



Animal &
Plant Health
Agency

EPIDEMIOLOGY REPORT

**H7N7 Low Pathogenic Avian
Influenza outbreak (AIV2015/01) in
broiler breeder chickens**

February 2015, England, UK



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1. Executive Summary

- a. Low Pathogenic Avian Influenza (LPAI) was confirmed on 2nd February 2015 in a broiler breeder chicken premises in Hampshire, England now designated as the Infected Premises (IP), reference number AIV2015/01. The company has a number of broiler breeder/rearer sites (including the IP) in Southern England, and supplies hatching eggs under contract to a local hatchery.
- b. The virus that caused the outbreak is strain H7N7 LPAI. The H7N7 subtype has been detected on several occasions in the last few years in poultry within the EU. Genetic analyses indicate that this virus is of avian origin closely related to contemporary European H7 strains and with no strong correlates for increased human affinity. Furthermore, these analyses suggest a recent introduction of the virus from a wild bird source, rather than via prior passage through chickens. The last time this strain was detected in the UK was in June 2008 near Banbury when the virus had been introduced to the IP as an low pathogenic strain (LPAI) but mutated to Highly Pathogenic Avian Influenza (HPAI) during spread through the flock.
- c. There is some uncertainty as to the source of infection for the IP, however all the available evidence strongly suggests that indirect contact with infected wild birds, as a result of flooding of the poultry housing on 15th January 2015 by water from a neighbouring field known to be frequented by large numbers of wild birds (including gulls, corvids and waterfowl), is the most likely source.
- d. This assessment is based on findings from the investigation including: the timing of clinical signs on the IP in relation to the flood, that no poultry or eggs were brought onto the IP during the source window; the absence of other cases having been identified in poultry in the UK despite heightened awareness and additional active surveillance; the time of year of this outbreak with respect to wild bird migratory movements, the finding of this strain of virus in healthy wild birds, and the analyses of the virus which suggest a recent introduction from wild birds to poultry.
- e. In addition evidence suggests that high levels of biosecurity are generally and consistently enforced on the IP and within the wider company structure. Equally the structural integrity of the shed makes direct contact with wild birds unlikely. This supports the hypothesis of indirect contact rather than direct contact with wild birds as could occur during the flooding of the poultry housing from a nearby field frequented by wild birds.
- f. There were no other premises containing poultry or captive birds found to be present within the 1km restriction zone. Evidence following epidemiological investigation of potential contacts to the IP, including sampling with negative results of five other premises considered to be medium risk tracings indicates that there has been no spread of infection from the Infected Premises.

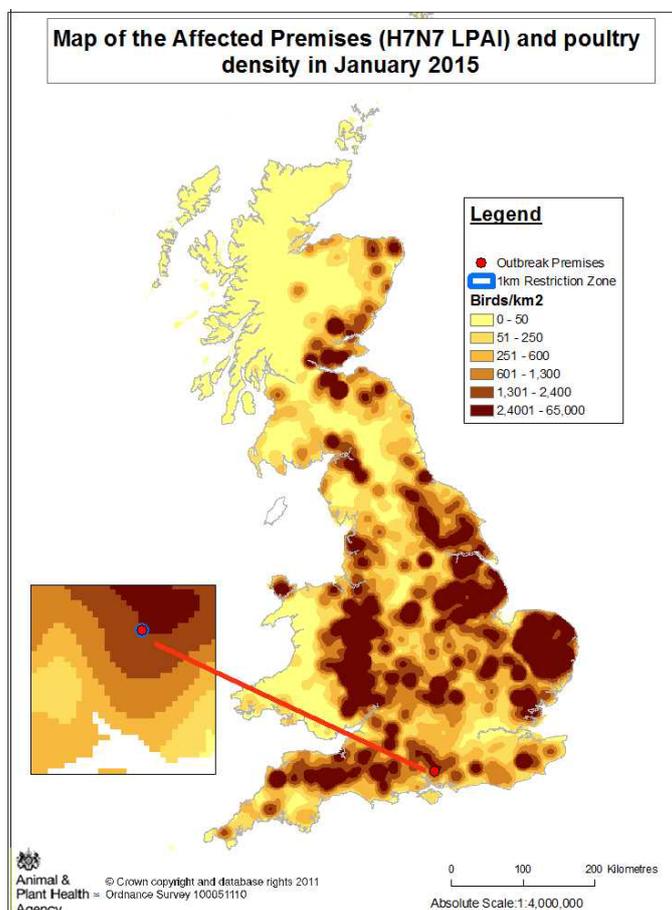
2. Introduction

This report documents the epidemiological investigations carried out which seek to describe and explain the outbreak of H7N7 Low Pathogenic Avian Influenza (LPAI) infection in broiler breeder chickens on a premises in Hampshire, England.

This report will be used to provide evidence to support the UK's claim to have controlled the outbreak and declare freedom from H7N7 LPAI to the EU and OIE; to provide source material for the technical annex for UK co-financing claims to the EU; to record logistics and technicalities of investigation and control to inform future resource planning, contingency plans and training requirements; and to highlight gaps in our understanding of LPAI and so identify areas for further research or other needs.

3. Description of the Infected Premises

The IP is a commercial indoor broiler breeding site in the south of England (see map) with one poultry shed housing approximately 10,000 birds equally divided between two pens (referred to as 'House 1' and 'House 2'), separated by a central service area (Figure 1). The site operates an all-in / all-out production system and the current flock of birds was placed in August 2014 and since then no live birds had been moved onto or off the site.



The company has a number of broiler breeder/rearer sites (including the IP) in Southern England, and supplies hatching eggs under contract to a local hatchery. Evidence suggests that high levels of biosecurity are generally and consistently enforced on the IP and within the wider company structure.

Visitors and site personnel must park off site. There is a disinfectant foot dip containing Defra-approved disinfectant (Virkon S™) at a chain vehicle barrier. Visitors and staff enter a small shed outside the poultry house to sign the visitor's book and put on site-dedicated overalls and green-coloured wellington boots that must be used before entering the poultry shed. Before entering the service area there is another foot dip for the green wellington boots.

In order to enter each bird housing area they must then change the white boots for green boots in a specially designated area with a hygiene barrier. Alcohol-based hand-sanitizers and washbasins are provided at the door for use before entering the bird areas. Before entering the bird housing areas dust masks must also be put on. The reverse of the above protocol must be followed on exiting the shed.

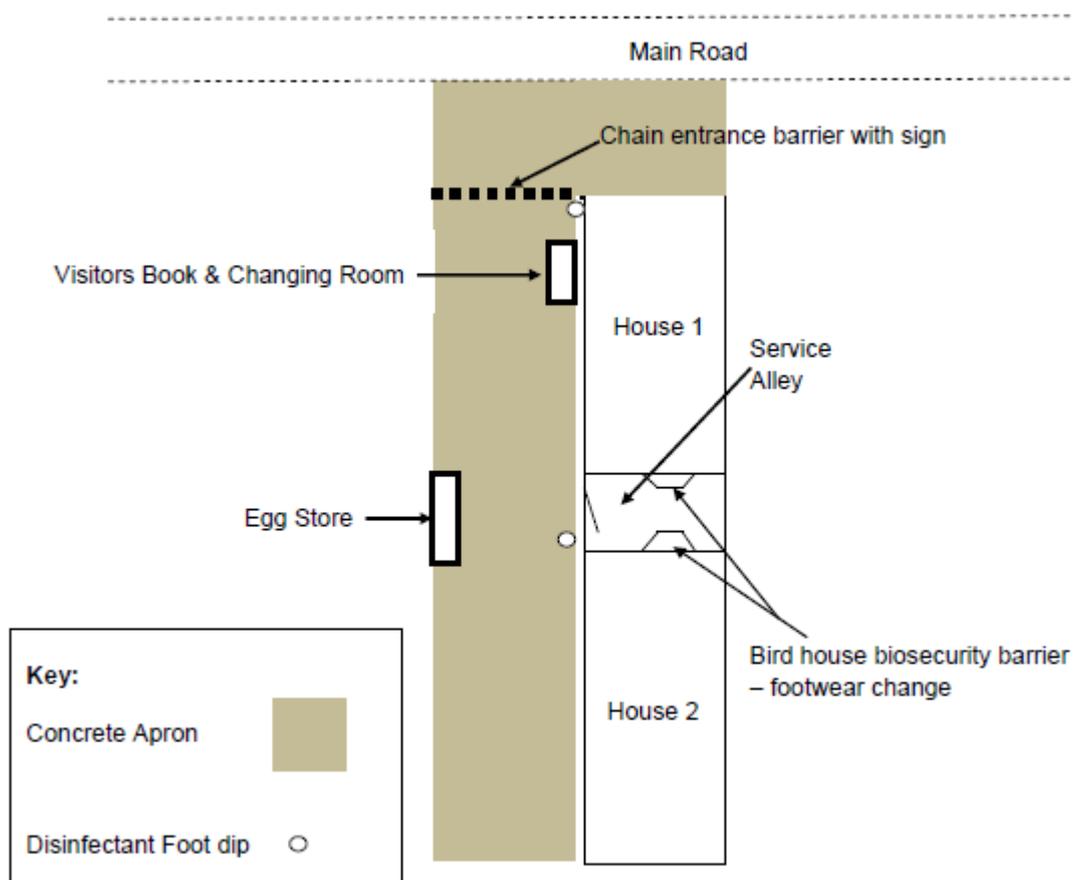


Figure 1. Site plan

Disinfectant for vehicle use is replenished as and when required and foot dips are replenished every 2-3 days. The disinfectant (Virkon S™) is used at a dilution approved for use under General Orders.

Company policy is that employees are prohibited from having contact with any poultry outside of the immediate company and must not keep poultry at home.

Most operations involving the birds are performed by company staff with minimal engagement of external contractors (e.g. no use of vaccination teams, animal by-products collectors etc.). Pest control is carried out by an external pest control company. The last visit by this company took place on the 18th December 2014. They do not have a regular plan of visits and visits would normally be triggered if the farm manager has concerns after he identifies vermin activity on farm. This system is designed to avoid unnecessary visitors to the farms.

For lorry deliveries/collections the vehicle wheels and wheel arches are sprayed with approved disinfectant on entering and leaving the site and protective over-boots supplied by the farm are available for drivers to wear and drivers do not enter the buildings

Eggs are collected three times a week. Eggs are laid in nest boxes containing astro-turf and then roll onto a collection belt which when activated transfers them to the service area. They are collected off the belt and transferred onto plastic trays where each tray contains 132 eggs. Plastic trays are then put onto a wheel rack metal trolley where each trolley contains 4752 eggs. The trolleys are put in containers ready to harbour up to 10 trolleys.

The egg collection vehicles come from a local hatchery. They pass through a security barrier at the entrance to the site (a chain barrier with signage to restrict unauthorised entry – see Fig. 2 above) after the wheels and wheel arches of the lorries have been sprayed with disinfectant on arrival by the drivers. The eggs are not routinely washed unless seen to be visibly contaminated with organic matter (surface contamination on farm is minimised by astro-turf laying areas and company policy is to discard most floor laid eggs because of the effect of contamination on hatchability - any eggs seen to be visibly contaminated are washed using a chlorine based detergent) nor fumigated on farm but are fogged inside the collection lorry – Virocid™ 0.5% (Defra Approved under General & Poultry Orders). Wheels and wheel arches are also sprayed on leaving the site. The IP held the oldest laying flock and so was routinely collected last on the collection route. Once at the hatchery eggs undergo further fogging in the egg store with subsequent formaldehyde fumigation and use of evaporative formaldehyde until close to hatching.

No eggs are sold for human consumption.

Mortality records are kept and differentiate between natural deaths and welfare culls. Carcasses of dead birds and egg shells, broken/soft-shelled eggs are bagged, frozen and kept in a freezer in the service area. These by-products are collected by a company owned dedicated vehicle which is covered and leak proof during transit and taken for disposal to a local ABP approved handling plant from whence they are consigned to an ABP approved Category 2 rendering plant. Bagged carcasses and reject eggs are brought out to the collection driver who does not enter the shed. At

the handling plant, the load is tipped and the vehicle is then disinfected afterwards. Carcasses are only collected from other farms within the same company structure.

Feed is delivered from the mill in sealed bulk blower lorries. The feed is blown into the external silo on site without the need for the driver to enter the shed. Delivery of feed into the poultry houses is via an automated system which schedules quantities supplied to the birds and the feed is always kept in a sealed and dry condition.

Water to the poultry shed is provided via mains supply.

Following depopulation of the site three disinfections and two fumigations are carried out on different days allowing sufficient time in between for disinfectant contact time between treatments. Sheds are maintained in good condition and secure against the entry of wild birds. Wood shavings are stored in polythene bags within the service area of the poultry house.

However, on 15th January 2015 an excess of accumulated surface water from a neighbouring field to the east of the site (owned by an outdoor pig unit) where a natural pond had formed and many wild birds including waterfowl and gulls had collected (attracted in particular during delivery of feed to the pigs) overflowed and breached a bund between this field and the IP site causing partial flooding of both poultry houses. It was reported that flooding had been more severe in House 1 than in House 2.



Figure 2. Flooded poultry houses (Photographs courtesy of the poultry company)

4. Timeline of key events

15/01	Overflow of surface water from neighbouring field caused partial flooding in both poultry houses. Reportedly more severe in House 1 than House 2.
19/01 – 20/01	Drop in egg production in House 1 on 20/01. A reduction in feed consumption was reported on 19/01. Production records show a reduction in water and feed consumption on 19/01 and 21/01 respectively, although this was of one day duration only. It is possibly artefactual but has been included on a precautionary basis. Dead birds were sent for post-mortem by private veterinary surgeon (PVS) on 20/01.
21/01	PVS post mortem suggests severe necrotic enteritis - 5 days of antibiotics agreed and started on 22/01.
23/01	Drop in egg production in House 2 from 23/01. Reduced feed consumption was also reported on 22/01 but is not reflected in production records.
27/01- 29/01	PVS authorised to undertake sampling to eliminate avian flu as a differential diagnosis on 27/01. Samples taken on 28/01 and tested on 29/01 which yielded non-negative results in some samples for influenza A virus by PCR. Verbal restrictions served in the evening of 29/01 via message on company answerphone.
30/01	Written restrictions served at 08:30 when APHA veterinary inquiry commenced and official samples collected and submitted.
31/01	Positive H7 serology and weak positive H7 PCR test results received.
02/02	2 day virus isolation results identified H7 influenza virus. UK confirmed presence of H7 low pathogenic avian influenza on IP (AIV2015/01). Nucleotide sequencing identified the virus as H7N7 LPAI. In accordance with European Union legislative requirements a LPAI Restricted Zone with a radius of 1 kilometre was put in place following confirmation of disease.
04/02	Culling of poultry on IP commenced.
06/02	Culling of approximately 10,520 birds on the IP was completed and the carcasses (along with over 50,000 hatching eggs that had been laid on the premises since the last delivery to the hatchery on 27 th January 2015) were removed for secure disposal at an approved rendering facility. Completion of preliminary C&D
07/02	Preliminary C&D considered to be effective.
28/02	Restrictions lifted

5. Investigations on the Infected Premises

In House 1 a significant decrease in egg production (8.9%) was seen on 20/01. In House 2 a significant decrease in production (10.3%) was seen on 23/01. Overall, the House 1 flock demonstrated a 22.3% and House 2 a 26.6% reduction in egg production over a 5 day period, thereafter egg production started to recover. Mortality rates for 22/01 – 28/01 were higher in both houses than usual (0.28% and 0.46% for house 1 and house 2 respectively), but only in house 2 is this mortality rate clearly exceeding the Company's expected threshold levels for their flocks at

this age and stage of lay. In all other weeks, the weekly mortality rates were below expected limits.

Reduced feed consumption was reported in House 1 on 19/01. Production records show a reduction in water and feed consumption on 19/01 and 21/01 respectively, although this was of one day duration only. However increased water consumption was noted on the following two days and feed consumption was recorded at normal levels on all other days preceding and following this single day's anomaly. It is difficult to determine the significance of this – although a reduction in feed and water consumption in response to infection could be expected, the very short term changes (only one day's duration) may indicate that this is an artefact.

Samples were taken on the basis of 'exclusion testing' to eliminate avian flu as a differential diagnosis on 28/01. Some of these samples gave non-negative results for influenza A virus by PCR and further official testing followed, leading to confirmation of disease in both House 1 and 2 as described above. Results of official testing of 60 birds per house revealed that the vast majority of the birds sampled had seroconverted to H7 at the time of official sampling (30/01) which together with improving production records showed that the flock was recovering from the infection. Virus was recovered from a single bird and identified as H7N7 LPAI.

Samples of residual surface water collected from near the poultry shed and the neighbouring field on 4 February were also examined with negative results for virus. However the likelihood of detection of virus even if it were present is considered very low given the dilution effect and virus stability in flood water. Therefore although virus was not recovered from the water itself almost three weeks after the flooding event, this does not rule it out as the source of infection.

Members of the Ornithological Expert Panel (OEP) undertook an Expert Ornithological Field Assessment (EOFA) in the area surrounding the IP on 4th February 2015 in order to:

- assess the wild bird populations immediately around the IP and the potential for contact between the broiler breeder shed and wild birds (this did not include any access to the controlled area of the IP - all observations were undertaken from unrestricted public roads).
- assess the wild bird populations in the area around the IP (ca 10 km) focusing on target species known to be involved in transmission of avian influenza viruses.

Key observations from their report include:

- The IP site appeared to be clean and well maintained with no evidence of soiled bedding or spilled feed being present around the site.
- The neighbouring outdoor pig farm had a large number of wild birds present, notably mallards, black headed gulls, common gulls, herring gulls, lesser black backed gulls and corvids.
- Presence of wild birds attracted to the pig farm when feed is delivered is likely to be a year-round feature. It was considered unlikely that the wild birds

transferred infection directly into the IP but the recent flood is the most likely mechanism for fomite transfer from the nearby fields.

- There are no large water bodies in the immediate surrounding area, the nearest site being approximately 9 miles away

6. Overview of tracing activities

Evidence based on the clinical picture, laboratory results and expert advice, together with the OIE requirement for a precautionary assumption of a 21 day incubation period prior to clinical signs, gave the following source and spread time windows:

- Most likely date of introduction of infection is **15/01/15** when overflow of surface water from a neighbouring field caused partial flooding in both poultry houses, with a maximum precautionary source period over which tracings were investigated from 29/12/14 to 18/1/15, a day before clinical signs were apparent.
- Most likely potential for spread from the premises is between **15/01/15 – 30/01/2015** (when restrictions were imposed), with a maximum precautionary spread period over which tracings were investigated extended back to 30/12/14.

All contacts to and from the IP in the whole period from 29/12/14 to 30/1/15 were identified and assessed as to their risk of introducing or spreading infection (see Tables 1 and 2).

A detailed veterinary risk assessment on the hatchery and the eggs dispatched to it in this period was carried out, informed by a visit to the hatchery including inspection of procedures and biosecurity protocols, and expert virological advice from the Reference Laboratory at Weybridge. Tracings identified as high risk were eggs laid and sent from the IP to the hatchery during the high risk period from the 15th January up until service of restrictions (although the last egg collection actually took place on 27th January). Other egg movements were assessed as of negligible risk.

Tracings identified as being of medium risk (due to movements of personnel) were investigated to establish whether the degree of contact with the IP was such as to pose a risk of transmission of virus. If such a risk could not be conclusively ruled out these premises were subject to movement restrictions, clinical inspections, record checks and sampling. A total of five other company premises identified as medium risk were visited and sampled with negative test results. Restrictions were put in place on these five farms until negative results were confirmed to contain any potential spread from these premises.

Tracings considered likely to be of low risk (due to movements of one person in the low risk tracing window) have been risk assessed, including analysis of production records obtained from the company. Only one of these required further investigation

due to increased mortality in one shed. This was found to be due to selective culling for poor bird quality, not related to an infectious cause, and was expected for this batch. No further investigation was required.

For all lorry collections and deliveries (egg collections, wood shavings, dead stock collections, feed) the IP was generally the last premises visited on the round and good biosecurity precautions are practised – the risk of transmission of virus was considered to be very low to negligible by this route.

A number of further potential tracings due to movements of other personnel and vehicles were considered to represent a very low to negligible risk as a result of biosecurity protocols in place and veterinary assessment that there had not been contact with susceptible poultry during the risk period. No further action was considered necessary in respect of these. A breakdown of numbers and types of tracings investigated and assessed is provided at Appendix 4.

7. Source investigations

For any outbreak of avian notifiable disease, the source of infection may be related to introduction of live birds from infected flocks, introduction of infected or contaminated products, contact with infected wild birds (directly or via fomites) or contact with contaminated equipment (fomites) including bedding.

A summary of the sources of infection considered is shown in Table 1; definitions of qualitative risk terms are given in Appendix 1.

Table 1: Possible source of infection for the Infected Premises AIV 2015/01, source tracing window 29/12/14 – 18/1/15.

Pathway	Comment	Assessment of likelihood of infection via this route
Direct introduction from wild birds	Considered unlikely due to structural integrity of the shed and biosecurity protocols in place.	Low likelihood but potentially possible. Moderate uncertainty
Indirect introduction from wild birds	Most likely source following ingress into housing of floodwater from the field of the neighbouring farm known to be frequented by large numbers of wild birds. Molecular analysis of virus isolated from the IP supports a recent introduction from a wild bird source without prior chicken to chicken transmission. Timing coincides with high risk source window derived from clinical signs.	Most likely source although moderate uncertainty remains about exact route of entry.
Undisclosed infection in the UK: Direct introduction by purchased birds	No birds had been introduced onto the site since the current flock was placed in August 2014	Negligible Low uncertainty

Pathway	Comment	Assessment of likelihood of infection via this route
Introduction from contaminated product(s)	No evidence that feed or wood shavings were contaminated. Both stored in such a way as to prevent access by wild birds; feed delivery – external silo filled using pipe & feed blown in; wood shavings delivery – bagged shavings dropped outside service alley and taken into service alley by farm staff to protect from weather and contamination by wild birds. Whilst the premises had access to both mains water supply and a borehole, the water supply used for the poultry shed was exclusively mains source.	Negligible Low uncertainty
Infected premises elsewhere in the world: Indirect contact with an infected flock	Molecular analysis supports a recent wild bird source. No recent trade in live poultry, day old chicks or hatching eggs into either the IP, associated premises or neighbouring premises.	Negligible. Low uncertainty.

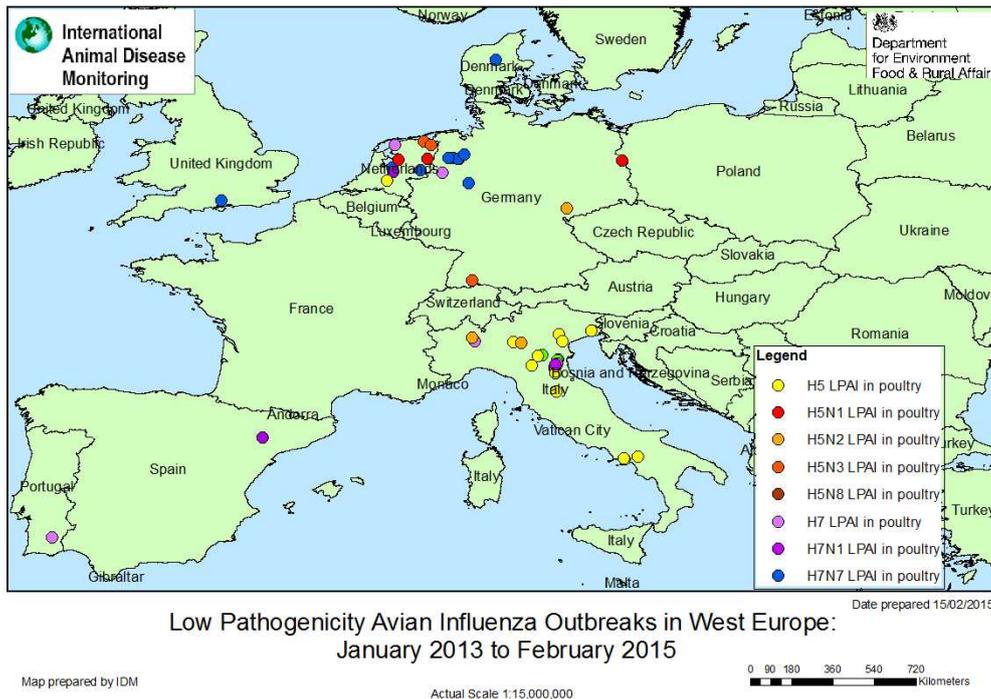
8. Further consideration of H7N7 LPAI in Europe & the role of wild birds

Low pathogenic avian influenza (LPAI) viruses are commonly found in wild birds which act as reservoir hosts. The LPAI viruses normally cause mild clinical signs or no apparent disease. Wild birds shed LPAI viruses in their droppings which can result in transmission to susceptible poultry and other birds via the faecal-oral route.

Outbreaks of LPAI H7N7 have been detected in poultry holdings in the EU in: Denmark 2013; Germany in 2009, 2011 and 2013; as well as in the Netherlands 2011, 2012 and 2013. Figure 3 shows the various LPAI outbreaks (both H5 and H7) in Europe since January 2013. Both the Netherlands and Germany have in place early warning systems for reporting mild clinical signs in poultry hence the higher number of reported outbreaks in these countries is most likely due to improved ascertainment rather than a true reflection of higher risk and frequency.

The last H7 outbreak in the UK (and last AI outbreak prior to H5N8 HPAI, East Yorkshire, November 2014) was in a free range laying farm near Banbury in June 2008. The virus was introduced to the Banbury flock as LPAI some time before the onset of clinical disease which was attributed to an increase in pathogenicity as a result of subsequent mutation to HPAI during spread of the LPAI virus within the flock.

Figure 3. Map to show LPAI outbreaks (both H5 and H7) in Europe since January 2013



9. Analysis of the virus

Full genome sequencing of virus isolated from the IP has been completed by APHA Weybridge. These analyses indicate that it is a virus of avian origin closely related to contemporary European H7 strains and with no strong correlates for increased human affinity. The presence of a full 'stalk' in the neuraminidase (NA) gene supports a relatively recent introduction from wild birds to poultry as upon chicken to chicken passage a deletion in this region is acquired, hence being a marker for poultry adaptation.

There is no record of pigs ever having been infected with H7N7 LPAI and pigs are rarely considered to be important epidemiologically in the context of avian influenza. As such the outdoor pigs on the neighbouring premises were not considered further during this investigation.

10. Assessment of likely source

The most likely source of the outbreak is indirect contact with wild birds, probably as a result of flooding of the poultry housing on 15th January 2015 by water from a neighbouring field known to be frequented by large numbers of wild birds (including gulls, corvids and waterfowl). This assessment is based on the following key pieces of evidence:

- Findings from the investigation suggest that high levels of biosecurity are generally and consistently enforced on the IP and within the wider company structure. Equally the structural integrity of the shed makes direct contact with wild birds unlikely.
- The genetic analyses of the virus indicate a relatively recent introduction from wild birds to poultry, the known presence of this strain of virus in apparently

healthy wild birds, and the location of the IP in Hampshire near the South Coast of England in an area where domestic poultry have been identified as being at higher risk of exposure to avian influenza infection in migratory wild birds (see Appendix 5), all support a hypothesis that the source was via wild bird contamination.

- The timing of onset of clinical signs being consistent with virus introduction at the time of the flooding incident.
- There have been no other cases of H7N7 identified in domestic poultry in the UK despite raised awareness following confirmation of disease and the recent H5N8 HPAI outbreak, tracings investigations undertaken and the ongoing passive surveillance programme with a legal requirement to report suspicion of avian influenza to APHA.
- There were no poultry or eggs brought onto the IP in the source window and there is also no evidence of contaminated product being brought on. There were also no consignments of hatching poultry eggs or live birds (day old chicks) imported into the local region or company farms during the risk period (after 29/12/2014).

11. Spread investigations

Potential routes of onward transmission both within and outside the company structure are shown in Table 2, together with comment on probability of transmission and action taken.

Available evidence following epidemiological investigation of potential contacts to the IP, including sampling with negative results of five other premises considered to be medium risk tracings indicates that there has been no domestic spread of infection from the Infected Premises. Review of TRACES show there were no dispatches from the IP into EU or Third Country trade during the spread tracing window.

Table 2: Possible spread of infection from the Infected Premises AIV 2014/01, spread tracing window 29/12/14 – 30/1/15.

Pathway	Comment	Assessment of likelihood of infection via this route
Direct contact of live birds on IP with infected domestic poultry on another holding	No live birds were moved off the IP during the maximum spread tracing window	Negligible. Low uncertainty given the management of the holding.

Pathway	Comment	Assessment of likelihood of infection via this route
Movement of contaminated substrate off IP - manure, litter, carcasses	<p>Waste chicken carcasses and rejected eggs were removed from the IP by a retired farm manager to a Category 2 rendering plant in a dedicated company vehicle which is disinfected afterwards. The vehicle only collected from farms within the same company and the driver did not enter the poultry shed – bagged carcasses/reject eggs were stored in a freezer in the service area and brought outside to the collection vehicle by farm staff. External ABP collectors were not employed.</p> <p>Used litter/bedding had not been moved off the premises during the maximum spread tracing period.</p>	<p>Very low risk from carcasses to rendering plant.</p> <p>Very low risk from litter as it remained on site and is subject to C&D procedures following depopulation.</p> <p>Additionally the litter type is wood chip; laboratory data indicates that wood chip litter is highly virucidal with virus being rapidly killed. These observations are supported by negative results for the presence of virus in the litter collected the following day after restrictions served.</p>
Indirect contact via personnel, equipment or vehicles	<p>Documented contacts include:</p> <ul style="list-style-type: none"> • Company personnel with bird contact who are known to have visited other company premises • A visiting poultry consultant (although this was outside the highest risk spread period) • Deliveries of feed and shavings, collection of hatching eggs and collection of by-products for disposal, although biosecurity protocols are such as to mitigate risk of transmission, including the fact that vehicle drivers do not access the bird housing: feed delivery – external silo filled using pipe & feed blown in; wood shavings delivery – bagged shavings dropped outside service alley and taken into service alley by farm staff to protect from weather and contamination; egg collection lorry – every 2-3 days. IP usually last in round before hatchery. 	<p>High likelihood of contact with infectious virus for first of these but subsequent contacts with susceptible birds investigated and an assessment of the likelihood that a transmission pathway may have existed made – including sampling with negative results of 5 medium risk contact premises and analysis of production records for low risk tracings.</p> <p>Low uncertainty.</p>
Local spread into LPAI RZ	<p>No premises with poultry or captive birds were located within the 1 km LPAI Restricted Zone</p>	<p>Negligible risk.</p> <p>Low uncertainty</p>

Pathway	Comment	Assessment of likelihood of infection via this route
Indirect contact with wild birds	The ornithological field assessment noted the presence of gulls, corvids and waterfowl on fields adjacent to the IP. Corvids and ducks are likely to roost locally and black headed gulls are likely to roost in coastal areas within a 30-40km range. There remains an ongoing potential risk of direct or indirect (e.g. by fomite transfer) transmission of virus to other poultry flocks in the country as a result of movement of wild birds which are known to act as reservoir hosts for avian influenza viruses.	Low risk. Moderate uncertainty.

12. Surveillance in the LPAI Restricted Zone

A census to identify all premises containing poultry and captive birds was undertaken in the LPAI Restricted Zone, in line with EU legislative requirements. No other premises containing poultry or captive birds were found to be present within a 1-km radius of the outbreak.

13. Public health impact

Public Health England (PHE) undertook a risk assessment following confirmation of H7N7 LPAI and concluded that the risk to the general public was very low – given there have been no reported cases of human infection with H7N7 LPAI and the low probability of exposure to infected birds. PHE determined the risk to persons occupationally exposed to H7N7 LPAI (i.e. workers on the IP) to be slightly higher than the general public but still low. PHE provided antiviral prophylaxis and health surveillance to those directly involved in handling and culling the affected flock and at the identified rendering plant, and provided advice on the need for appropriate Personal Protective Equipment (PPE).

Both PHE and the Food Standards Agency (FSA) advised that on the basis of current scientific evidence avian influenza does not pose a food safety risk for UK consumers (<http://www.food.gov.uk/news-updates/news/2014/13230/fsa-advice-about-avian-bird-flu>). Furthermore genetic analyses of the virus at APHA Weybridge failed to reveal any mutations known to increase affinity for human infection.

14. Remaining uncertainty

There is a continually present risk of further outbreaks of avian influenza (not limited to H7N7 LPAI) as a result of the ongoing presence of AI viruses within the wild bird

population, and there is ongoing AI surveillance (both active and passive) in the UK aimed at early detection of such an incursion.

15. Concluding remarks

The most likely source of infection is virus introduced into the poultry housing as a result of ingress of floodwater contaminated by wild birds (including gulls, corvids and waterfowl species) from a field owned by the neighbouring farm on 15th January 2015.

Evidence of considerable wild bird activity in the area surrounding the IP, particularly in the neighbouring field where wild birds are attracted by feeding of the outdoor pigs, and evidence from genetic analysis of virus isolated from the IP which indicates a recent incursion from a wild bird source without intermediate passage through chickens strongly supports this hypothesis.

Investigation of other premises identified as potential contacts via tracings of personnel and vehicle movements, including sampling with negative results of five premises considered to be of medium risk, revealed no other premises that could have been a source of infection for the IP, and indicated that infection had not spread from the IP to other premises.

National Emergency Epidemiology Group
February 2015

Acknowledgments:

The views expressed in this report are those of the National Emergency Epidemiology Group (NEEG). However, we would like to express our thanks to the many colleagues who have assisted us.

16. Appendices

Appendix 1. Definitions for qualitative risk terms and level of confidence

Table 1: Definitions for the qualitative risk terms based on EFSA (2006) and OIE (2004) with expanded descriptions adapted from NHS (2008), IPCC (2005), and Kahn *et al.*, (1999)

Risk level	Definition	Expanded description
Negligible	Event is so rare, does not merit consideration	The chance of the event occurring is so small it does not merit consideration in practical terms (i.e. < 0.1% probability); it is not expected to happen for years;
Very low	Event is very rare, but cannot be excluded	The event is not expected to occur (very rare) but it is possible (i.e. >0.1-1% probability); it is expected to occur at least annually
Low	Event is rare, but does occur	The event may occur occasionally (rare) (i.e. >1-10% probability); expected to occur at least monthly
Medium	Event occurs regularly	The event occurs regularly (i.e. >10-66% probability); expected to occur at least fortnightly
High	Event occurs very often	The event will happen more often than not (i.e. ≥66-90% probability); expected to occur at least weekly
Very high	Event occurs almost certainly	The event will undoubtedly happen (i.e. >90% probability); expected to occur at least daily

Appendix 2: Summary of laboratory results on AIV2015-01

House	Date tested	Sample	Test	Number Positive	Number samples taken
1	PVS samples	Cloacal swabs	PCR	0/4 pools*	20
		Oropharyngeal swabs	PCR	0/4 pools	20
2		Cloacal swabs	PCR	1/4 pools	20
		Oropharyngeal swabs	PCR	0/4 pools	20
1	APHA Samples	Cloacal swabs	PCR	2	60
		Oropharyngeal swabs	PCR	0	60
		Serum	Serology	55	60
2		Cloacal swabs	PCR	6	60
		Oropharyngeal swabs	PCR	0	60
		Serum	Serology	59	60

*PVS (private veterinary surgeon) samples tested as pools of five.

Appendix 3: Estimated timeline and tracing windows

Source and spread windows indicated by purple and yellow shading respectively; darker shades indicate increased probability of source/spread in this time period)

Source Tracing Window	Spread Tracing Window	Date	
		29/12/14	start of precautionary clinical signs incubation period for OIE (21 days)
		30/12/14	
		31/12/14	
		01/01/15	
		02/01/15	
		03/01/15	
		04/01/15	
		05/01/15	
		06/01/15	
		07/01/15	
		08/01/15	
		09/01/15	
		10/01/15	
		11/01/15	
		12/01/15	
		13/01/15	
		14/01/15	
		15/01/15	Houses 1 & 2 flooded
		16/01/15	
		17/01/15	
		18/01/15	
		19/01/15	Most Likely date of first clinical signs - reduced feed consumption reported by manager in House 1
		20/01/15	House 1 egg drop, dead birds sent for post-mortem examination (PME)
		21/01/15	PVS PME suggestive of severe necrotic enteritis - 5 days antibiotics agreed
		22/01/15	House 2 reduced feed consumption. 5 days antibiotics started
		23/01/15	House 2 egg drop starts
		24/01/15	
		25/01/15	
		26/01/15	
		27/01/15	PVS authorised to undertake exclusion sampling for AI differential diagnosis
		28/01/15	Exclusion sampling for AI differential diagnosis undertaken and samples submitted
		29/01/15	Non-negative results reported. Verbal restrictions served - message left on company answerphone 21:30
		30/01/15	APHA Veterinary inquiry DPR 2015/05. Statutory restrictions imposed and official samples collected
		02/02/15	Disease confirmed AIV 2015/01
		04/02/15	Culling commenced
		06/02/15	Culling completed
		06/02/15	Completion of preliminary C&D
		07/02/15	Preliminary C&D considered to be effective

Appendix 4: Details of tracings investigated

Number of locations with tracings

A total of 59 tracing tasks were generated for assessment involving 31 premises, of which 22 were sites within the same poultry company as the IP.

	Both	Source	Spread	Total traced premises
Total premises by trace type	11	3	17	31

Number of locations with spread tracings

Tracing category	Hatching Eggs	Egg Collections	Area Manager	IP Workers	Company Director	Feed Delivery	Shavings Delivery	ABP Collections	Poultry Consultant	Total
High Risk	1	0	0	0	0	0	0	0	0	1
Medium Risk	0	0	5	0	0	0	0	0	0	5
Low	0	0	0	0	0	0	0	0	4	4
Very Low / Negligible	0	21	0	0	3	0	1	0	0	25
Total locations per traced item	1	21	5	0	3	0	1	0	4	35

Number of locations with source tracings

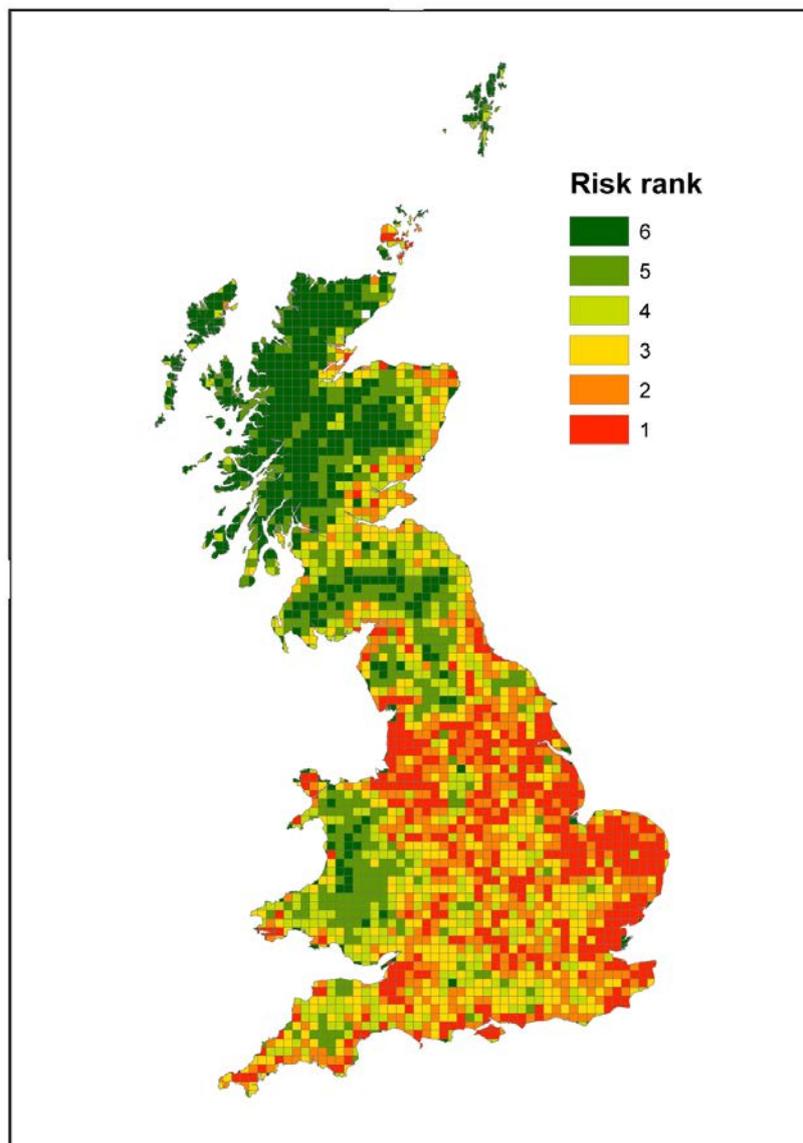
Tracing category	Hatching Eggs	Egg Collections	Area Manager	IP Workers	Company Director	Feed Delivery	Shavings Delivery	ABP Collections	Poultry Consultant	Total
High	0	0	0	0	0	0	0	0	0	0
Medium	0	0	4	0	0	0	0	0	0	4
Low	0	0	0	3	0	0	0	0	5	8
Very Low/Negligible	0	7	0	0	1	2	0	2	0	12
Total locations per traced item	0	7	4	3	1	2	0	2	5	24

Note: the total number of traced locations shown above is lower than the sum of source tracing locations and spread tracings locations, because a number of locations had both a source and a spread tracing and additionally some locations were investigated as a result of more than one tracing type (for example, egg collections and other personnel visits).

Appendix 5: Map showing estimated risk of incursion of H5N1 HPAI from wild birds into domestic poultry

(NB unpublished, paper in preparation)

Using a semi-quantitative approach, the geographical areas where commercial poultry are at greatest risk of an incursion of H5N1 from wild birds was estimated for each 10 km square area within GB by overlaying the abundance of 24 migratory wild bird species that winter in GB and are deemed to have a high probability of exposure to H5N1 outside the European Union (EU) with the estimated density of commercial poultry. This map is similar to that published in 2007* but data on migratory birds and poultry distribution has been updated. Incursion risk is ranked 1 to 6 in order of high to low risk.



*Snow LC, Newson SE, Musgrove AJ et al. Risk-based surveillance for H5N1 avian influenza virus in wild birds in Great Britain. *Veterinary Record*, 2007; 161 (23):775-81