Year End Descriptive Epidemiology Report: Bovine TB Epidemic in the England Edge Area

County: Leicestershire

Year-end report for 2017

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1. Executive Summary
a) **Leicestershire** is part of the Edge Area that was established in 2013 and was later incorporated into the Government’s strategy to achieve Officially Bovine Tuberculosis Free (OTF) status for England by 2038. It has a low but recently rising incidence of infected herds. This end of year report describes the bovine tuberculosis (bTB) epidemic in Leicestershire.

b) **Local cattle industry.** Small beef herds predominate in Leicestershire, however there is a significant number of large dairy herds in the county.

c) **Level of bovine TB.** The herd incidence seen in 2017 was 4.9% in comparison with 5.6% seen last year. This is due to the reduction in the number of new TB breakdowns identified.

d) **New breakdowns of bovine TB.** The number of breakdowns has reduced from 53 in 2016 to 45 in 2017. In 2016 there were 17 Officially Bovine Tuberculosis Free Status Withdrawn (OTFW) breakdowns (32% of total TB breakdowns) compared to 20 OTFW breakdowns (44.4% of total breakdowns) in 2017. Therefore although there has been a reduction in the total number of TB breakdowns in 2017 there has been a 12.4% increase in OTFW breakdowns.

e) **Disclosing tests.** The majority of reactors (71%) were disclosed by routine annual surveillance testing. Only 4% of breakdowns in 2017 have been disclosed by passive (slaughterhouse) surveillance. There has been a reduction in disclosure of breakdowns by slaughterhouse surveillance (post-mortem meat inspection) from 13% of all new breakdowns in 2016 to 4% this year. This is an indication that infected cattle are being disclosed at an earlier stage through live testing on farms.

f) **Risk pathways for bovine TB infection.** In 2017, 60% of all breakdowns were attributed to a wildlife source, 24% to the movement of purchased cattle, 4% to local spread and 11% were of an undetermined source.

g) **Impact of bovine TB: reactor numbers.** The number of TB test reactors increased from 261 detected in 2016 to 348 in 2017. This equates to an increase of 87 reactors removed in the reporting year. There has been an increase in the number of reactors detected per breakdown, from 5 in 2016 to 8 in 2017. The number of reactors per 1000 animal tests has gone up from 1.74 in the previous year to 2.63 in this reporting year. The increase in the number of reactors is a reflection of the increased number of OTFW incidents occurring in 2017 – additional testing (statutory interferon-gamma testing) is applied to fully confirmed breakdowns in the TB Edge Area. The supplementary interferon-gamma blood test identified 46% of all reactors removed in 2017, compared to 35% of all reactors removed in 2016.

h) **Cases in other species.** There have been no laboratory confirmed isolations of *M. bovis* in other species in Leicestershire. Submission rates are extremely low in other domestic species. There is no systematic surveillance that would reveal such infection in badgers and other wildlife. A Defra-funded survey of TB in found dead badgers in Edge Area counties was completed in 2017 and its results are not available at the time of writing.

i) **Risks to the Low Risk Area and from the High Risk Area.** Risk from the High Risk Area of England (HRA) to the Leicestershire Edge Area remains unchanged from the 2016 year end report. The TB cluster in north east Leicestershire, which has clear evidence bTB endemicity, continues to pose a risk to the Low Risk Area (LRA) of Lincolnshire.

j) **Forward look.** Emphasis on risk-based trading, making herd/holding data available more widely to encourage industry ownership of disease control. Enhancement of wildlife control measures needed.
2. Introduction

A key action in the implementation of the Government’s objective to achieve Officially Bovine Tuberculosis Free (OTF) status for England by 2038 was to recognise the different levels of TB in different parts of the country and varying the approach to control accordingly. To this end three management regions or zones have been established. This report describes the epidemiology of bovine TB (bTB) in Leicestershire which forms part of the Edge Area (see Appendix 1). This area has a low but recently rising incidence of infected farms and control efforts are seeking to slow down and reverse geographic spread, and reduce the incidence rate, with the aim of obtaining OTF status for this area as soon as possible.

3. Cattle industry in the Edge Area of Leicestershire

Herd Types
As shown in Figure 1 below and in Appendix 2, there is a predominance of beef cattle (59%), although dairy cattle continue to exist in significant numbers (36.8%). There is a predominance of mainly small herds of up to 50 cattle as shown in Figure 2, and it would be reasonable to assume that the majority of these are beef cattle. There are some herds numbering over 500 cattle and a small number with over 1000 cattle. Appendix 2 contains the full data set for breed purpose and herd size.

Markets
There is one livestock auction market in Leicestershire for cattle – Melton Mowbray Market - and this market has a section for the sale of cattle exempt from pre-movement testing.

Approved Finishing Units
There are 12 Approved Finishing Units (AFUs). There has been an increase of five AFUs in 2017 relative to 2016. These units are non-grazing and if correctly operated are not considered a risk for introduction or spread of bTB into the surrounding areas.

Common Land
There are some small areas of common land in Leicestershire, with low numbers of cattle grazed and no significant co-grazing by more than one herd. Spread of bTB related to cattle usage of common land is unlikely in this area.

Figure 1: Proportions of cattle in Leicestershire according to breed purpose
4. Overview of the TB epidemic in the Edge Area of Leicestershire

a. History of TB in the Edge Area of Leicestershire

The number of breakdowns has reduced from 53 in 2016 to 45 in 2017. In 2016 there were 17 Officially Bovine Tuberculosis Free Status Withdrawn (OTFW) breakdowns (32% of total TB breakdowns) compared to 20 OTFW breakdowns (44.4% of total breakdowns) in 2017. Therefore although there has been a reduction in the total number of TB breakdowns in 2017 there has been a 12.4% increase in OTFW breakdowns. Figures 3 and 4 below show a peak in breakdowns disclosed in March and April in both 2016 and 2017. This could be associated with the increase in TB testing before turning animals out for the grazing season. No data is available to show the distribution of whole herd tests throughout the year and whether these epidemic curves are proportional to this.
Figure 4: Epidemic curve showing the distribution of OTFW and OTFS breakdowns per month.

b. **Geographical distribution of bovine TB cases (new and ongoing) in Leicestershire**

The geographical distribution of all new TB breakdowns in 2017 and any pre-2017 OTFW breakdowns still ongoing at the end of the report period is shown at Figure 5 overlaid on a map showing the cattle holding density for the Midlands Edge Area.
The distribution of cases in 2017 is similar to that of 2016, but with fewer breakdowns in the northwest in 2017. Breakdowns are distributed equally over the county apart from in the south east. The majority of lesion and culture-negative (OTF status suspended) breakdowns have occurred in the south west of Leicestershire.

An emerging infected area has been identified in a cluster of OTFW breakdowns in the northeast of the county next to the Lincolnshire Low Risk Area (LRA), with a similar distribution to 2016. This cluster, around Melton Mowbray, has a relatively high number of OTFW breakdowns attributed to a wildlife origin with genotype 25:a being disclosed.

A fuller description of this cluster is given in Section 6 (Summary of Risks to the LRA).

There is an increasing number of breakdowns associated with wildlife from 2015 to 2017. This trend suggests the development of endemic areas in some parts of Leicestershire.
Genotype 25:a is endemic in parts of the neighbouring High Risk Area (HRA) counties of Staffordshire and Derbyshire. This genotype has also been increasingly identified in Leicestershire in the preceding years: 35% of all OTFW cases in 2016, in comparison to 55% of all OTFW cases in 2017. Figure 6 shows all genotypes which were isolated in 2017.

Figure 6: Genotypes identified in 2017

5. Descriptive epidemiology of bovine TB in Leicestershire

a. Level of bovine TB

*Incidence* (number of new TB cases occurring during a reporting year) conveys information about the risk of contracting the disease. The incidence of bTB breakdowns in Leicestershire was calculated for 2015 to 2017 and these are shown in Figure 7 below. The reporting of an annual incidence is based on unique herds tested rather than number of tests or 100 herd-years at risk (as in the National Statistics). The number of TB breakdowns has reduced by eight from 53 in 2016 to 45 in 2017. As Figure 7 shows, incidence has reduced by 0.75% between 2016 and 2017.

Figure 7: Incidence from 2015 to 2017 calculated for all new breakdowns (OTFS and OTFW) in the reporting period as a percentage of unique OTF cattle herds tested in the reporting period
b. Risk pathways for bTB infection

Figure 8 shows the likely source, and genotypes where known, for new breakdowns in Leicestershire in 2017. As can be seen, the breakdowns are distributed equally over the county although OTFW breakdowns tend not to be located in the south east portion of the county. North east Leicestershire has a relatively high number of OTFW breakdowns attributed to wildlife. This is similar to the pattern seen in 2016 with a noticeable increase in the number of OTFW breakdowns.

![Figure 8: All new breakdowns in 2017 OTFS and OTFW and origin when known. (Map produced and supplied by Stafford GIS team)](image-url)
For each breakdown, both OTFS and OTFW, the likely infection source was considered. The infection sources can be categorised as follows: wildlife, local cattle (residual infection within herds or contiguous spread), cattle movement (purchased animals, shows etc.) and undetermined.

Figure 9 shows the origin of disease for all breakdowns in 2016 and 2017. There has been an increase in the number of TB breakdowns associated with wildlife infection and a reduction in breakdowns associated with cattle movements.

There has been a notable reduction in TB breakdowns in 2017 where origin of infection could not be determined. This could be associated with an increase in the number of OTFW cases in 2017 in comparison to 2016. Genotyping is an important tool to assess and support the analysis of specific transmission pathways.

![Graph showing origin of disease in 2016 and 2017](image)

**Figure 9: Origin of disease in all breakdowns in 2016 and 2017**

Origin of all the new OTFW breakdowns in Leicestershire by sector.

As shown in Figure 10:

1. **Beef suckler:** Approximately 57% of breakdowns in beef suckler herds were attributed to infection via contact with wildlife and 43% to cattle movements. There has been a reduction in the number of breakdowns attributed to wildlife infection in 2017 compared to 2016 where 62% of TB breakdowns were of wildlife origin.
2. **Beef fattener:** Half of all breakdowns in this sector were attributed to infection via contact with wildlife in contrast with 2016 where none of the TB breakdowns in this sector were of wildlife origin. The increase in the number of non-grazing AFUs in the area will somewhat reduce this risk, providing that they operate as per the licence conditions, hence the importance of routine unannounced visits to these units.
3. **Dairy sector:** Almost 88% of the OTFW breakdowns in 2017 were considered to be of wildlife origin. This is an increase on the 2016 figures where 50% of TB breakdowns were associated with a wildlife infection source.
4. **Mixed farming:** There is also a bigger percentage of OTFW breakdowns associated with wildlife infection: 67% of all OTFW breakdowns in this sector.

There is no evidence of residual disease in a herd as the origin of infection in any of the OTFW breakdowns for this reporting year. This is an indication that the use of interferon-gamma testing in OTFW herds is effective in removing infected cattle which had remained undetected by the skin test.

Overall in all sectors, with the exception of the beef suckler sector, there has been an increase in the number of OTFW breakdowns attributed to a wildlife source.
Figure 10: Origin of infection for new OTFW breakdowns in the reporting period by herd type

Figure 11 shows OTFW breakdowns associated with a wildlife origin for 2015, 2016 and 2017. The number of OTFW breakdowns attributed to wildlife infection has increased gradually from seven (30.5%) of the total OTFW breakdowns in 2015 to eight (47%) in 2016 and then to thirteen (65%) in 2017. This could indicate that, in areas which are currently considered to be non-endemic, disease is already present in the wildlife population and these cattle breakdowns could be evidence of this.

Figure 11: OTFW cases attributed to wildlife origin from 2015 to 2017

c. Role of other species:

a. Badgers and other wildlife
There have been no laboratory confirmed isolations of *M. bovis* in wild animals such as badgers, wild deer or wild boar carcases in 2017 in Leicestershire. The Defra-funded Edge Area found dead badger survey will provide some information about the prevalence of *M. bovis* in badgers in Leicestershire and results for this are awaiting publication.
b. Other domestic species:
There have been no laboratory confirmed isolations of *M. bovis* in domestic non-bovine farm animals (camelids, goats, sheep, and pigs), pets, zoo animal collections, captive (farmed/park) deer holdings and captive wild boar farms.

Two herds of farmed bison remained under restrictions (OTFS) in Leicestershire as a result of long-term overdue routine skin tests.

d. Detection of cases

Surveillance types and disclosure of new breakdowns

The chart in Figure 12 shows the proportion of breakdowns that were disclosed by different surveillance types. Most notable for Leicestershire is that the majority of reactors (71%) were disclosed by routine annual surveillance testing (WHT). In addition to this, 4% of breakdowns have been disclosed by post mortem inspections in the slaughterhouse. This could be an indication of improved application of TB skin testing leading to earlier detection of disease within a herd with consequently fewer breakdowns being identified by passive surveillance in the slaughterhouse.

![Pie chart showing breakdown disclosure by surveillance methods](image)

**Figure 12: Frequency of breakdown disclosure by different surveillance methods**

Initial reactor disclosure following a retest of an inconclusive reactor at a skin test

Figure 13 shows the number of reactors which were disclosed at an inconclusive reactor (IR) retest in comparison to the number of reactors found at the initial test.

- **Breakdowns identified at IR retest** Almost 40% of breakdowns identified by surveillance testing were disclosed by an IR retest, of which almost 30% of these showed lesions at slaughter. In 2016 only 9% of reactors disclosed at an IR retest were found to have visible lesions at slaughter. This value correlates with the increase in the number of OTFW cases this year. This reinforces the requirement to isolate inconclusive reactors, as they are a potential infection risk to the rest of the herd. In addition it underlines the significance of the resolved IR policy introduced on 1st November, 2017 which prevents resolved IRs from moving off the holding of disclosure unless to slaughter.

- **Breakdowns disclosed at surveillance skin test** Surveillance testing detected 60% of all breakdowns. Half of these breakdowns were OTFW, an increase on last year’s figure of 42%.
e. Burden of bovine TB

The number of reactors disclosed by different test types in breakdowns in 2017 in Figure 14 shows that 54% of all reactors were identified by the skin test rather than by the interferon-gamma test. This is in contrast to 2016 where 65% of reactors were identified by the skin test. This could be as a result of the increase in the number of OTFW breakdowns from 2016 to 2017: the interferon-gamma test is applied in all OTFW breakdowns in the TB Edge Area.

Despite the increase in the number of OTFW cases and the number of herds undergoing statutory interferon-gamma testing, there is still a greater number of reactors disclosed by the skin test. This is an indication of the effectiveness of the skin test.

There was a higher number of reactors in total in 2017, with 348 reactors being removed in comparison to 223 in 2016. This is despite 13,827 head reduction in the number of cattle tested in 2017, from 146,392 to 132,565, as well as a reduction in the number of cattle herds tested. Almost 90 fewer cattle herds were tested in 2017 than in 2016. There have been fewer breakdowns, and more reactors
disclosed in each breakdown in 2017. This correlates with the fact that there has been an increase in the number of OTFW breakdowns (where there are usually more reactors disclosed per breakdown).

This could be an indication that the Edge Area measures are helping to control the spread of disease to other herds although in areas where disease is established within the wildlife population the measures taken are not effective enough to eliminate disease.

f. Key drivers of the bovine TB epidemic

• Infected badgers

Of the 17 OTFW cases disclosed in 2016, eight (47%) were considered to have had a badger source. In 2016, a badger source was considered to be the origin of 62.5% of beef suckler herd breakdowns and 50% of dairy herd breakdowns. In 2016 no beef fattening herd breakdowns were considered to have had a badger source of infection - all were associated with inward movement (purchase) of cattle.

In this reporting year there has been an increase in the number of OTFW cases from 17 to 20 despite the decrease in the total number of breakdowns. Half of beef fattening herd breakdowns (n=2), 57% of beef suckler herds (n=4), 83% of dairy herds (n=5) and 67% mixed herds (n=2) have been associated with wildlife infection.

In 2015 a TB cluster in the northeast of Leicestershire was detected in a single parish all sharing the same genotype (25: a). Neighbouring parishes have seen the same genotype in closed herds. The cluster still has active breakdowns and there has been an increase in genotype 25:a breakdowns in 2017, with four further breakdowns in the northeast of Leicestershire, all with badgers as the most likely source of infection.

The map at Figure 15 shows the breakdown distribution in 2016 and 2017 within the cluster providing evidence that disease is potentially endemic in this area. It also reflects the proximity to the LRA of Lincolnshire and that overspill of disease into wildlife has potentially serious consequences. The map shows the increase in the number of breakdowns from 2016 to 2017 and the wider distribution in neighbouring parishes. Note that in 2015 the TB cluster in Melton Mowbray had three OTFW cases all associated with wildlife infection and all within the one parish (Freeby).

There has been active encouragement, both from the NFU and the local Wildlife Trust, for participation in the collection of found dead badgers as part of the Defra-funded Edge Area survey. Leicestershire has submitted the required quota and it is hoped that the ensuing results may help to provide more certainty regarding badger infection in the area. The results are awaiting publication at the time of writing.

Part of the Vale of Belvoir is included in the Defra-funded Badger Edge Vaccination Scheme (BEVS). Vaccination of badgers was suspended in 2016 and 2017 due to a worldwide shortage of BCG vaccine and prioritisation of stocks for use in children, but vaccination is due to recommence in 2018 once a new vaccine source is approved. A larger scale roll out is anticipated for October 2018.
Cattle movement

The inward movement of cattle was the source of infection for 31% (n=7) of new OTFW breakdowns in 2017. This is different from previous year, where inward cattle movement was thought to have been responsible for the source of infection in 45% of the OTFW cases in 2016. This may be indicative of changes in buying practices or an indication that wildlife sources, particularly badgers, are becoming more significant in terms of the degree of direct or indirect contact with cattle or the levels of infection in the badger population, but there is considerable uncertainty around this.

A new, industry led bTB accreditation scheme regulated by the Cattle Health Certification Scheme (CHeCS) was established in 2016 to try to encourage farmers to minimise risk when buying cattle. However, there needs to be collaboration with industry, government and private veterinarians to encourage uptake of these schemes.

The Farm Level bTB reports issued during a breakdown have proven useful and of interest to farmers. It would be useful to be able to generate these reports at the request of the farmer or private veterinarian in order for them to be used to inform herd health plans or the CHeCS scheme.

Recurrence and persistence

There were no reports of persistence of infection in 2017, but there were five cases of recurrent infection, where herds experiencing a new TB breakdown in 2017 had had a breakdown in the previous three years. The origin of disease was attributed to residual infection in the herd in only one case, with the rest of these cases considered to have had direct or indirect contact with infected badgers as a source.

g. County descriptions

Despite the reduction in incidence in Leicestershire in 2017, the apparent establishment of endemic areas in this county suggests that it would not be a candidate for achieving OTF status in the near future.
6. Summary of risks to the Low Risk Area and any mitigating factors

The summary of risks to the LRA is unchanged from those detailed in the 2016 report. Specifically, the northeast Leicestershire cluster continues to be of concern because of its persistence and its contiguity with the LRA of Lincolnshire. Genotype 25:a of *M. bovis* has been identified in several TB breakdowns in this cluster as well as in the south of Nottinghamshire and in one holding of? the neighbouring Lincolnshire parishes. In the northeast Leicestershire cluster the majority of these cases are associated with wildlife infection. The cases in the border with Nottinghamshire and Lincolnshire sharing the same genotype have an undetermined origin.

A request to determine the whole genome sequence (WGS) of the *M. bovis* isolates from the cases mentioned above has been submitted in order to further investigate the possible transmission pathways. This should help to assess the need for more specific and targeted measures in this area.

In Freeby parish, two breakdowns disclosed in 2016 and associated with wildlife have reoccurred in 2017. In addition two new TB breakdowns sharing the same genotype 25:a and associated with wildlife infection have been disclosed in the area in 2017 and are listed below.

- One breakdown disclosed in Freeby parish, but not previously involved in the Freeby TB cluster that has been attributed to wildlife origin.
- One breakdown in a nearby parish (Somerby) within the 3 km zone, in a dairy farm. The origin of infection has been attributed to wildlife and the genotype isolated has been 25:a. This provides ongoing evidence of wildlife infection.

Figure 16 below shows the distribution of OTFW cases with genotype 25:a in Leicestershire from 2014 to 2017. These maps show that the biggest increase of this particular genotype has been in the northeast of the county. In 2014 this particular genotype was evenly distributed in comparison with 2017, where the majority of OTFW breakdowns with genotype 25:a have been disclosed in the east of the county. This could be an indication that the disease is becoming endemic in the northeast of the county, hence the proposal to carry out whole genome sequencing of TB isolates from this area to provide further information on the patterns of infection and possible infection pathways.
Summary of the risk to the Edge Area from the HRA

The summary of risks to Leicestershire is unchanged from those detailed in the 2016 report, noting in particular the ongoing risk posed by the movement of cattle from higher risk herds into the county. There has been an increase in the number of beef fattener units converting their premises into AFUs. These units are non-grazing and, if correctly operated, are not considered to be a risk for introduction or spread of bTB into the surrounding areas.

7. Assessment of effectiveness of controls and forward look

Parallel interferon-gamma blood testing has been useful in removing infected cattle undetected by the skin test. This has been effective in reducing within and between herd spread, but other measures are still required to address the sources and pathways of infection to prevent recurrence or introduction of new infection once testing and slaughter has removed disease.

Serial interferon-gamma testing has been utilised in the past to identify some rare instances of fraudulent behaviour (tampering with the TB skin test to create ‘reactors’) and has resulted in the resolution of cases which had erroneously appeared to have disease persistence.

Other control measures in the Edge Area that have been implemented in 2017:

- Restriction for life of all IRs that are re-tested with negative results. Those animals can only be moved from the farm where they were first identified as IRs to a slaughterhouse or an AFU. Alternatively, they can be de-restricted if subjected to a private interferon-gamma blood test paid for by the farmer, with negative results.
- Once in a breakdown situation any further testing is carried out at least 60 days post reactor removal rather than 60 days post reactor isolation. This measure ensures that in cases where isolation of reactors is not properly maintained any animals that may have been exposed to infection while the reactor awaits removal will have sufficient time to mount a detectable immune response to the skin test.

Additional bTB control measures to be implemented from the 1st January 2018 in Leicestershire:

- Radial testing in the vicinity of farms affected by an OTFW incident, to supplement annual herd testing in the eastern section of the Edge Area, including Leicestershire. Decoupling of the interferon-gamma test from the skin test, the aim being to apply the interferon-gamma test as soon as a breakdown has been confirmed (by visible lesions or positive culture result) to allow for any exposed/infected animal missed by the skin test to be removed as soon as possible and potentially shorten the duration of the breakdown.
APPENDICES

Appendix 1: Overview of risk and surveillance areas of England and Edge Area objectives and controls

Figure A1: Bovine TB risk and surveillance areas of England effective since January 2013, as set out in the Government’s Strategy for Achieving Officially Tuberculosis-Free Status for England.

1.1 Policy objectives for the Edge Area:
Short to medium term:
   a. slow down geographic spread
   b. maintain crude herd incidence of OTFW breakdowns <2% overall by 2019
   c. begin to reduce the incidence rate

Longer term:
   d. reduce geographic spread of bTB and push the Edge Area boundaries westward
   e. reduce OTFW herd incidence to <1% by 2025
   f. attain OTF status (incidence of indigenous OTFW herd breakdowns <0.1) for the lowest incidence counties in the Edge Area.

1.2 Key Control Measures
Surveillance
   a. enhanced herd test coverage (annual)
   b. extend targeted surveillance to 3km around new OTFW breakdowns in Cheshire and Derbyshire (radial testing), with six month follow-up
   c. possible RTA badger survey

Management of cases ('breakdowns')
   a. increased sensitivity of breakdown herd testing:
      - OTFS breakdowns to pass two short interval tests at severe interpretation to regain OTF status
      - mandatory IFN-g parallel testing in OTFW
   b. enhanced epidemic investigation and data analysis
   c. information sharing - location of breakdown herds
Appendix 2: Cattle industry in the Edge Area of Leicestershire

Number of cattle premises by size band in the Edge Area of the region at 1 January 2017
(RADAR Cattle book 2008 (or most current update))

<table>
<thead>
<tr>
<th>Cattle per premises</th>
<th>1-50</th>
<th>51-100</th>
<th>101-200</th>
<th>201-350</th>
<th>351-500</th>
<th>501+</th>
<th>All</th>
<th>Mean</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of premises</td>
<td>442</td>
<td>160</td>
<td>180</td>
<td>81</td>
<td>47</td>
<td>51</td>
<td>971</td>
<td>128</td>
<td>60</td>
</tr>
</tbody>
</table>

Number of Approved Finishing Units (AFUs) registered: 12.

Common land in the county:
There are some small areas of common land in Leicestershire, with low numbers of cattle grazed and no significant co-grazing by more than one herd. Spread of bTB related to cattle usage of common land is unlikely in this area.

Cattle/herd purpose:

<table>
<thead>
<tr>
<th>Leicestershire</th>
<th>Beef</th>
<th>Dairy</th>
<th>Dual breed</th>
<th>Unknown</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>71,743</td>
<td>47,441 (38.4%)</td>
<td>4,359 (3.5%)</td>
<td>21 (0.0%)</td>
<td>123,564</td>
</tr>
<tr>
<td>2017</td>
<td>74,120 (59.6%)</td>
<td>45,771 (36.8%)</td>
<td>4,389 (3.5%)</td>
<td>16 (0.0%)</td>
<td>124,296</td>
</tr>
</tbody>
</table>
Appendix 3: Summary of the Leicestershire headline cattle TB statistics

<table>
<thead>
<tr>
<th>Herd-level statistics</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Total number of cattle herds live on Sam at the end of the reporting period</td>
<td>1,092</td>
<td>1,091</td>
<td>1,078</td>
</tr>
<tr>
<td>b. Total number of herd tests carried out in the period</td>
<td>1,593</td>
<td>1,491</td>
<td>1,404</td>
</tr>
<tr>
<td>c. Total number of OTF cattle herds TB tested during the period for any reason</td>
<td>1,497</td>
<td>943</td>
<td>926</td>
</tr>
<tr>
<td>d. Total number of OTF cattle herds at the end of the report period (i.e. herds not under any type of TB02 restrictions)</td>
<td>1,049</td>
<td>1,037</td>
<td>997</td>
</tr>
<tr>
<td>e. Total number of cattle herds that were not under restrictions due to an ongoing TB breakdown at the end of the report period.</td>
<td>1,074</td>
<td>1,070</td>
<td>1,027</td>
</tr>
<tr>
<td>f. Total number of new TB breakdowns detected in cattle herds during the period¹</td>
<td>42</td>
<td>53</td>
<td>45</td>
</tr>
<tr>
<td>• OTF status suspended (OTF-S)</td>
<td>19</td>
<td>36</td>
<td>25</td>
</tr>
<tr>
<td>• OTF status withdrawn (OTF-W)</td>
<td>23</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>g. Of the OTF-W herd breakdowns:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• How many can be considered the result of movement, purchase or contact from/with an existing breakdown based on current evidence?</td>
<td>12</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>• New OTFW breakdowns triggered by skin test reactors or 2xIRs at routine herd tests</td>
<td>10</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>• New OTFW breakdowns triggered by skin test reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, etc.)</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>• New OTFW breakdowns first detected through routine slaughterhouse TB surveillance</td>
<td>9</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>h. Number of new breakdowns revealed by enhanced TB surveillance (radial testing) conducted around those OTFW herds (may not be applicable to every county in the Edge Area)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>• OTF-S</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>• OTF-W</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

¹ In some cases there is minor variation (under 4) between the total number of breakdowns reported in the Year End Descriptive Epidemiology Reports for individual counties and the report on Bovine tuberculosis in England in 2017. These are due to differences in the breakdown case definition, where incidents first detected in late 2016 are included as 2017 breakdowns in the individual county reports; and where incidents occur in epidemiologically linked premises.
### Herd-level statistics

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Number of OTF-W herds still open at the end of the period (including any ongoing OTF-W breakdowns that began in a previous quarter)</td>
<td>10</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>j. New confirmed (positive <em>M. bovis</em> culture) incidents in non-bovine species detected during the report period (indicate host species involved)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Animal-level statistics (cattle)

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Total number of cattle tested in the period (animal tests)</td>
<td>132,033</td>
<td>146,392</td>
<td>132,565</td>
</tr>
<tr>
<td>b. Reactors detected:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tuberculin skin test</td>
<td>119</td>
<td>157</td>
<td>188</td>
</tr>
<tr>
<td>additional IFN-gamma blood test reactors (skin-test negative or IR animals)</td>
<td>199</td>
<td>104</td>
<td>160</td>
</tr>
<tr>
<td>c. Reactors per breakdown</td>
<td>7.5</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>d. Reactors per 1000 animal tests</td>
<td>2.41</td>
<td>1.78</td>
<td>2.63</td>
</tr>
<tr>
<td>e. Additional animals identified for slaughter for TB control reasons (DCs, including any first-time IRs)</td>
<td>3</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>f. SLH cases (tuberculous carcasses) reported by FSA</td>
<td>21</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>g. SLH cases confirmed by culture of <em>M. bovis</em></td>
<td>11</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>
Appendix 4: Suspected sources of *M. bovis* infection for all the new OTFW breakdowns identified in the report period

<table>
<thead>
<tr>
<th>Most likely origin</th>
<th>Leicestershire</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prov.</td>
</tr>
<tr>
<td>Introduction (e.g. purchase) of infected animal(s)</td>
<td>1</td>
</tr>
<tr>
<td>Local - lateral spread from neighbouring holdings</td>
<td>0</td>
</tr>
<tr>
<td>• exposure to infected wildlife</td>
<td>3</td>
</tr>
<tr>
<td>• other farmed species</td>
<td>0</td>
</tr>
<tr>
<td>• recrudescence of residual infection from a previous TB breakdown</td>
<td>0</td>
</tr>
<tr>
<td>• infected human source</td>
<td>0</td>
</tr>
<tr>
<td>Undetermined/obscure</td>
<td>0</td>
</tr>
<tr>
<td>Other (explain)</td>
<td>0</td>
</tr>
</tbody>
</table>

All new OTFW TB breakdowns identified in Leicestershire were categorised using the following risk matrix, according to (a) the probability of them being the result of introduced infection (inward cattle movements) and (b) the strength of evidence that we are dealing with an isolated incident without further propagation from the index farm to neighbouring herds (or vice versa). The corresponding numbers of breakdowns were entered in the relevant boxes. Narrative text below describes the uncertainties that result in cases being included in the ‘possible’ column or row.

<table>
<thead>
<tr>
<th>Probability of introduced <em>M. bovis</em> infection</th>
<th>Probability of isolated, sporadic (‘one-off’) breakdown, without secondary cattle to cattle spread</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Likely (no secondary breakdowns detected)</td>
</tr>
<tr>
<td></td>
<td>Possible (no secondary breakdowns detected, but dataset incomplete)</td>
</tr>
<tr>
<td></td>
<td>Not likely (secondary spread has occurred)</td>
</tr>
<tr>
<td>Definite</td>
<td>1</td>
</tr>
<tr>
<td>Likely</td>
<td>4</td>
</tr>
<tr>
<td>Possible</td>
<td>2</td>
</tr>
<tr>
<td>Not likely (indigenous infection in the locality)</td>
<td>3</td>
</tr>
</tbody>
</table>

List of CPHs of those herds with OTF-W breakdowns categorised as definite or likely introduced cases with no evidence of local spread (greyed-in boxes):

This premises is a fattening unit with a high turnover of cattle and no breeding taking place. The WHT disclosed two reactors, one of which was visibly-lesioned (genotype 25:a), both with the same farm of origin. They moved on to the breakdown holding on the 9th of September, 2017 and remained there, housed, until the 29th of November (six weeks approximately). Further skin testing revealed two IRs and five interferon-gamma positive animals, all NVL. The WHT of 288 cattle carried out at the farm of origin on the 31st of October, 2017 disclosed 11 reactors, of which nine were visibly lesioned (VL). Genotype 25:a was identified. Based on the information above, this particular breakdown can be safely regarded as caused by the translocation of infected animals, as the confirmed animals had been resident in an area with the relevant homerange genotype (25:a) on a premises which was disclosed to...
be infected shortly after the animals in question moved off. There is no evidence of subsequent spread from the Leicestershire farm.

Three farms under the same CPH, managed separately. The reactor animal was on farm for a short period of time and had come from a farm that had a breakdown with the same genotype. IFN-gamma test was only applied to the fattening herd. Disease contained within the one farm without spread to the other two farms. Well-managed farm with good biosecurity standards. Origin of disease is clearly purchased.
Appendix 5: Overview of the bTB Control Programme in this Region of the Edge Area

### 5.1 Edge Testing Policy

- No discretionary measures implemented in OTFS breakdowns:
- Mandatory interferon-gamma parallel testing for OTFW breakdowns and discretionary interferon-gamma test for OTF breakdowns (see above) disclosed 160 additional reactors (45% of all reactors)
- No exemptions were applied to the deployment of the interferon-gamma blood test in OTFW breakdowns
- No persistently infected herds identified and hence no recommendations made for enhanced case management of such herds.

### 5.2 Unusual bTB breakdowns

- No unusual TB breakdowns identified
- No known confirmed or suspected cases of zoonotic (human) *M. bovis* infection
- No suspected cases of fraudulent skin test reactors.

### 5.3 Other Testing Measures

- A request to determine the Whole Genome Sequence (WGS) of the north east Leicestershire cluster of cases has been submitted in order to investigate how closely related to each other these breakdowns are and to evaluate the likelihood that wildlife might be playing a part in the transmission of these cases.

### 5.4 Other Control Measures

- Regional meetings held with farmers in the TB eradication group of the Vale of Belvoir area (partially South Nottinghamshire and North Leicestershire), led by the NFU
- The 2016-17 survey of TB in found-dead badgers funded by Defra in the Edge Area was completed in autumn of 2017. Results pending at the time of writing
- Badger vaccination project: The four-year projects which Defra funded under the original Badger Edge Vaccination Scheme (BEVS) which started in 2015 were terminated in 2016 due to the fact that manufacture of the ‘BadgerBCG’ vaccine had stopped. One of those projects was run by Nottinghamshire Wildlife Trust on the Nottinghamshire/Leicestershire border. A new scheme – BEVS2 – was launched at the end of 2017. An expanded version of the previous Nottinghamshire Wildlife Trust project has been approved and started in May 2018.
APHA is an Executive Agency of the Department for Environment, Food and Rural Affairs and also works on behalf of the Scottish Government, Welsh Government and Food Standards Agency to safeguard animal and plant health for the benefit of people, the environment and the economy.