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

Regional Office: North; counties in the Edge: CHESHIRE (part). Year-end report for 2015

EXECUTIVE SUMMARY

1. INTRODUCTION

2. CATTLE INDUSTRY IN THE EDGE AREA OF CHESHIRE

3. HISTORY AND GEOGRAPHIC DISTRIBUTION OF BOVINE TB IN THE CHESHIRE EDGE

4. DESCRIPTIVE EPIDEMIOLOGY OF BOVINE TB IN IN CHESHIRE EDGE

5. SUMMARY OF RISKS FOR SPREAD OF BOVINE TB IN THE CHESHIRE EDGE

6. ASSESSMENT OF EFFECTIVENESS OF CONTROLS AND FORWARD LOOK

APPENDICES

TR398 (Rev. 03/16) 1
Executive Summary

a. The ‘Edge Area’ 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 farms and is divided into three regions for reporting purposes. This report describes the bovine tuberculosis (bTB) epidemic in the North Region of the Edge Area, corresponding to most of Cheshire.

b. Cheshire is predominantly a dairy county with medium sized dairy herds of 100-300 cattle, however in recent years the beef sector, including both suckler and fattener herds, has increased significantly.

c. The Cheshire Edge Area has seen a steady increase in the annual number and incidence of bovine TB breakdowns over the last decade, until 2015 when there was a slight decrease. The incidence fell from 9.3% in 2014 to 9.1% in 2015 and the total number of breakdowns reduced from 136 to 112. The number of fully confirmed breakdowns (OTF-W) saw a slightly greater proportionate reduction, from 90 in 2014 to 70 in 2015. Most breakdowns occur in the east of Cheshire.

d. The overall prevalence of bTB remained the same for both years with, at any one time, approximately 6% of herds in the Cheshire Edge Area under TB restrictions due to a TB breakdown (about 85 herds). The average duration of TB restrictions for OTF-W (fully confirmed) breakdowns that resolved during 2015 was 5.7 months which is similar to that for 2014. The figure for strongly suspected (OTF-S) breakdowns showed a slight increase to 4.4 months.

e. The most common genotype of M. bovis isolated in infected cattle herds in the Cheshire Edge Area is 25:a (64/70 incidents that were typed), followed by genotype 17:a (6/70 incidents); both have home ranges that, together, cover most of Cheshire and overlap to a degree. Genotype 25:a was also the only genotype isolated in the 20 infected badger carcases found in the Liverpool University 2014 ‘found dead’ badger survey, whose genotyping was completed in 2015. This, together with other evidence such as the frequency of closed herds among those that suffer a breakdown, make badger contamination a likely source for almost three quarters of breakdowns in 2015 in the Cheshire Edge Area. Few breakdowns could be definitely attributed to movement of infected cattle onto the farms. Deer are widespread in Cheshire however evidence suggests they are not important in local bTB epidemiology.

f. One alpaca holding near Macclesfield was depopulated due to M. bovis infection; infection in the local badger population is strongly suspected as the source of this TB incident.

g. New control measures were implemented in 2015 including six-monthly whole herd TB testing, which replaced annual surveillance and supplementary radial TB testing. Six-monthly testing and mandatory IFN-gamma testing both appear to have been successful in detecting TB earlier resulting in reduced reactor numbers and earlier resolution of breakdowns. The Badger Edge Vaccination Scheme was put on hold in late 2015 due to the disruption in the production of BCG vaccine licensed for badgers and global shortage of human BCG vaccine supplies. However, some individual farmers and estates vaccinated badgers on their own farms earlier in 2015, although the exact figures are unknown, and it has not been possible to assess any potential impact.

h. There is an endemically infected area of approximately 170km² in east Cheshire, which is of great concern due to recurrent and prolonged disease in herds, absence of typical risk factors for cattle to cattle transmission and known badger infection in the locality causing an increased risk of bovine exposure.

i. The following potential risks of disease progression in the Cheshire Edge Area have been identified from the epidemiological evidence in 2015:
  
  • Risk of spread westwards of genotype 25:a towards Northwich
• Risk of spread to LRA near Stockport due to evidence of infected badgers and cattle incidents in the locality with no physical barriers that could prevent badger movement

• Risk of further spread into the Cheshire Edge from the HRA in Cheshire and Staffordshire from badger movements & from further south from cattle movements

• Risk of spread or introduction of new genotypes of *M. bovis* by the possible relocation of rescued infected badgers

• Increased risk of infection of larger herds due to use of fragmented land parcels, thus increased exposure to environmental contamination at grazing

j. A change of the genotype recovered from 25:a to 17:a has occurred in one part of the Cheshire Edge Area affecting multiple unrelated farms, however as only one isolate is typed from each case this is hard to interpret.

k. The increased cattle controls in the Cheshire Edge Area have been effective and are expected to continue to enable earlier detection and reduce reactor numbers, and possibly breakdown numbers, in the short term. However, reduction in the heavy infection challenge from infected badgers in some areas is believed necessary to enable a sustained reduction in the epidemic here.

1. Introduction

The Government published its strategy to achieve Officially Bovine Tuberculosis Free (OTF) status for England by 2038 in 2014. A key action in its implementation was to recognise the different levels of bTB in different parts of the country and vary the approach to control accordingly. To this end three management areas were established in 2013 (see Appendix 1). This report describes the epidemiology of bovine TB in the Cheshire Edge Area, which comprises most of Cheshire (except its southernmost parishes) and forms the northern part of the ‘Edge’ Area. The Edge Area sits within the annual testing area of England, creating a zone of increased surveillance between the High Risk Area which has a much higher incidence of bTB and the Low Risk Area where bTB is approaching eradication. It 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.

In this report bovine bTB incidents (usually referred to as ‘breakdowns’) which are strongly suspected (‘OTFS’) and fully confirmed (‘OTFW’) are presented separately in recognition of the Edge Area characteristic of adjoining both the High and Low risk areas (HRA and LRA) in which the predictive value of positive tests differ. That is, while OTFS breakdowns are very likely to truly be infected with bTB, this likelihood decreases as the overall level of disease decreases, so OTFS breakdowns in the LRA are less likely to be truly diseased. This is discussed further in Appendix 3. Note that due to the timing of this report, all data are derived directly from the transactional database ‘Sam’ and so will differ slightly from the data to be published later this year in the annual bTB reports for England, for which the data have been reviewed to remove duplicates and correct errors. The use of such data also means that the incidence measure in this report is derived by calculating the number of new breakdowns per 100 herds tested, while the measure used in the annual reports is adjusted for the effect of variable frequency of testing by measuring the number of breakdowns per 100 herd years ‘at risk’. This has little effect on the comparison within an area, but improves the comparability of incidence between areas.

2. Cattle industry in the Edge Area of Cheshire

Cheshire is included in the North region of APHA and is the only county with an Edge Area in this region. Traditionally Cheshire is predominantly a dairy county (see figures 1b & 1c), but over recent years, the beef sector has significantly increased in size due to the effects of economic drivers in the cattle industry.
Figure 1a: Proportion of cattle in herds of the size shown in the Cheshire Edge (n= 1521).

Figure 1a shows that there are many small herds in Cheshire with fewer very large herds. The majority of dairy herds will be 100-350 in size, but there are a few very large herds. Continuous outdoor grazing all year is practised by a few. The more traditional smaller dairy herds are housed over winter and grazed in the summer. Maize is commonly grown and fed to dairy cattle. The most common grazing practices include paddock, set-stocking and strip grazing. Beef fattening units are dispersed throughout the Cheshire Edge Area and the cattle are generally all purchased and housed. Thus this area has particular risk factors for bTB with more than a quarter of herds having over 200 animals, and the common practice of feeding maize to cattle. Although there are more beef than dairy herds (Figure 1b), there are many more dairy animals than beef animals in the Cheshire Edge Area (Figure 1c) and as these tend to be in larger herds, the greater impact of bTB in this area falls on dairy farmers. Please see appendix 2 for full details of the cattle industry in the Cheshire Edge Area.
3. History and geographic distribution of bovine TB in the Cheshire Edge

The Cheshire Edge Area was first defined on the 1st January 2013 and extraction of new incident data for Edge parishes shows that bovine TB in the Cheshire Edge Area has risen from 37 new breakdowns in 2006 to 136 new breakdowns in 2014 (see Figure 2 & refer to Appendix 3 for the data).

In 2015, the number of new incidents dropped to 112, which represents a decrease of 17% in new incidents compared to 2014.

In late 2010, there appeared to be a large increase in new incidents of almost 85% compared to 2009 and the reason for this is unclear except for the fact that the winter was extremely cold and
there would have been less grazing available and an increase in the length of time cattle were housed with potentially more cattle-cattle and badger-cattle interaction due to the shortage of feed supplies at pasture.

In 2013 there was another sudden increase in new incidents of 37% which may be explained by the fact that the whole of Cheshire changed from two and four year testing to annual herd testing in 2012 so all herds were being tested more frequently. This meant that breakdowns that might have been detected over later years (as herds became due for testing), were all detected in the same year.

The biggest increase occurred in 2014 with 136 new incidents. There were 90 OTFW breakdowns in the Cheshire Edge Area, representing the highest increase in confirmation in recent years. A possible reason would be the implementation of radial TB testing in 2014, replaced by six-monthly testing in 2015 and increased testing leading to increased detection. Radial TB testing was difficult to manage in Cheshire as many radial testing zones overlapped with each other. Resourcing the radial testing was logistically challenging and in 2015 whole herd six-monthly TB testing replaced annual surveillance and radial testing to enable more effective resourcing and to spread the testing over the year. This is logistically more acceptable to farmers and OVs too. As a result of six-monthly TB testing, the requirement for contiguous testing was no longer necessary, which has further aided resourcing and earlier detection, ensuring that disease in herds is not left for long periods to propagate.
a. Geographical distribution of all bovine TB breakdowns (new and ongoing) in the Edge Area of Cheshire

Figure 3a: Map showing all incidents and spoligotypes of bovine TB in cattle and an alpaca herd in the Cheshire Edge Area for 2015 & ongoing incidents carried over from 2014 overlaid on a background of the density of cattle holdings.

*Figure 3a shows the division of Cheshire into the Edge Area and the High Risk Area. Please note that new incidents for the HRA are not illustrated on this map.*
Almost 90% of the OTFW incidents in the Cheshire Edge are in the eastern half of the county, with very few occurring in the west in 2015. Figure 3b illustrates that the highest density of reactors and
slaughterhouse breakdowns is in the eastern half of Cheshire. It also shows the relationship between the HRA to the south with the adjoining Staffordshire Moorlands and North Shropshire, where there are also high densities of reactors. To the immediate North of Cheshire there have been no reactors disclosed due to the fact that these are highly urbanised areas of the cities of Liverpool and Manchester. More Easterly and Northerly the maps show the LRA where the incidence of disease is very low.

The OTFS incidents appear to be evenly dispersed across Cheshire East and West with no evidence of disease presence to the far north and north-west of the county. This is probably due to a reduction in cattle density in this area as the areas become more urbanised plus the fact that these areas are the furthest away from the HRA.

At the end of 2015 there were 40 OTFW breakdowns still ongoing. Four of these were carried over from 2014. Of these, three are in the Gawsworth/Marton area south of Macclesfield and one is near Frodsham. There were fewer breakdowns carried over from 2014, most probably due to enhanced case management procedures in these breakdowns where increased control measures and advice had been given.

**Established areas**

There is a clustering of breakdowns around the Congleton to Macclesfield area and west from here towards Knutsford as described in the 2014 & interim 2015 reports and there appears to be a spread of breakdowns of spoligotype 25 westwards compared to 2014 and a significant spread eastwards towards Knutsford and Holmes Chapel over the past 10 years. There would be relatively few movements between herds in these areas as many are relatively small herds and breed their own replacements with little opportunity for nose to nose contact between cattle and arable breaks between neighbouring farms as farmers become more aware of the risks of cattle contact. The reason for this spread westwards and further north is most likely the movement of infected wildlife due to the same spoligotype isolations and the fact that infected badgers have been found in these areas.

![Figure 3c](image_url)

*Figure 3c* shows one area of approximately 170km² which extends from Knutsford to Macclesfield, south to Congleton and back towards Holmes Chapel. In 2015, there were 33 new cattle and one alpaca incidents infected with spoligotype 25, many with recurrence (20 breakdowns). These tend to
be more traditional family farms with few cattle purchases in many of these herds as they breed their own replacements. Of the 23 dairy herds affected by spoligotype 25 in this area, 18 are described as predominantly closed herds with only the occasional purchase of a breeding bull or imported heifers from Europe. Small beef suckler herds also breed their own replacements. Many of these herds operate over a single site and do not share equipment with other farmers and do not allow the opportunity for nose to nose contact with neighbouring herds so this makes the likelihood of direct cattle to cattle transmission between herds and fomite spread of TB much less likely. Due to the large number of infected badgers identified here, it is much more likely that local badger infection leading to environmental contamination is the most likely explanation for the density of incidents within this area. Spoligotype 25 was also isolated from an alpaca herd in this area which was eventually culled due to established, widespread disease in the herd (please see section 5.c.b).

The majority of OTFW breakdowns in the Cheshire Edge Area (64 breakdowns) are spoligotype 25 with very few (six breakdowns) breakdowns of spoligotype 17. There is one case of spoligotype 9 towards the south eastern boundary of the Cheshire Edge Area, which is most likely of purchased origin.

**Other areas of concern**

Several farms were affected with genotype 17:a in 2014 & 2015. These farms are situated to the North of Crewe at Warmingham, Leighton and Minshull Vernon.

![Figure 3d: SPIDA map showing genotype 17:a distribution in Cheshire (beige patches) and the red hatched area included in the home range for 17:a.](image)

Figure 3d shows the three beige parishes mentioned above just below the CHESHIRE label on the map. This is clearly to the east of the homerange for 17:a but it is likely that we are starting to see spread eastwards of this genotype. Genotype 25:a was commonly found in this area historically and the affected herds have no cattle contact between them as they are not contiguous and not related in any way. The farms are also on single sites so there is no possibility of cattle movements locally to explain movement. Exposure to contamination from infected badgers is a likely explanation for these breakdowns. The planned TB prevalence survey of badgers in the Edge Area in 2016 will help to clarify the epidemiology in this area.
Figure 3e: SPIDA map showing genotype 25:a distribution in Cheshire (beige patches) and the red hatched area included in the home range for 25:a.

The home range map for genotype 25:a extends to over 50% of the Cheshire Edge Area as shown in Figure 3e. Interestingly, there appears to be a spread in a north westerly direction of genotype 25:a into Northwich compared to previous years’ data. As already discussed there is a high density of genotype 25:a isolates in East Cheshire (shown by the darker beige-orange patches). Infection in the badger population has been confirmed in this area to the west of Northwich at Weaverham. It is likely that there will be more cattle breakdowns in this area.

Figure 4a: Number of strongly suspected (OTFS) and fully confirmed (OTFW) breakdowns of bovine TB in the Cheshire Edge Area in 2014 and 2015

Figure 4a shows that there has been relative decrease of 22% in the number of fully confirmed incidents (OTFW) in 2015 compared with 2014 and a smaller decrease of strongly suspected breakdowns (OTFS) of 8.9%. The reasons for this overall decrease are unclear as six monthly herd testing was implemented in the Cheshire Edge Area in January 2015, so the amount of TB testing increased in 2015 and an increase was anticipated. With six-monthly TB testing, disease is disclosed earlier resulting in earlier removal of infected cattle, and the relative increase in the
proportion of OTFS breakdowns may be reflecting the widely held hypothesis that the confirmatory tests are less sensitive early in the course of disease. Farmers are also more aware of increasing biosecurity, the need to consider disease risk when sourcing replacement cattle and reducing cattle-badger interaction in many breakdowns.

In the Cheshire Edge Area six-monthly herd testing has resulted in the earlier disclosure of 40 new incidents, 30 of which were OTFW.

![Figure 4b: Bar chart showing the number of reactors disclosed at the initial WHT (6 monthly) in the Cheshire Edge Area in 2015 for all OTFW breakdowns (n=30).](image)

Figure 4b shows that 18 of the OTFW breakdowns disclosed by the unique testing regime of six monthly whole herd testing implemented in the Cheshire Edge Area (as part of the Edge strategy), only had one reactor at the disclosing test. However disease was identified in all 18 breakdowns either with lesions detected at slaughter or by positive cultures. The remaining 12 OTFW breakdowns disclosed two or more reactors at the initial test (range 2-16). The earlier disclosure of disease is important to reduce the amount of spread within herds awaiting longer interval TB surveillance TB testing. A further ten breakdowns disclosed as a result of six monthly herd testing remained strongly suspected (OTFS).

4. Descriptive epidemiology of bovine TB in in Cheshire Edge

a. Level of disease

In 2015, there was a reduction in the number of new incidents of bTB in the Cheshire Edge Area compared to 2014 (see figure 4a above). This partly due to the reduction in the total number of herds, so although the numbers of incidents dropped by 18%, the incidence (i.e. proportion of herds tested that had a new breakdown), decreased by just 0.2% between 2014 & 2015, from 9.3% to 9.1%. The reduction is encouraging but unexpected, as it coincided with increased frequency of herd testing as part of the strategy for the Cheshire Edge which might be expected to increase the number of breakdowns found in the short term.

In the whole of the England Edge Area the number of new incidents dropped but the incidence increased overall. In 2014, the Cheshire Edge Area accounted for almost 39% of the new incidents for the whole of the England Edge Area and this has decreased to 33% in 2015.
A possible explanation for this decrease in incidence in Cheshire is the increased frequency of skin testing and IFN-gamma testing where positive cattle are removed from the herds much earlier resulting in a reduction in the number of infected cattle being left on farm which would later give rise to new incidents. However, this has not worked in all areas of Cheshire and it is less likely to be of benefit where there is badger infection as there is a continued source of infection other than cattle within the farm. Such continued exposure usually manifests where we see continued disclosure of fully confirmed breakdowns at subsequent skin tests after the IFN-gamma has been completed sometimes several months before new disease is disclosed. There have been several breakdowns where this has occurred in the most heavily infected areas of Cheshire such as Gawsworth, Siddington, Lower Withington and Marton within the area described in figure 3d.

Other possibilities for the decrease include increased farmer awareness of sourcing replacement cattle, avoiding higher risk areas and ensuring incoming cattle are pre-motion TB tested; increased awareness of biosecurity on farm and avoiding areas of grazing which are higher risk due to environmental or badger exposure; reduction in the use of maize as a fodder crop; reduction in environmental contamination. Further epidemiological investigation such as a case control study would be needed to clarify the most likely cause of the decrease.

The herd prevalence in the Cheshire Edge Area has remained similar in 2014 and 2015 at 6%. This means that at any one time approximately 6% of the cattle herds in the Cheshire Edge Area were under TB restrictions at any one time which equates to approximately 85 herds.

Persistent breakdowns
There were three ‘persistent’ breakdowns at the end of 2015, i.e. those which have been ongoing for at least 18 months. Two of these were in the east of Cheshire in the Gawsworth/ Marton area between Congleton and Macclesfield where badger infection is suspected due to the numbers of positive badgers identified in the 2014 University of Liverpool found dead badger survey. All have undergone the mandatory cattle testing including IFN-gamma testing but disease continued to be disclosed. Other persistent breakdowns carried over from 2014 eventually resolved in 2015 due to enhanced case management.

Number of reactors per incident
The number of reactors disclosed decreased in 2015 to 979 compared with 1342 in 2014 which represents a reduction of almost 40%. In 2015, 50% of these reactors were disclosed by the skin test and 50% by the IFN-gamma test. The mean number of reactors per breakdown in 2015 was 8.7 compared to 9.9 in 2014. The full figures can be viewed in appendix 3 under animal level statistics. Again, this shows quite a dramatic reduction in reactor numbers disclosed where most of the herds have fewer reactors as the increased herd testing is reducing the proliferation of disease. If this effect continues, this will have a significant impact on the costs and duration of restrictions.

Duration of restrictions
Of the 70 new OTFW breakdowns in 2015 in the Cheshire Edge Area, 36 resolved in 2015 with an average duration of 5.5 months under TB2 restrictions. Some delays were caused by failure to return a cleansing and disinfection declaration (BT5) after the statutory testing was completed. Comparison with other years’ data shows that the average duration of restrictions has decreased to almost half in six years. In 2009 the average duration for an OTFW case was 10.9 months in Cheshire. Possible factors include the use of the IFN-gamma, increased skin testing resulting in earlier detection of TB and reduction in environmental exposure as described above.

24 strongly suspect (OTFS) breakdowns within the Cheshire Edge Area resolved with an average duration of 4.4 months which has increased slightly compared to previous years (3.6 months in 2010) and will be due to the mandatory requirement for OTFS herds in the Edge to improve the likelihood of truly eliminating TB infection before restrictions can be lifted through the increased sensitivity of detection that results from undergoing two clear short interval tests.
Longer duration of restrictions can have a significant effect on the farm income due to the restricted outlets for stock, especially on dairy farms where calves would normally be sold via markets. Whilst under restrictions, calves can only be sold to approved destinations such as Approved Finishing Units (AFU) or direct to slaughter, and as the moves are direct, this can have a significant economic effect on farm income. This is due to the lack of economic competition in an open market. However, many dairy farms are not equipped for calf rearing and depending on the time of year, heavy costs may be incurred, e.g. through treatments for pneumonia caused by increased stocking density. There might be advantage in taking the financial loss at an early stage to maximise the chances of recovery sooner and to release some of the burden of caring for young stock that would not normally be present.

b. Likely origin for bTB infection

Please refer to the risk matrix in Appendix 4 for the full details. The sources of infection are determined as part of the disease investigation into each TB incident. Data is collected at a visit to the farm and an epidemiological investigation is undertaken to attempt to ascertain the provisional and final sources of infection for each incident. The provisional assessment allows earlier intervention to be taken and the final assessment is made once all the evidence is available. Preparation is undertaken before the visit to examine the source of the reactors using the Cattle Tracing System database (CTS) and the APHA database (SAM) to investigate the testing history of the cattle and if purchased, the testing history of the farm of origin. At the visit, information is gathered regarding cattle contact between farms, use of parcels of land, heifer rearers, secondary premises, linked premises and husbandry practices. Samples are cultured from the reactors at slaughter to provide strain typing which can tell us whether the genotype or strain is commonly found in the area or whether there is a possibility it has been purchased. This investigation is performed by vets and after consideration of all the findings, provisional origins are identified and final origin when the incident has resolved.

Figure 5a: Provisional origins for bovine TB in OTFW incidents in the Cheshire Edge Area in 2015

(N=112, 70 recorded, 'undetermined' are OTFS)

Provisional origins include exposure to infected wildlife either at grazing or whilst housed (badgers, deer or wild boar); purchase from HRA, LRA, Edge, Wales, Ireland or Scotland; other farmed
species; contiguous contact; infected human source; residual infection; obscure or other. For the 70 OTFW Cheshire Edge breakdowns infected wildlife was cited in 49% of breakdowns as the most likely provisional source. This is probably due to the recent evidence of infected badgers found in Cheshire and the proximity to the incident. In 41% of the OTFW breakdowns, the most likely source recorded was ‘obscure’ and this usually means that there is not enough evidence initially to attribute one source until more evidence such as genotyping becomes available. In the breakdowns where infected wildlife is cited, the initial reactors may be homebred and the purchase history minimal or absent. Only 9% were provisionally purchased breakdowns which is in stark contrast to incidents in the LRA. However source was not assessed for OTFS incidents which formed a substantial proportion of breakdowns and so knowledge of their likely source could change these estimated proportions.

Figure 5b below shows the final origins attributing most likely or definite source of infection. Infected wildlife was attributed as the most likely source in 64% of the resolved breakdowns (55), residual infection most likely in 5% and purchase in 3%. The remainder of the breakdowns were obscure and this could be because there were several possible routes with no clear indication that one was more likely than the rest. For example the herd had been infected before with the same genotype; there had been some purchase history within the Edge or there is a possibility of environmental exposure but no exact risk could be attributed in these breakdowns. It is easier to exclude pathways in some breakdowns, such as wild boar or deer if there are none present. In other breakdowns, it is very difficult to attribute a source and multiple sources may have equal ranking in the final reports.

Many farmers report that their cattle do not have the possibility of nose to nose contact with other cattle, and this is usually verified during the investigation by examining maps and boundaries to the farm.

![Figure 5b: Final origins for bovine TB in OTFW incidents in the Cheshire Edge Area in 2015 (N=112, 60 recorded, 'undetermined are OTFS) (please note that data is incomplete as some of the breakdowns are still ongoing to date).](image)

Analysis of the probability that introduced infection resulted in secondary spread has also been reported and the data can be viewed in appendix 4. Only one incident is likely to have definitely purchased infection as the infection was disclosed as a slaughterhouse case from an Approved
Finishing Unit and had only been on farm for a couple of weeks. Two further breakdowns were likely to have been purchased as one was from a pre-movement exempt finishing unit disclosed as a slaughterhouse case. This had been present on farm longer but there was no secondary spread. Another case is most likely of purchased origin but the dataset is incomplete as the case is still ongoing.

Unless the genotype is out of home range, it is often difficult to attribute a purchased source to many breakdowns in the Cheshire Edge as genotype 25:a is very commonly isolated from new incidents. Further spread within the herd is possibly due to indirect contact with infected wildlife through environmental contamination of forage, pasture and feedstuffs rather than direct contact with infected wildlife as it has been shown that badgers rarely come into direct contact with cattle but infected badgers can excrete large quantities of *M. bovis* bacilli in urine and faeces.  

### c. Role of other species:

#### Badgers and other wildlife

Badger populations are generally considered to have increased dramatically in Cheshire over the past 10 years and there is a range of evidence to support this. At the incident investigation (DRF) visit, it is not uncommon to hear of new setts being reported by the affected farmers when there were previously fewer setts historically. However, badgers are rarely reported to be seen near cattle. The general perception is that more badger road kills are seen in Cheshire than in previous years and far fewer hedgehog casualties than previously. There are no feral pigs reported in Cheshire, but wild deer are very prominent in the area to the north of Congleton bordering on Staffordshire. Wild deer are easily visible in the Bosley area. and it is thought that these can travel large distances over the hills to and from Staffordshire where there is known endemic *M. bovis* infection. However the deer are culled regularly for local consumption and meat inspection has only once found suspicion of TB in one of these carcasses (near the River Dane) several years ago, providing useful evidence that deer are not important in the epidemiology of bTB in Cheshire. Further into Cheshire, there have been deer sightings, but these are much less common further south and west from Congleton. With regular controlled culling there is good ongoing surveillance for TB in this species.

In 2014, the University of Liverpool conducted a pilot study of found dead badgers in Cheshire as described in the 2014 report. The finding that 20% of the badgers tested were infected with bTB spoligotype 25, and that these were from the west of the county where the incidence of bTB in cattle is lower raises concern that there may be a high relative prevalence of infection in badgers in the East of Cheshire. The full results of this study are expected to be published soon.

*Figure 5c* below shows the locations of the positive badgers submitted in the survey. It also shows that there is evidence of infection in Staffordshire just over the border from the East Cheshire clusters and to the south in the HRA of Cheshire and North Staffordshire/Shropshire borders. The same map shows locations of cattle herd breakdowns infected with spoligotype 25 *M. bovis*. Over to the East where we believe there to be endemic wildlife infection, there is close correlation between the infected badgers and cattle locations. However, of concern, there are infected badgers towards the West of the county not specifically co-located with current cattle disease but located where there have been previous cattle breakdowns prior to 2014. It is therefore, likely that we will see further breakdowns in cattle in these areas and there will be continued spread towards the West.

---


2. [http://wrap.warwick.ac.uk/72701/1/WRAP_srep12318.pdf](http://wrap.warwick.ac.uk/72701/1/WRAP_srep12318.pdf)
Voluntary badger vaccination has taken place on several unrelated farms in Cheshire, although to date, this has been sporadic in nature and small in number which means it is unlikely to have a wider effect than in the locality of the immediate farm. In some cases much fewer than 50% of the badgers have been vaccinated. It is difficult to estimate the exact populations living on farms as it is impossible to assess the exact numbers present in one sett at any one time. A small number of farms mainly to the west have been vaccinating for several years and one large group of four estates in the West have participated in the Badger Edge Vaccination Scheme funded by DEFRA although unfortunately, vaccination activities will cease in 2016 due to a global shortage of available vaccine due to manufacturing issues. An estate in North-east Cheshire has also participated in vaccination although the benefit will be unknown for several years due to the vaccine being unavailable for 2016 for the foreseeable future. Vaccination may reduce the excretion of TB but it will not cure badgers which are already infected3. Ideally badgers would be tested before vaccination but there is no suitably reliant test and method yet available that wouldn’t require heavy sedation of badgers which adds to the logistical difficulties and costs.

An area of great concern is the possibility of infected badgers being relocated after rehabilitation in wildlife rescue centres to areas with little or no badger bTB infection. There are rehabilitation centres in Cheshire which receive badgers from all over the country. Badger cubs may be tested for TB before release but this is unlikely to be done with adults due to the complexity of the testing protocol and the consequent time constraints involved to ensure that three tests are performed before release. Badgers also require heavy sedation or anaesthesia in order to take blood samples which adds to the risk and costs. The Secret World Wildlife Rescue badger rehabilitation protocol (2003)4 states badger adults should be released where they are found as they are territorial in

---

3 [http://dx.doi.org/10.1371/journal.pone.0049833](http://dx.doi.org/10.1371/journal.pone.0049833)

4 [http://media.wix.com/udg/0c3b82_4ef9b12f84e49879c895434590f87d4.pdf](http://media.wix.com/udg/0c3b82_4ef9b12f84e49879c895434590f87d4.pdf)
nature but cubs can be relocated in suitable habitats anywhere. It is likely that cubs will have been mixed with other cubs during rehabilitation to form social groups but they will be blood tested before release although the sensitivity and specificity of the test is relatively poor\(^5\). Currently, there is no statutory requirement to present records or to consult with local farmers or APHA staff. Much relies on trust and the fact that the rescue centres are fully aware of the disease situation at the release sites.

It has been shown that badger faeces can contain up to 75,000 tuberculosis bacilli per gram whilst urine and pus can contain 300,000 and 200,000 bacilli per ml respectively\(^6\) which is much higher than that shed by cattle via the same routes. Putting this into context means that inhalation of as little as 0.03 ml of the infected badger urine on pasture or feedstuffs could result in infection in cattle. However, cattle will avoid grazing visibly contaminated pasture but bovine TB can survive in forage and when cattle are not grazed, by contamination of feed during the housed period.

**Other domestic species:**

In 2015, an alpaca herd near Macclesfield (see Figure 5d) was culled due to severe infection with bovine TB. Sudden deaths were reported in a number of alpacas in this small herd at the end of 2014.

---


\(^6\) [http://www.bovinetb.info/docs/johngallt_b_review9-04.pdf](http://www.bovinetb.info/docs/johngallt_b_review9-04.pdf)
Initial post-mortem results revealed no abnormalities, but further post-mortem examinations revealed lesions suspicious of TB, which were then reported to APHA. Voluntary TB testing revealed a further seven skin reactors, with six alpacas having widespread lesions consistent with TB (five were open cases with lung abscesses). The second skin test was completed in October 2015 and three skin reactors were disclosed, two of which had lesions at post-mortem examination. Serology of the remaining 12 alpacas disclosed a further eight positives leaving only four alpacas. The holding was totally depopulated as a result due to the overwhelming infection present and for the risk to public health as they were pets. As shown in figure 5d above, the herd is situated in an area close to other confirmed cattle breakdowns infected with the same genotype 25:a. There is no evidence of cattle contact with this herd, although there is a strong suspicion of infected wildlife as despite herd interferon-gamma parallel testing and regular skin testing in the cattle, disease is ongoing in these herds.

There were no other non-bovine species reported as suspect cases of bovine TB in 2015 in the Cheshire Edge Area.

d. Detection of breakdowns

In 2015, all cattle herds in the Cheshire Edge Area were subjected to six-monthly whole herd TB testing of all eligible cattle over 42 days of age following a review of the Defra Edge Area strategy. 37% of the new incidents reported were recurrent breakdowns which suggests that the current strategy is not sufficient in itself to effectively control and eradicate sources of infection. There is a high probability that due to the management and purchase behaviour of most of these recurrent herds, that badger infection is present and maintained in specific areas, mainly in east Cheshire as described previously. Cattle measures alone cannot prevent recurrence if environmental exposure is the driver. This is particularly pertinent in the grazing period; strip grazing; all year grazing; or when zero grazing is practiced and feed stores are unprotected. Zero grazing is practised in a small number of herds and grass is cut freshly in summer and preserved forage used in winter, and both presented to the housed cattle. This can increase the risk of transmission of bovine TB as the cattle cannot choose which grass they eat naturally. The cut grass could be contaminated with infected urine or faeces.

![Figure 5e: Methods of detection of new OTFW herd incidents in the Cheshire Edge Area in 2015 and number of each](image)

Routine TB testing including six-monthly whole herd testing resulted in the disclosure of 70% of the new OTFW incidents in the Cheshire Edge Area in 2015 (see Figure 5e) compared to just 26% in 2014. This shows the benefit of the six-monthly testing in terms of earlier disease disclosure and an extension of this strategy will be important for longer term consequences. The overwhelming majority of Cheshire farmers have accepted this measure with no objection and many are of the opinion that they would rather find reactors sooner than later when disease has had time to
propagate within the herd. It will be important to support this strategy with effective control measures to prevent the spread of disease from badgers to cattle, certainly in the East of the Cheshire Edge.

Slaughterhouse surveillance disclosed 9% of new OTFW breakdowns in 2015 compared to 12% in 2014. It is hoped that this figure should reduce further with the increased TB testing although it is known that heavily infected cattle can pass the skin test and a negative pre-movement TB test result is not a guarantee that incoming cattle are not in the early stages of infection. Slaughterhouse surveillance will remain a vital tool in the identification of TB in cattle and other species.

Some radial TB testing carried over into early 2015 and this along with trace tests disclosed a further 20% of new OTFW incidents in 2015. 52% of OTFW incidents were disclosed using trace tests and radial TB testing in 2014. The radial testing, although valuable has now been replaced by the six-monthly TB testing. In 2014, there were also a larger number of positive trace tests disclosures than expected due to the Cumbrian herd dispersal.

Recurrence rate
The recurrence rate increased in 2015 compared to 2014. In 2015 the recurrence rate among OTFW herds was 37% (26/70 breakdowns) compared to 33% in 2014 (30/90). Incidents included in this category had disclosed OTFW incidents on the same premises in the last 3 years. Again this could be the result of undisclosed infection remaining in the cattle between TB tests or there is ongoing environmental exposure on the farm. The use of the IFN-gamma will hopefully reduce the former in the absence of environmental factors but will make no difference to incidents caused by exposure to TB bacilli surviving in the farm environment from badger contamination or in slurry although there is a limited timescale for TB survival in slurry. M. bovis contaminated faeces may remain infective for up to six months when deposited in winter but only one to two months in the summer, depending on the temperature and the concentration of pathogens in the faeces. Much will depend on the concentration of TB bacilli in the slurry, dilution and climatic conditions. In contrast, TB bacilli will survive for years in a living animal as it enters periods of latency and reactivation. The most likely method of transmission between cattle is via aerosol spread. However, this route is highly unlikely from badgers to cattle and vice versa due to the low likelihood of direct interaction between the two species. It is more likely that infection is transmitted by indirect contact and environmental exposure through contamination of feedstuffs and water. M. bovis is very susceptible to UV light, high temperatures and low pH levels. If these conditions are not attained then bovine TB can survive for very long periods in dark, cold, damp conditions in slurry, at pasture and particularly in sheds over the winter. This can act as a source of disease re-circulating within herds as well as cattle-cattle interactions.

e. Burden of bovine TB
The direct burden of bovine TB in the Cheshire Edge Area is less than in counties in the HRA as at any one time in 2015 only about 6% of farms were restricted, although this still represents about 85 farmers impacted by restrictions.

The impact of bTB is also reflected in metrics of the control programme and in 2015, in the Cheshire Edge Area 356,603 cattle were TB tested in 2861 herd tests and 979 reactors detected and compulsorily slaughtered.

   f. Key drivers of the bovine TB epidemic

Some of the key drivers for the epidemic in the Cheshire Edge Area include risks from the HRA by way of cattle movements into the Edge driven by economics and habitual behaviour; infected wildlife moving across the county from the HRA and endemic areas of Cheshire; poor biosecurity

---

practices on some farms and limited knowledge regarding good husbandry practices and herd management.

There are four busy livestock markets within easy reach of Cheshire farmers, two of which are in the HRA and will readily attract purchasers. Store cattle will be pre-movement TB tested but the sensitivity of the skin test is not perfect and this is only a risk reduction measure. However, cattle entering the Cheshire Edge Area from the HRA will be included in six-monthly herd tests and may be monitored with slaughterhouse surveillance, so it is unlikely that diseased cattle will remain undetected for long periods reducing the potential for propagation of disease within herds. Six-monthly TB testing, which is unique to the Cheshire Edge Area at the moment, is proving to be very valuable in detecting disease earlier as previously reported.

One of the main concerns currently is to support the robust and intense cattle testing measures that are already in place and successfully identifying cattle disease earlier with measures to control the infected wildlife reservoir, which is re-infecting herds in parts of Cheshire. A Government-funded badger TB prevalence survey is planned and will be implemented during 16/17. This is much needed to provide further evidence for licensed badger population control in areas of Cheshire. The University of Liverpool survey results will also be published, which will be an important step.

Prospects for OTF status
Given the recent reduction in the incidence for the Cheshire Edge Area and the intense cattle measures in place already, there is potential to achieve OTF status in 2025, providing exposure to infection from badgers (including those released from rescue centres) can be controlled.

5. Summary of risks for spread of bovine TB in the Cheshire Edge Area

Summary of the risks from the Edge Area of Cheshire to the neighbouring LRA

There are no physical barriers between the Cheshire Edge Area and the contiguous LRA of Greater Manchester and Wirral. The urbanisation North of Cheshire of the cities of Liverpool and Manchester provide a physical barrier to form a break for wildlife movements, but cattle movements can still take place. The breaking of BCMS links between the two risk areas has resulted in improved monitoring of movements between the Edge and LRA and better farmer compliance with pre-movement TB testing. However, there are still large fragmented farms in the Cheshire Edge Area which move cattle between the Edge and HRA and could potentially move cattle to the LRA with expansion of their businesses.

To the north east of Cheshire there are more dense cattle holdings and increasing evidence of TB in badgers (see figure 3a) compared with the far north and these could potentially increase the risk to Greater Manchester & Stockport areas.
Figure 6a: Map showing approximate locations of all OTFW incidents in the Cheshire Edge Area (below the red line) at this location in 2013-2015 in relation to the border with Greater Manchester & Stockport. The arrows highlight the potential risk areas of bTB spread.

The home range map for genotype 25:a (see figure 3f) and the recent OTFW incidents close to the border (see figures 3b & c) means that spread into this area immediately below Stockport is a high probability as there are no geographical or physical barriers preventing spread here.

Infected badgers were found in the locality in the dead badger survey (see figure 5c) in the Wilmslow and Adlington areas of the Cheshire Edge Area which is very close to the LRA, highlighting the need for farmers to focus on biosecurity to supplement the range of badger controls that are being developed under the eradication strategy.

A one-off check test of farms in the Stockport area in early 2015 was successful and there were no OTFW incidents except for one which was OTFW in 2014 and had links with the Edge Area. However, inconclusive reactors and OTFS incidents have been disclosed in this area in 2015, raising concern that bTB might be present.

The markets within the Edge Area attract customers from all over the UK and cattle can move from the LRA via the markets and back into the LRA by means of dispersal sales or Pedigree sales. The implementation of post-movement TB testing for cattle moving to the LRA from the HRA and Edge will undoubtedly reduce these types of cattle movements and alter farmer purchase behaviour in the LRA to an extent but there will still be economic drivers for cheaper cattle.

There will be dealers who take cattle from Cheshire into Lancashire, Yorkshire and Cumbria but the volumes are unknown. The post-movement TB testing will make this less economic in future, hopefully leading to a reduction in the practice and so a reduction in the risk of moving bTB into the LRA.

Summary of the risk to the Edge Area from the HRA

The main risks from the HRA lie to the south-east and southern borders between the Cheshire Edge Area and the HRA as there are no physical or geographical barriers along this border.
There is already evidence of spread of TB historically in the Congleton and Bosley (North of Congleton) areas where there are numerous OTFW incidents with the same genotype as that found in North Staffordshire just over the border in these areas. Infected badgers were also identified in these areas of Cheshire and over the border towards Leek and Rudyard.

The same scenario has been found in South Cheshire with spread of disease upwards from Shropshire (Market Drayton, Adderley and Norton in Hales) to farms in Cheshire in the HRA. Infected badgers have been found in these areas, in particular Audlem and there is now evidence of spread of infected wildlife northwards towards Nantwich (see figure 5c).

Neither of these areas has geographical or physical barriers to stop the movement of infected wildlife.

There are popular markets in Leek and Market Drayton which are regularly used by Cheshire Edge Area farmers, so there is a likely movement of cattle into the Edge from these HRA areas. Currently there are no disincentives to stop the movement of cattle in this direction except for the requirement to pre-movement TB test. However, the few of the new incidents in the Cheshire Edge in 2015 for which a risk pathway could be determined were attributed to cattle movements, so it is likely that the volumes of movements are not significant or that pre-movement TB testing is protecting the Cheshire herds to a degree.

There are dealers in Cheshire who bring cattle from further south in the HRA, in particular from Somerset and Mid Shropshire. There are also dealers who bring cattle from high risk areas of Wales such as Powys and south-west Wales. This trade will continue and may even increase with the new policy of post-movement testing into the LRA as these cattle will require outlets and economic drivers may make them more attractive within the HRA & Edge further north.

6. Assessment of effectiveness of controls and forward look

Enhanced measures in cattle
With the continued six-monthly TB testing in the Cheshire Edge Area, earlier detection of TB will continue and the number of reactors per breakdown should decrease. Six-monthly TB herd testing replaced annual surveillance testing and the radial testing implemented in 2014 and has proved much easier to resource and appears to be detecting disease earlier.

**Wildlife control measures & vaccination**
In the most heavily infected areas of Cheshire in the east, the effectiveness of six-monthly TB testing will soon plateau unless further controls are applied. The further controls will only be effective if exposure to infected badgers is substantially reduced or prevented over a substantial period such as 4-5 years, which will need focus on both biosecurity and badger controls. Only then, in combination with the increased cattle controls, will we see a more sustained reduction of bovine TB in this area of England.

Badger control in these areas would also protect the lower risk areas of Cheshire towards the North and West which will in turn help to protect the immediate LRAs of Stockport and Wirral. The current badger vaccination policy which allows badger vaccination on non-contiguous land on a sporadic basis is unlikely to be effective when resumed, unless large conjoined areas can be vaccinated.

**Other measures**
Continuation of IFN-gamma parallel testing in OTFW breakdown herds is also essential in the Cheshire Edge Area and extension of its use to the HRA of Cheshire will also be essential to increase the sensitivity of testing in breakdown herds. Ideally the whole of Cheshire should be treated as one.

The discretionary use of the IFN-gamma test is also important for persistent herd breakdowns to increase the likelihood of finding all diseased animals.

Improved on farm biosecurity education will help, but only in combination with other measures. With the economic drivers in the dairy industry, it is anticipated that we will see a reduction in dairy farming in Cheshire over the next two years, but the possibility of herds expanding and increasing fragmentation is very likely.
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 (in effect from January 2013, as set out in the strategy for achieving Officially Bovine Tuberculosis Free status for England)

1.1 Policy objectives for the Edge Area:

Short to medium term:
- Slow down geographic spread
- Maintain crude herd incidence of OTFW breakdowns <2% overall by 2019
- Begin to reduce the incidence rate

Longer term:
- Reduce geographic spread of bTB and push the Edge Area boundaries westward
- Reduce OTFW herd incidence to <1% by 2025
- 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 Derbyshire (radial testing), with 6 month follow-up
c. 6 monthly whole herd testing in Cheshire from January 2015
d. Survey of badgers found dead in the Edge area (starting Spring 2016)

Management of cases (‘breakdowns’)
a. Increased sensitivity of breakdown herd testing:
   - OTFS breakdowns to pass 2 short interval tests at severe interpretation to regain OTF status
   - Mandatory IFN-g parallel testing in OTFW
b. Enhanced epidemiological investigation & data analysis

Preventive measures
a. Compulsory pre-movement TB testing
b. Remove CTS links between HRA and Edge areas
c. Approved Finishing Units (AFUs) with grazing not permitted
d. Promote risk based trading of cattle
e. Badger (Edge) vaccination scheme (currently suspended due to vaccine supply issues)
f. bTB biosecurity review project (underway)
g. Local bTB awareness events and Eradication Boards
h. Information sharing – location of breakdown herds published

Appendix 2: Cattle industry in the Edge Area of the region

Number of cattle premises by size band in the Edge Area of the region at 1 January 2015 (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>638</td>
<td>208</td>
<td>261</td>
<td>200</td>
<td>112</td>
<td>93</td>
<td>1521</td>
<td>158</td>
<td>73</td>
</tr>
</tbody>
</table>

Number of Approved Finishing Units (AFUs) registered in the Region’s Edge Area: Eight

Common land in the County or Counties: No common land in Cheshire

Cattle/herd purpose:

<table>
<thead>
<tr>
<th></th>
<th>Beef</th>
<th>Dairy</th>
<th>Dual purpose</th>
<th>Unknown</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>56225</td>
<td>173415</td>
<td>10341</td>
<td>55</td>
<td>240036</td>
</tr>
<tr>
<td>%</td>
<td>23.4%</td>
<td>72.2%</td>
<td>4.3%</td>
<td>0.0%</td>
<td></td>
</tr>
</tbody>
</table>

Full text extracted from the interim 2015 report for the Cheshire Edge Area

Cheshire is included in the North region of the APHA regions and is split into a High Risk Area (HRA) south of Nantwich, extending from Malpas to Betley, and the rest of the county has been included in the Edge Area (red hatched) under the TB England Eradication Strategy since 2014. Further north the region includes the counties of Lancashire, Cumbria, Yorkshire and Northumberland, Greater Manchester and Wirral which are all 4 year TB testing areas and are classed as part of the Low Risk Area (pink). To the east, Cheshire borders Greater Manchester and Derbyshire; to the south, Staffordshire; to the west, North Wales and Shropshire, and to the north, Lancashire and Wirral.

The north of the county is bordered by the large urbanised areas of Liverpool and Manchester, the Manchester Ship Canal and the River Mersey. It is divided into two local authorities, Cheshire East and Cheshire West and Chester.

There are two livestock markets, Beeston Castle Auction and Chelford Market which joined together under the same management in 2014. Currently, both markets are very busy with cattle sales which attract buyers from all over the country. Beeston is situated south of Chester in the west of Cheshire and Chelford is situated in the north east of the county near Knutsford. Both markets operate slaughter collections and sales for TB restricted cattle which some farmers prefer as they are selling live weight. Just south-west of Cheshire, in Shropshire, there is another busy livestock market at Market Drayton and one in Leek Staffordshire south-east of Cheshire. Many Cheshire farmers also use these markets to trade cattle.

Cheshire has several cattle abattoirs: Beesons at Haslington, near Crewe and close to the M6, is contracted by APHA and DEFRA to slaughter TB reactors. Hewitts of Huxley, near Tarporley and Jacksons near Knutsford both kill a variety of species including cattle.

Cheshire is predominantly a dairy farming county with many Pedigree Holstein Friesian herds although there are also a large number of beef suckler and beef fattening herds. In recent years, dairy herds have increased in size and the New Zealand style farming system has become more common across Cheshire. Share farming has also increased in popularity and increased the fragmentation of herds with dispersal of cattle all over the county and beyond into the High Risk Areas of the neighbouring counties of Staffordshire, Shropshire and into North Wales.
The use of robotic milking facilities has increased the amount of zero grazing practised in a few large dairy herds across the county.

The more traditional dairy herds are grazed in summer and housed over the winter. Batch spring calving is increasing in popularity for relative ease of management over winter with the New Zealand systems.

Most farms make grass silage and over the years, to support higher milk yields, maize has become a very popular feed in Total Mixed Rations (TMR) which is fed all year round on many dairy farms. TMR is mixed on farm using straights stored in bulk and fed generally in feed passages both inside and on the outside of buildings.

Grazing practices vary between; strip grazing, set-stocking and paddock grazing. The use of mineral licks is common in Cheshire and many of these are accessible to wildlife when used at pasture. Most dairy cattle, with the exception of the New Zealand systems, are housed over winter in cubicle sheds with feed passages either inside or on the outside of the sheds.

Artificial insemination is utilised in many dairy herds with very few relying on natural service. Most farmers purchase bulls and replace them every 2-3 years. Many farmers breed their own replacement heifers although there are a few which are classed as flying and buy all replacements which may be sourced from anywhere in the UK. Many replacements heifers have also been sourced from mainland Europe in recent years. There appears to have been more of a shift towards risk based trading and sourcing replacements more carefully for many farmers. Initially they may like to be classed as closed herds but in reality they may buy a few replacements or import some in calf heifers as replacements.

Truly closed herds are relatively uncommon now as many use multiple sites for management purposes as their herds have increased in size. They may also use heifer rearers where the heifers leave the main farm as calves and return at the point of calving. Some of these are dedicated rearers for one source and others rear for several farmers. Others maintain a single site but may occasionally purchase bulls or replacement heifers to vary the bloodlines.

The majority of dairy herds practise vaccination for BVD, IBR and leptospirosis and many monitor for Johnes disease and use parasite control regimes. Many of the dairy farms have routine veterinary visits 2-4 times per month depending on their size.

There are a relatively large number of beef suckler herds varying in size. These are distributed throughout Cheshire. There is also a moderate number of beef fattening units which tend to house the cattle all year round with dynamic populations of cattle and with most moving stock direct to slaughter on a weekly basis providing a good level of slaughterhouse surveillance for TB.

The beef suckler herds are generally grazed in summer and occasionally out wintered or loose housed. Intensive finishing units will keep cattle continuously housed from purchase and are usually fed a cereal based diet often including maize until slaughter.

In the Cheshire Edge, there has been an increase in the number of non-grazing AFUs over the past year. Seven are in the Edge and one in the HRA. There are also ten pre-movement exempt finishing units in the Edge.

There are no areas of common grazing in Cheshire.
Appendix 3: Cheshire Edge Area cattle TB statistics

Epidemic curve data: number of breakdowns per month from 2006 to 2015

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>55</td>
</tr>
<tr>
<td>February</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>10</td>
<td>22</td>
<td>6</td>
<td>66</td>
</tr>
<tr>
<td>March</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>10</td>
<td>19</td>
<td>12</td>
<td>81</td>
</tr>
<tr>
<td>April</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>14</td>
<td>10</td>
<td>9</td>
<td>62</td>
</tr>
<tr>
<td>May</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>48</td>
</tr>
<tr>
<td>June</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>11</td>
<td>7</td>
<td>13</td>
<td>55</td>
</tr>
<tr>
<td>July</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>9</td>
<td>12</td>
<td>54</td>
</tr>
<tr>
<td>August</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>September</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>14</td>
<td>22</td>
<td>9</td>
<td>80</td>
</tr>
<tr>
<td>October</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>14</td>
<td>11</td>
<td>4</td>
<td>6</td>
<td>58</td>
</tr>
<tr>
<td>November</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>14</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>13</td>
<td>74</td>
</tr>
<tr>
<td>December</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>11</td>
<td>10</td>
<td>11</td>
<td>52</td>
</tr>
<tr>
<td>Grand Total</td>
<td>37</td>
<td>26</td>
<td>32</td>
<td>39</td>
<td>72</td>
<td>73</td>
<td>85</td>
<td>117</td>
<td>135</td>
<td>112</td>
<td>728</td>
</tr>
</tbody>
</table>

Herd Level Statistics

In this report bTB incidents which are strongly suspected ('OTFS') and fully confirmed ('OTFW') are presented separately in recognition of the Edge characteristic of spanning the High and Low risk areas (HRA and LRA) in which the predictive value of positive tests differ. In general cattle that react positively to any of the bTB tests are likely to be inflected, however in the LRA where disease is much less common, there is more chance that a positive test could occur in an animal that was not inflected with bTB. The situation is less clear cut in the Edge, particularly in view of the hypothesis that infected animals tested early in the progress of infection are likely to give a positive result to the live animal tests that cannot be confirmed by post mortem tests. The increased controls in the Edge Area are expected to find disease earlier, so the proportion of OTFS classified breakdowns will increase if this hypothesis is valid, but the probability that they are inflected will remain higher than similar breakdowns in the LRA due to the higher incidence of disease. Analysis of the Edge Area data provides the opportunity to explore this as shown in this report.

### Herd-level statistics

<table>
<thead>
<tr>
<th>Description</th>
<th>Cheshire Edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Total number of cattle herds live on Sam at the end of the reporting period</td>
<td>1418</td>
</tr>
<tr>
<td>b. Total number of herd tests carried out in the period</td>
<td>2861</td>
</tr>
<tr>
<td>c. Total number of OTF cattle herds TB tested during the period for any reason</td>
<td>1229</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>1329</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>1364</td>
</tr>
<tr>
<td>f. Total number of new TB breakdowns detected in cattle herds during the report period</td>
<td>112</td>
</tr>
<tr>
<td>g. Of the OTF-W herd breakdowns:</td>
<td></td>
</tr>
<tr>
<td>• Occurred on a holding affected by another OTFW breakdown in the previous three years?</td>
<td>26</td>
</tr>
</tbody>
</table>
### Herd-level statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Cheshire Edge</th>
</tr>
</thead>
<tbody>
<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>1</td>
</tr>
<tr>
<td>• New OTF-W breakdowns triggered by skin test reactors or 2xIRs at routine herd tests</td>
<td>49</td>
</tr>
<tr>
<td>• New OTF-W breakdowns triggered by skin test reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, etc.)</td>
<td>14</td>
</tr>
<tr>
<td>• New OTF-W breakdowns first detected through routine slaughterhouse TB surveillance</td>
<td>6</td>
</tr>
<tr>
<td>h. Number of new breakdowns revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds (may not be applicable to every county in the Edge Area)</td>
<td>n/a</td>
</tr>
<tr>
<td>• OTF-S</td>
<td>n/a</td>
</tr>
<tr>
<td>• OTF-W</td>
<td>n/a</td>
</tr>
<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>40</td>
</tr>
<tr>
<td>j. New confirmed (positive <em>M. bovis</em> culture) incidents in non-bovine species detected during 2015</td>
<td>1 alpaca</td>
</tr>
</tbody>
</table>

### Animal-level statistics (cattle)

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Total number of cattle tested in the period (animal tests)</td>
<td>356603</td>
</tr>
<tr>
<td>b. Reactors detected:</td>
<td>979</td>
</tr>
<tr>
<td>• tuberculin skin test</td>
<td>496</td>
</tr>
<tr>
<td>• additional IFN-gamma blood test reactors (skin-test negative or IR animals)</td>
<td>483</td>
</tr>
<tr>
<td>c. Reactors per breakdown</td>
<td>8.74</td>
</tr>
<tr>
<td>d. Reactors per 1000 animal tests</td>
<td>2.75</td>
</tr>
<tr>
<td>e. Additional animals identified for slaughter for TB control reasons (DCs, including any first-time IRs)</td>
<td>2</td>
</tr>
<tr>
<td>f. SLH breakdowns (tuberculous carcasses) reported by FSA</td>
<td>18</td>
</tr>
<tr>
<td>g. SLH breakdowns confirmed by culture of <em>M. bovis</em></td>
<td>11</td>
</tr>
</tbody>
</table>
Appendix 4: Suspected sources of *M. bovis* infection for all the new OTF-W breakdowns identified in the report period

<table>
<thead>
<tr>
<th>Most likely origin</th>
<th>Cheshire Edge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prov.</td>
</tr>
<tr>
<td>Introduction (e.g. purchase) of infected animal(s)</td>
<td>6</td>
</tr>
<tr>
<td>Local - lateral spread from neighbouring holdings</td>
<td>0</td>
</tr>
<tr>
<td>• exposure to infected wildlife</td>
<td>34</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>1</td>
</tr>
<tr>
<td>• infected human source</td>
<td>0</td>
</tr>
<tr>
<td>Undetermined/obscure</td>
<td>29</td>
</tr>
<tr>
<td>Other (explain)</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Probability of introduced <em>M. bovis</em> infection</th>
<th>Likely (no secondary breakdowns detected)</th>
<th>Possible (no secondary breakdowns detected, but dataset incomplete)</th>
<th>Not likely (secondary spread has occurred)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Likely</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Possible</td>
<td>2</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Not likely (indigenous infection in the locality)</td>
<td>11</td>
<td>2</td>
<td>38</td>
</tr>
</tbody>
</table>

Probability of isolated, sporadic (‘one-off’) breakdown, without secondary cattle to cattle spread

greyed-in boxes show introduced breakdowns with no evidence of local spread
Appendix 5: Overview of the bTB Control Programme in the Cheshire Edge Area

5.1 Edge Testing Policy

- OFT-S enhanced TB testing with two SITs on severe interpretation & continuation of discretionary measures in all OTF-S incidents such as IFN-gamma testing and removal of inconclusive reactors
- The mandatory IFN-gamma test is very useful in identifying early disease and disease undetected by the skin test in breakdown situations and should be continued
- The use of ‘bovine-only’ interpretation of the skin test should be considered and implemented when required, not necessarily on a herd basis but on an individual cohort group where there have been large numbers of reactors disclosed
- Exemptions to the compulsory IFN-gamma testing policy for OTFW breakdown herds should continue to be applied using TR173 – particularly applicable to housed intensive beef fattening units where regular ongoing slaughterhouse surveillance is undertaken
- Radial TB testing no longer applies in the Cheshire Edge Area and was replaced with the six-monthly herd testing policy, which has proved very useful in terms of earlier disease disclosure, ability for more effective resourcing and better timing of tests throughout the year
- There are three breakdowns undergoing enhanced case management the Cheshire Edge. Two are situated in the most heavily infected area of Cheshire. Extra testing measures and biosecurity measures are being planned for these

5.2 Unusual bTB breakdowns

- There have been no extraordinary TB breakdowns in 2015 but lesions have been reported as typical in several pre-scapular lymph nodes in several cases and have cultured positive for *M. bovis*
- There have been no further confirmed or suspected cases of zoonotic TB infection reported to APHA for the Cheshire Edge Area, although this information is difficult to access due to patient confidentiality. One farmer was suspected of being infected as he had a chronic cough and symptoms highly suspicious of TB, but this has not been confirmed to APHA staff.
- In 2015 there were no obvious cases of fraudulent skin test reactors although non-specific skin reactors have been suspected on a couple of farms
- There were no breakdowns involving open farms or producer-retailers/ cheesemakers in 2015

5.3 Other Testing Measures

- Discretionary exemptions have been granted to a minority of beef units which have signed TR433 declarations as per the Operations Manual procedures where they have declared that they do not graze cattle, no breeding takes place, all cattle are present for fewer than 12 months and all go direct to slaughter. When a declaration is received, CTS checks are made to verify the declaration. Tests are still marked forward with a view to review the situation on a regular basis. Some previously exempt beef fatteners have applied for Approved Finishing Unit status.
- There are no potential hot spot areas in Cheshire but there are endemically infected areas where it is hoped further information on the wildlife infection can be obtained by means of a further found dead survey.
- The badger genotyping results from the 2014 survey took months to complete. No contagious TB testing was done in these areas as a result of the delays in obtaining genotype information but the majority were already on radial or six-monthly herd TB testing so adequate surveillance was already in place
- Overdue TB testing levels remain low in Cheshire compared to other areas and this is constantly under review. The imposition of financial penalties via the SFP motivates people to get testing completed within the window with a few exceptions. Also the Delivery Partners XL North are more aware of on farm situations and any requirements for adjusting testing windows due to ill-health or bereavement.

5.4 Other Control Measures

- There are plans for the Cheshire Eradication Board to hold a biosecurity event on farm in 2016 which will be useful to view practical solutions to badger-proofing farms and for reducing the environmental exposure to disease
- OV audits will continue albeit at a reduced rate by APHA from previous years. Intelligence led audits are more likely as Veterinary Delivery Partners XL North and Improve International conduct their own OV testing audits
- Regular monthly meetings with XL North are held to discuss issues arising with TB testing and delivery.
- The Cheshire Eradication Board remains active although meetings are held less frequently than in previous years. Visits to other eradication board meetings have been made by board members to share experiences e.g. North Wales TB Eradication Board and Derbyshire Eradication Board meetings.
- Voluntary risk based trading is practised in the local markets and information displayed regarding the testing area and test status where relevant for stock sold. This will become increasingly prominent for buyers from the LRA as post-movement TB testing is implemented.
• Regular liaison with the local authorities in Cheshire takes place although less so than in previous years due to resource issues. More work is intelligence based and more efficient use of reduced resource can be utilised.
• The local authorities are still present in markets although the level of attendance is not known as APHA do not routinely attend as they used to historically. This was a useful forum for gaining intelligence and for improving public relations that is sadly no longer available to APHA staff. The local authority liaison has decreased as a result.

The Animal and Plant Health Agency is an Executive Agency of the Department for Environment, Food and Rural Affairs working to safeguard animal and plant health for the benefit of people, the environment and the economy.