fumes or odour from facilities
222 we regulate are considered to represent a statutory nuisance by the local authority.

223 Guidance on categorising impacts to human senses and amenity issues are provided in a
224 separate section. These must be considered in addition to the main guidance on impacts to air.

225 The level assigned will be the category in which the most serious criteria selected are listed.

226 Do not forget to consider the possible impact on land and water from any fall-out from air.

227 Record any impacts on surface waters or groundwater under the 'Impact on water' scheme.

228 Record any impacts on land under the 'Impact on land' scheme.

229

230 *Assessing effects on air quality*

231 Assess effects on air quality against the UK Air Quality Strategy (AQS) standards.

232 Consider the following aspects when determining the impact:

- 233 • the effects of weather and/or traffic (these will need to be differentiated from the effect
234 of the polluting source);
- 235 • the duration of the incident, the actual pollutant levels;
- 236 • the frequency of the incidents and their immediate and/or longer term impact on UK
237 AQS objectives or local Environmental Quality Standards;
- 238 • the scale of the pollutant release.

239

240 Incidents related to the exceedence of UK AQS standards may arise from alarm conditions
241 from Defra's or the local authorities' monitoring networks as well as from reports by the public.

242 Note: Major incidents arising from an installation would probably cause one or more breaches
243 of the permit/authorisation with gross exceedence of emission limits.

244

245 The Pollution Inventory can provide some historical emission history for a particular
 246 installation to view the seriousness and abnormality of the release.

247

248 **Table B2. CICs Tier 12 classification - Impact on air.**

Category	Criteria	Definition and guidance on impact criteria (one or more definition or criteria are met)
Category 1	Major effect on air quality	<p>A persistent and/or extensive effect on air quality including:</p> <ul style="list-style-type: none"> • Release of materials which directly cause or will lead to significant exceedence of the standards in the UK Air Quality Strategy for a sustained period, over an extensive area.
	Major damage to nature conservation	<ul style="list-style-type: none"> • Extensive and significant deterioration in air quality from a release of large quantities of toxic materials. This may follow a serious loss of control, major fire or major equipment failure. Smoke and combustion products arising from a fire contain toxic materials. • Release of very large quantities of materials which are prohibited in production and/or use (such as, CFCs linked to global warming or ozone depletion). • Release causing major adverse effect on a statutorily protected site or on a species or Water Framework Directive water body.
		<p>Refer to Impact on nature conservation sites and species for guidance.</p>

Category	Criteria	Definition and guidance on impact criteria (one or more definition or criteria are met)
		<p>Major damage to nature conservation can arise from acute effects of a major toxic or radioactive release, although dispersion by wind of the pollutants even for large releases often ameliorates the impact of single major incidents.</p> <p>Chronic effects can arise from sustained pollutant release although the full impact may only become evident some months or even years later.</p>
Serious effect on human health		<ul style="list-style-type: none"> <li data-bbox="687 857 1409 1330">• Fatality, serious injury (such as loss a limb or organ) or acute effect on human health as a result of release of substance(s) to atmosphere. This could apply to employees on the release site (for which HSE are responsible under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations [RIDDOR]) or the general public. <li data-bbox="687 1373 1409 1697">• Public exposed to concentration levels over a widespread area giving rise to serious and known health risks in either the short or longer term following a release. Likely to cause severe offence to human senses. <p>This could include smoke and combustion products arising from a major fire or a short term but very toxic high impact release.</p>

Category	Criteria	Definition and guidance on impact criteria (one or more definition or criteria are met)
Major effect on amenity value	Major impact on property	<p>The incident may need significant intervention and remedial action by the emergency services. For example, a containment failure at a hazardous waste treatment facility which led to the release of hydrogen sulphide, the evacuation of local residents and hospitalisation of two or more workers.</p> <p>Significant effects may be noticed by sensitive and non-sensitive individuals and action to avoid these effects may be needed (such as evacuation).</p> <ul style="list-style-type: none"> • Release resulting in a major adverse effect on an important recreation activity or public event prohibiting the normal range of activities. For example, cancellation a national sporting event following a release from a regulated site. • Release resulting in danger to the public requiring action by the emergency services to advise the public on window closure, the need to remain indoors, closure of access roads or evacuation of property. • Release or significant fall out of material causing serious contamination of property requiring specialised remediation, decontamination or destruction of property.

Category	Criteria	Definition and guidance on impact criteria (one or more definition or criteria are met)
	Major damage to agriculture/commerce	<ul style="list-style-type: none"> • Major damage to agricultural activity such as the extensive contamination of crops or soil rendering them unfit for use and/or death or slaughter of livestock, due to airborne pollution. • Major disruption to commercial interests such as extended closure of an industrial site serious interruption of production due to airborne pollution.
Category 2	Significant effect on air quality	<ul style="list-style-type: none"> • Release of materials which directly causes or will lead to significant exceedence of the standards in the UK Air Quality Strategy for a sustained period, over a localised area. • Noticeable and sustained deterioration in air quality from visible sources (dust and particulate fallout) or emission of toxic materials impacting on the locality. • Release of large quantities of materials which are prohibited in production and/or use (such as, CFCs linked to global warming or ozone depletion).
	Significant damage to nature conservation	<ul style="list-style-type: none"> • Damage to a statutorily protected site or species or Water Framework Directive water body. • Extensive and/or significant damage to BAP species or habitats and non-statutory protected species.

Refer to Impact on nature conservation sites and species for guidance.

Category	Criteria	Definition and guidance on impact criteria (one or more definition or criteria are met)
Significant effect on human health		<ul style="list-style-type: none"> • Significant injury (usually involving the need to go to hospital) or effect on human health as a direct result of release of substance(s) to atmosphere. • Public exposed to concentration levels giving rise to possible minor health risks in either the short or longer term following a release into the atmosphere. Likely to cause significant offence to human senses. <p>Significant effects may be noticed by sensitive individuals and action to avoid or reduce these effects may be needed (such as reducing exposure by spending less time in polluted areas outdoors). Asthmatics will find that their 'reliever' inhaler is likely to reverse the effects on the lung.</p>
Significant effect on amenity value		<ul style="list-style-type: none"> • Significant adverse effect on recreational activity, event or public space, prohibiting the normal range of activities. This includes effects caused by smoke and airborne dust.
Significant impact on property		<ul style="list-style-type: none"> • Significant damage to property. This includes damage caused to car paintwork and windows from the fall out of material and resulting in compensation claims against the responsible party.

Category	Criteria	Definition and guidance on impact criteria (one or more definition or criteria are met)
	Significant damage to agriculture/ commerce	<ul style="list-style-type: none"> • Significant but localised damage to agricultural activity. Such as, the contamination of crops which need extra treatment to restore to useable condition. Or distress to livestock and the need for veterinary treatment. • Significant damage to commercial activity such as the short-term closure of a site or limited loss of production.
Category 3	Minimal effect on air quality	<ul style="list-style-type: none"> • Shorter term, local effect on air quality arising from smells or visible impact (smoke and dust).
	Minor damage to local nature conservation	<ul style="list-style-type: none"> • Very limited impact upon nature conservation or Water Framework Directive water body. <p>Refer to Impact on nature conservation sites and species for guidance.</p>
	Minimal effect on human health	<ul style="list-style-type: none"> • Minor injury or effect on human health as a direct result of release of substance(s) to atmosphere. For example, a few individuals with temporary sore throats or headaches. Record the impact as a Category 2 where multiple complaints of minor health effects are reported. • Public exposed to concentration levels that present no known or a minimal risk to health. Likely to be mildly offensive to senses.

Category	Criteria	Definition and guidance on impact criteria (one or more definition or criteria are met)
		Mild effects, which are unlikely to require action, may be noticed amongst sensitive individuals.
	Minor effect on amenity value	<ul style="list-style-type: none"> • Minor transitory affect on the public local to the site. May be considered to be a minor nuisance, with minor effects on the normal range of activities.
	Minor impact on property	<ul style="list-style-type: none"> • Minor effect on property. This includes visible fallout of inert dust or particulate, onto car paintwork or buildings, but which causes no damage and is easily removed.
	Minimal damage to agriculture/ commerce	<ul style="list-style-type: none"> • Minor damage to agriculture or commerce. Such as, inert dust or particulate fallout but which has no deleterious effect on crops, livestock or commercial activity. Would be easily washed off by rain or water.
Category 4	No impact	Substantiated incident with no impact to air quality.

249

250

251 **Appendix C. Applying an adapted Carstairs deprivation index to rural areas**
252 **around intensive farms**

253

254 **Methods**

255 Fecht et al., (2017) adapted the Carstairs deprivation index to make the index more sensitive to
256 capturing deprivation in urban areas. To create the adapted index, RCar, the standard Carstairs
257 index scores were re-calculated and re-standardised to COAs classified as rural areas (Equation
258 B1).

259

$$RCar = \sum_{i=1}^n \frac{X_i - \bar{x}}{sd_x}$$

Equation B1

$$X_i = \frac{n_i}{d_i}$$

260

261 Where:

- 262 • n_i is the numerator of the deprivation variable X_i (e.g. the number of households that
263 do not own a car)
- 264 • d_i is the dominator of deprivation variable X_i (e.g. the number of households in England)
- 265 • \bar{x} is the mean of X_i
- 266 • sd_x is the standard deviation of X_i

267

268 The RCar was then categorised into quintiles.

269

270 **Results**

271 The deprivation characteristics using RCar per distance band are presented in Table B1.

Table B1. Population, and deprivation characteristics (using RCar at COA level) around intensive farms by distance band

		Distance from the facility (m)				
		≤100	>100 - ≤500	>500 - ≤1,000	>1000 - ≤4,828	The rest of rural England ^a
No. of COAs in rural areas^b (%)		5	140	570	10,417	19,977
Total Population in rural areas^b (%)		1,242	41,628	175,530	3,151,596	5,993,424
Population per RCar	1	288	8,321	34,226	598,697	1,283,827
	(%)	(23.19)	(19.99)	(19.50)	(19.00)	(21.42)
deprivation quintile^b	[p-value] ^c	[0.23]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
	2	279	9,003	43,880	653,287	1,202,010
	(%)	(22.46)	(21.63)	(25.00)	(20.73)	(20.06)
1=least deprived	[p-value] ^c	[0.09]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
	3	541	8,457	45,014	670,766	1,169,895
	(%)	(43.56)	(20.32)	(25.64)	(21.28)	(19.52)
	[p-value] ^c	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
	4	0	9,989	26,476	638,688	1,187,660
	(%)	(0.00)	(24.00)	(15.08)	(20.27)	(19.82)
	[p-value] ^c	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
	5	134	5,858	25,934	590,158	1,150,032
	(%)	(10.79)	(14.07)	(14.77)	(18.73)	(19.19)
	[p-value] ^c	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]

a – Comparison area

b – Based on data available at COA level, where the COA population weighted centroid falls within the stated distance band

c – Chi-squared test when comparing to the comparison area (>4,828m, the rest of rural England)

Appendix D. Results: Incidents and notifications attributed to intensive farms

The number of incidents and notifications attributed to intensive farm facilities per year are presented in Figure D1.

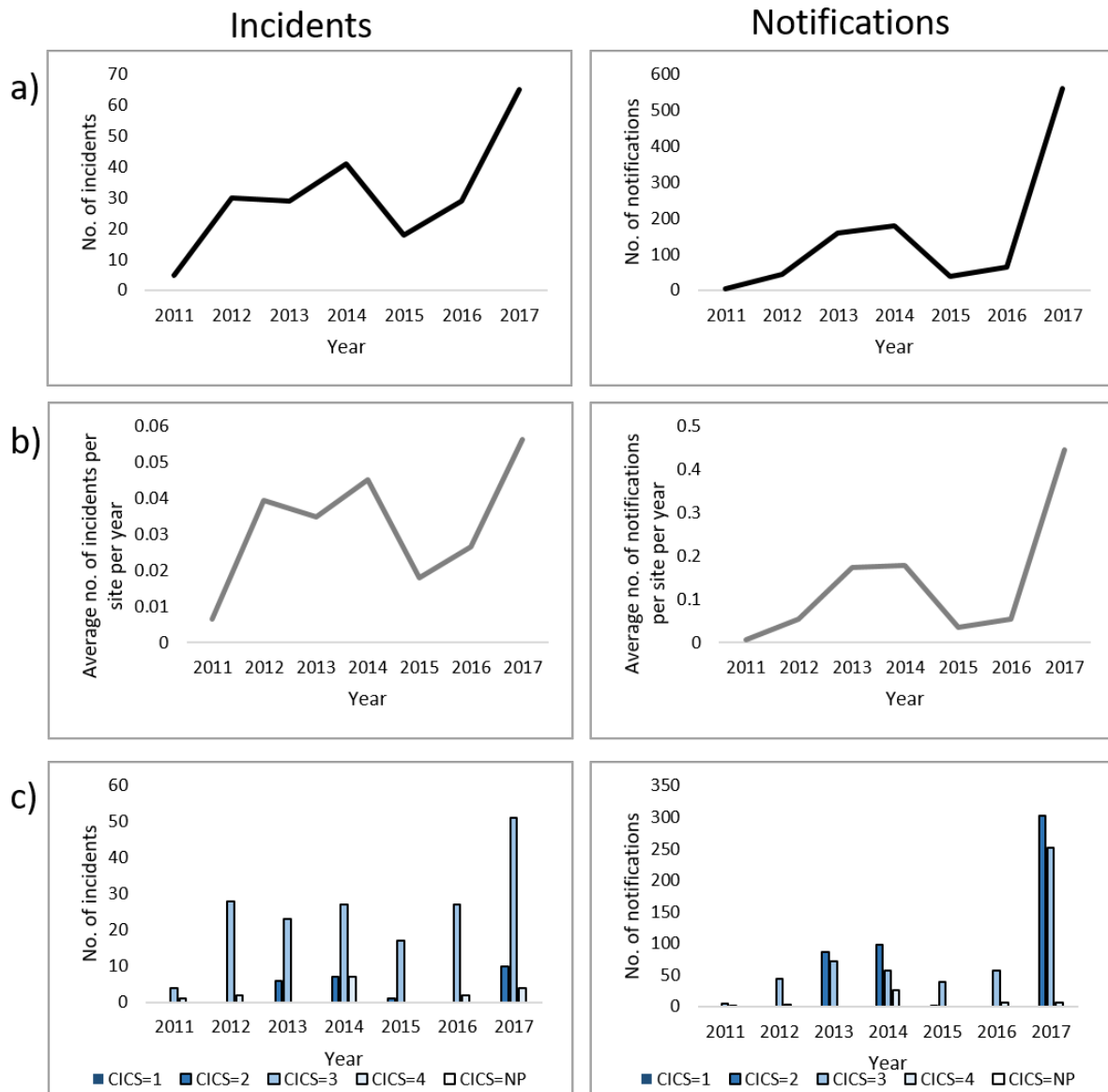


Figure D1. The number of incidents and notifications attributed to intensive farming facilities: (a) The number of incidents and notifications per year; b) The number of incidents and notifications per year, averaged by the number of intensive farm facilities operating that year; c) The number of incidents and notifications per CICS category per year (1=major, serious, persistent and/or extensive; 2=significant; 3=minor or minimal;

impact or effect on the environment, people and/or property, 4= substantiated incident with no impact, NP=not provided))

Overall, the number of incidents is increasing, with 5 incidents reported in 2011, and 65 reported in 2017 (92.31% increase); similarly, the number of notifications per year are also increasing (Figure 5a). This trend remains when averaging the number of incidents and notifications by the number of operational intensive farm facilities (Figure 5b). The incidents and notifications are attributed to a small number of intensive farms, with 65 incidents reported in 2017 attributed to 22 intensive farm facilities (2%); more than one incident was attributed to 10 of these farms (the maximum number of incidents attributed to a single facility was 19, with 250 notifications).

The majority of incidents (82%) were classified as CICS score 3 (minor or minimal impact or effect on the environment, people and/or property) (Figure 5c). The majority of notifications were classified as CICS score 2 (significant impact or effect on the environment, people and/or property) (46%) or 3 (50%). The number of incidents and notifications in each CICS category has also increased over time. There were no CICS score 1 (major, serious, persistent and/or extensive impacts or effects on the environment, people and/or property) incidents.

Overall, this suggests that the emissions from intensive farm facilities are getting worse over time, resulting in an increase in the number of reported air pollution related incidents and notifications. It also suggests that public concern regarding emissions from intensive farm facilities is also increasing. However, the incidents tend to be attributed to the same intensive farms.

Appendix E. Results: Population characteristics around intensive farming facilities with reported incidents.

Table E1. Population and area-level characterises (at Census Output Areas (COAs)) close to intensive farming facilities which had at least one incident classified with a CICS score 2, by distance band

	Distance from the facility (m)			
	≤100	>100 - ≤500	>500 - ≤1,000	>1,000 - ≤4,828
No. of COAs (%)^a	0 (0.00)	43 (1.08)	144 (3.61)	3,804 (95.31)
Total Population (%)^a	0 (0.00)	932 (0.62)	7,488 (5.00)	141,264 (94.38)
No. Males (%)^a	0 (0.00)	492 (52.79)	3,724 (49.73)	68,701 (48.63)
No. of Children (%)^{a,b}	0 (0.00)	114 (12.23)	1,969 (26.30)	31,800 (22.51)
No. of Older adults (%)^{a,c}	0 (0.00)	320 (34.33)	1,087 (14.52)	30,136 (21.33)
Population per Carstairs 1 deprivation quintile (%)^a	0 (0.00)	298 (31.97)	5,570 (74.39)	48,358 (34.23)
2	0	508	1,327	39,442

1=least deprived		(0.00)	(54.51)	(17.72)	(27.92)
	3	0	126	0	31,383
		(0.00)	(13.52)	(0.00)	(22.22)
	4	0	0	591	18,532
		(0.00)	(0.00)	(7.89)	(13.12)
	5	0	0	0	3,549
		(0.00)	(0.00)	(0.00)	(2.51)
Population in Urban areas (%)^a		0	238	6,704	80,850
		(0.00)	(25.54)	(89.53)	(57.23)
No. of Schools (%)^d	Total	0	0	4	66
		(0.00)	(0.00)	(5.71)	(94.29)
	Primary education^e	0	0	4	58
		(0.00)	(0.00)	(100.00)	(87.89)
	Secondary education^f	0	0	0	8
		(0.00)	(0.00)	(0.00)	(12.12)

a. Based on data available at COA level, where the COA population weighted centroid falls within the stated distance bands

b. Number of children aged ≤ 19 years, based on data available at COA level

c. Number of elderly adults aged ≥ 65 years, based on data available at COA level

d. Based on data available at postcode level

e. Number of schools classed as 'Primary', 'Middle deemed primary', 'Nursery', 'All through', 'Not applicable' or classification is missing (mean average lowest age of students =4.19, mean average highest age of students =11.48)

f. Number of schools classed as 'Secondary', 'Middle deemed secondary', or '16 plus' (mean average lowest age of students =11.06, mean average highest age of students =17.30)

Table E2. Population and area-level characterises (at Census Output Areas (COAs)) close to intensive farming facilities which had at least one incident classified with a CICS score 3, by distance band.

	Distance from the facility (m) ^g			
	≤100	>100 - ≤500	>500 - ≤1,000	>1,000 - ≤4,828
No. of COAs (%)^a	9 (0.04)	315 (1.27)	684 (2.75)	23,810 (95.94)
Total Population (%)^a	260 (0.03)	11,139 (1.17)	23,349 (2.44)	919,954 (96.36)
No. Males (%)^a	119 (45.77)	5,410 (48.57)	11,502 (49.26)	451,453 (49.07)
No. of Children (%)^{a,b}	41 (15.77)	2,689 (24.14)	5,417 (23.20)	218,686 (23.77)
No. of Older adults (%)^{a,c}	97 (37.31)	2,108 (18.92)	4,237 (18.15)	164,62 (17.89)
Population per Carstairs 1 deprivation quintile (%)^a	0 (0.00)	3,591 (32.24)	5,142 (22.02)	213,266 (23.18)
2	260 (100.00)	1,998 (17.94)	5,292 (22.66)	237,984 (25.87)
1=least deprived				
3	0 (0.00)	3,177 (28.52)	5,668 (24.27)	191,866 (20.86)

	4	0	1,422	4,552	140,046
		(0.00)	(12.76)	(19.49)	(15.22)
	5	0	951	2,695	136,792
		(0.00)	(8.54)	(11.54)	(14.87)
Population in Urban areas (%)^a		0	5,141	12,755	650,991
		(0.00)	(46.15)	(54.63)	(70.76)
No. of Schools (%)^d	Total	2	5	11	374
		(0.51)	(1.28)	(2.81)	(69.90)
	Primary education^e	1	5	10	316
		(50.00)	(100.00)	(90.91)	(84.49)
	Secondary education^f	1	0	1	58
		(50.00)	(0.00)	(9.09)	(15.51)

a. Based on data available at COA level, where the COA population weighted centroid falls within the stated distance bands

b. Number of children aged ≤ 19 years, based on data available at COA level

c. Number of elderly adults aged ≥ 65 years, based on data available at COA level

d. Based on data available at postcode level

e. Number of schools classed as 'Primary', 'Middle deemed primary', 'Nursery', 'All through', 'Not applicable' or classification is missing (mean average lowest age of students =4.19, mean average highest age of students =11.48)

f. Number of schools classed as 'Secondary', 'Middle deemed secondary', or '16 plus' (mean average lowest age of students =11.06, mean average highest age of students =17.30)

g. It was not possible to geocode 1 intensive farm that had at least one incident with a CICS score of 3

Appendix F. Results: Incidents and notifications attributed to composting facilities

The number of incidents and notifications attributed to composting facilities per year are presented in Figure E1. There are more incidents (n=1,721) and notifications (n=7,251) attributed to composting facilities than intensive farm facilities (217 incidents, 1,051 notifications).

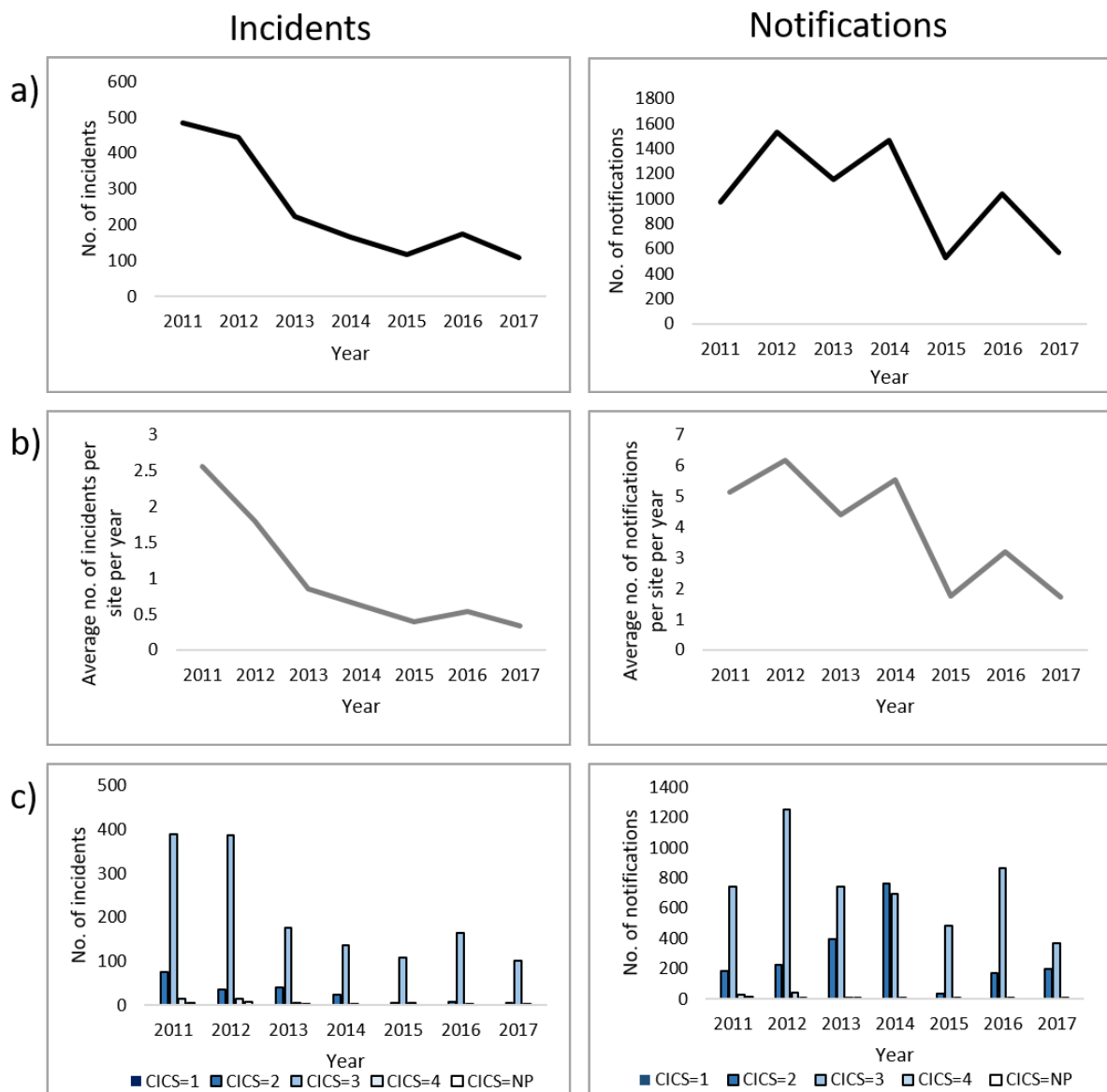


Figure E1. The number of incidents and notifications attributed to composting facilities: (a) The number of incidents and notifications per year; b) The number of incidents and notifications per year, averaged by the number of composting facilities operating that

year; c) The number of incidents and notifications per CICS category per year (1=major, serious, persistent and/or extensive; 2=significant; 3=minor or minimal; impact or effect on the environment, people and/or property, 4= substantiated incident with no impact, NP=not provided))

Overall, the number of incidents are reducing, with 485 incidents reported in 2011, and 110 reported in 2017 (61.40% decrease) (Figure 6a), despite a 72% increase in the number of composting facilities (Figure 1); similarly, the number of notifications per year are also decreasing over time. A similar trend is observed when averaging the number of incidents and notifications by the number of operational composting facilities (Figure 6b). As seen for intensive farm facilities, the incidents and notifications relate to a small number of composting facilities, with 110 incidents reported in 2017 relating to 41 composting facilities (13%); 14 of these composting facilities had more than one incident reported (the maximum number of incidents related to a single facility was 185, with 1,025 notifications).

The majority of incidents (85%) and notifications (71%) were classified as CICS score 3 (Figure 6c). The number of incident and notifications in each CICS category decreased over time, although there was an isolated increase in CICS score 2 notifications in 2014, which accounted for 52% of notifications that year. There were two CICS score 1 incidents (each received 3 notifications, which occurred in 2014).

Overall, this suggests that the emissions from composting facilities are improving over time, resulting in fewer reported air pollution related incidents, and that public concern regarding emissions from composting facilities is reducing. However, the incidents tend to be attributed to a small number of composting facilities (some with multiple incidents).

Appendix G. Results: Population characteristics around intensive farming facilities with reported incidents.

Table G1. Population and area-level characteristics (at Census Output Areas (COAs)) close to composting facilities which had at least one incident classified with a CICS score 2, by distance band.

	Distance from the facility (m)				
	≤250	>250 - ≤750	>750 - ≤1,500	>1500 - ≤2,500	>2,500 - ≤4,000
No. of COAs (%)^a	142 (0.47)	849 (2.81)	2,276 (7.53)	6,800 (22.51)	20,139 (66.67)
Total Population (%)^a	6,112 (0.43)	39,715 (2.81)	112,227 (97.96)	315,169 (22.34)	947,232 (67.15)
No. Males (%)^a	2,953 (48.31)	19,390 (48.82)	54,627 (48.68)	154,673 (49.08)	462,439 (48.82)
No. of Children (%)^{a,b}	1,410 (23.07)	10,097 (25.42)	27,699 (24.68)	75,497 (23.95)	226,222 (23.88)
No. of Older adults (%)^{a,c}	784 (12.83)	6,083 (15.32)	18,852 (16.80)	56,412 (17.90)	158,992 (16.78)
Population per 1 Carstairs	2,136 (34.95)	9,610 (24.20)	19,050 (16.97)	75,361 (23.91)	183,708 (19.39)
2	1,089	6,511	24,277	72,088	236,512

deprivation quintile		(17.82)	(16.39)	(21.63)	(22.87)	(24.97)
(%)^a	3	1,575	9,523	24,953	64,324	220,991
		(25.77)	(23.98)	(22.23)	(20.41)	(23.33)
1=least deprived	4	1,012	6,914	26,730	57,168	185,148
		(16.56)	(17.41)	(23.82)	(18.14)	(19.55)
	5	300	7,152	17,217	46,228	120,873
		(4.91)	(18.01)	(15.34)	(14.67)	(12.76)
Population in Urban areas (%)^a		5,775	36,817	103,070	271,300	840,596
		(94.49)	(92.70)	(91.84)	(86.08)	(88.74)
No. of Schools (%)^d	Total	2	16	45	139	359
		(0.36)	(2.85)	(8.02)	(24.78)	(63.99)
	Primary	2	12	38	121	311
	education^e	(100.00)	(75.00)	(84.44)	(87.05)	(86.63)
	Secondary	0	4	7	18	48
	education^f	(0.00)	(25.00)	(15.56)	(12.95)	(13.37)

a. Based on data available at COA level, where the COA population weighted centroid falls within the stated distance bands

b. Number of children aged ≤19 years, based on data available at COA level

c. Number of elderly adults aged ≥65 years, based on data available at COA level

d. Based on data available at postcode level

e. Number of schools classed as 'Primary', 'Middle deemed primary', 'Nursery', 'All through', 'Not applicable' or classification is missing (mean average lowest age of students =4.19, mean average highest age of students =11.48)

f. Number of schools classed as 'Secondary', 'Middle deemed secondary', or '16 plus' (mean average lowest age of students =11.06, mean average highest age of students =17.30)

Table G2. Population and area-level characterises (at Census Output Areas (COAs)) close to composting facilities which had at least one incident classified with a CICS score 3, by distance band.

	Distance from the facility (m) ^g				
	≤250	>250 - ≤750	>750 - ≤1500	>1,500 - ≤2,500	>2,500 - ≤4,000
No. of COAs (%)^a	160 (0.16)	2,229 (2.25)	9,908 (9.98)	26,331 (26.54)	60,599 (61.07)
Total Population (%)^a	6,446 (0.14)	101,794 (2.16)	454,652 (9.67)	1,245,516 (26.49)	2,893,219 (61.54)
No. Males (%)^a	3,101 (48.11)	49,944 (49.06)	223,475 (49.15)	611,214 (49.07)	1,419,666 (49.07)
No. of Children (%)^{a,b}	1,596 (24.76)	26,636 (26.17)	115,836 (25.48)	312,997 (25.13)	706,528 (24.42)
No. of Older adults (%)^{a,c}	1,194 (18.52)	14,785 (14.52)	70,270 (15.46)	197,416 (15.85)	464,294 (16.05)
Population per 1 Carstairs deprivation quintile 2 (%)^a	1,862 (28.89)	16,896 (16.60)	61,022 (13.42)	188,632 (15.14)	483,059 (16.70)
3	1,466 (22.74)	16,67 (16.38)	71,169 (15.65)	225,094 (18.07)	587,214 (20.30)
1=least deprived	564 (8.75)	19,127 (18.79)	71,258 (15.67)	222,554 (17.87)	561,039 (19.39)

	4	1,459 (22.63)	19,303 (18.96)	97,336 (21.41)	237,280 (19.05)	567,859 (19.63)
	5	1,095 (16.99)	29,798 (29.27)	153,867 (33.84)	371,826 (29.85)	693,943 (23.99)
Population in Urban areas (%)^a		4,446 (68.97)	79,814 (78.41)	389,067 (85.57)	1,097,797 (88.14))	2,576,684 (89.06)
No. of Schools (%)^d	Total	3 (0.15)	32 (1.62)	202 (10.24)	525 (26.62)	1,210 (61.36)
	Primary education^e	2 (66.67)	29 (90.63)	179 (88.61)	449 (85.52)	1,040 (85.95)
	Secondary education^e	1 (33.33)	3 (9.37)	23 (11.39)	76 (14.48)	170 (14.05)

a. Based on data available at COA level, where the COA population weighted centroid falls within the stated distance bands

b. Number of children aged ≤ 19 years, based on data available at COA level

c. Number of elderly adults aged ≥ 65 years, based on data available at COA level

d. Based on data available at postcode level

e. Number of schools classed as 'Primary', 'Middle deemed primary', 'Nursery', 'All through', 'Not applicable' or classification is missing (mean average lowest age of students =4.19, mean average highest age of students =11.48)

f. Number of schools classed as 'Secondary', 'Middle deemed secondary', or '16 plus' (mean average lowest age of students =11.06, mean average highest age of students =17.30)

g. It was not possible to geocode 50 composting facilities that had at least one incident with a CICS score of 3

References

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