Animal &
Plant Health
Agency

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

Delivery Area: Northern

Name of County: **Cheshire**

Year-end report for: **2018**

TB Edge Area - CHESHIRE

Cheshire

Contents

Executive Summary

1. The Edge Area has a low but recently rising incidence of infected herds. **Cheshire** is part of the Edge Area that was established in 2013 as part of the Government's strategy to achieve Officially Bovine Tuberculosis Free (OTF) status for England by 2038. Originally, only the northern part of the county was included in the Edge Area set up in 2013. The rest of the county was part of the High Risk Area (HRA) until 1st January 2018, when the HRA portion of Cheshire was incorporated into the Edge Area. This end of year report describes the bovine tuberculosis (TB) epidemic in the whole county of Cheshire in 2018.

2. **Local cattle industry.** A predominantly dairy county but with some beef fattener and suckler herds of varying sizes, calf rearers, smallholders and pet cattle.

3. **New breakdowns of bovine TB.** The number of new breakdowns in 2018 has decreased slightly (by 2%) from 182 in 2017 to 179 in 2018. The number of new incidents in the portion of the county included in the Edge Area since 2013 has decreased from 149 in 2017 to 124 in 2018 representing a decrease of 17.6%. The converse has happened in the portion of the county previously included in the High Risk Area (HRA) with 33 new incidents in 2017 and 55 new incidents in 2018, representing an increase of 67%.

4. **Risk pathways for bovine TB infection.** In the majority of TB incidents in 2018, infected badgers were the most attributed source (66.3%) followed by movements of undetected infected cattle (14.8%), residual infection in cattle herds (9.7%) and spread from contiguous cattle herds (5.4%).

5. **Role of other species.** There were no reported incidents of TB in species other than cattle in Cheshire in 2018.

6. **Disclosing tests.** Routine herd surveillance testing continues to be the main method of disclosure of new TB incidents (117/176 = 66.5%) followed by 6M post-breakdown testing (29/176 = 16.5%) and slaughterhouse surveillance (14/176 = 8%) in 2018.

7. **Impact of bovine TB, reactor numbers.** A total of 2231 cattle were slaughtered from Cheshire TB incidents in 2018 as skin or interferon gamma test reactors. Of these, 62.3% (1389 cattle) were interferon gamma positive and 37.7% (842 cattle) were skin test reactors. There was an increase compared to 2017 due to the incorporation of the former HRA part of the county into the Edge Area and subsequent application of six-monthly surveillance testing and mandatory interferon gamma testing of OTFW breakdown herds in the incorporated area.

8. **Risks to the Low Risk Area (LRA).** The risk to the LRA remains as in previous years in the area adjacent to the Greater Manchester and Stockport area of the LRA and via cattle movements from Cheshire to the LRA. However, the impact of cattle movements has been lessened with the introduction of mandatory post-movement TB testing in the LRA in 2016.

9. **Risks from the High Risk Area and/or other adjacent Edge Area counties.** The risks both to and from Derbyshire Edge are similar for both Cheshire and Derbyshire either via cattle movements or movement of infected wildlife. There are persistent risks to and from north Staffordshire, north Shropshire and north Wales in adjoining parishes as there are no significant geographical barriers preventing cattle or wildlife movements.

10. **Forward look.** Incorporation of the former HRA portion of the county into the Edge Area in January 2018 has resulted in an increased herd incidence in that area due to the increased TB testing frequency. It was likely that there was undisclosed cattle infection in the absence of mandatory

interferon gamma testing in herds in the HRA portion of the county prior to its incorporation into the Edge Area. However, there is evidence of infected wildlife in this area so it is essential to enable relevant controls to be put in place to remove both infected cattle and infected badger populations.

Recommended measures include:

- Continued use of six-monthly herd surveillance testing.
- Continued mandatory use of interferon gamma testing in OTFW incidents, and additional discretionary use in OTFW and OTFS incidents.
- Encourage implementation of improved on-farm biosecurity measures, use of the TB Advisory Service[1], and dissemination of knowledge using available resources such as the TB Hub[2] and ibTB websites[3].
- Target the use of badger vaccination to areas of lower herd incidence combined with badger culling as part of a holistic approach to wildlife control in the county.

---

[1] TB advisory service - http://www.tbas.org.uk/

[2] TB hub website - https://tbhub.co.uk/

[3] ibTB website - https://ibtb.co.uk/

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 to vary the approach to control accordingly. To this end three management regions or zones were established in 2013. Overall, the Edge 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. This report describes the epidemiology of bovine TB in Cheshire which forms part of the Edge Area (see Appendix 1).

Changes to the Edge Area in 2018

On 1st January 2018 the Edge Area boundary was expanded westwards to absorb fully into the Edge Area the former HRA parts of the five previously split counties of Cheshire, Derbyshire, Warwickshire, Oxfordshire and East Sussex. The reports for those five counties will focus on incidents of bovine TB in the whole county, but noting key differences between the old and new parts where relevant.

On 1st January 2018 annual herd surveillance testing was replaced by six-monthly herd surveillance testing in the former HRA of Cheshire. Cattle herds in the original Edge Area of Cheshire have been, and continue to be, subject to six-monthly surveillance testing since 2015.

Cattle industry in Cheshire

Cheshire is still predominantly a dairy county with 68% of cattle herds in this classification (see Appendix 2). The county also has numerous beef enterprises – suckler herds, calf rearers and fattening units as well as some smallholders. Many dairy herds breed their own replacement cows, but some are partly or entirely 'flying' herds, where replacement cows or heifers are purchased from other farms.

As shown in Figure 1, there are 534 herds (40%) of 50 cattle or fewer, which represent hobby farmers as well as small scale beef herds, calf rearing units and pedigree herds. A total of 31% of herds have over 200 cattle, which may include many dairy units and a few beef units in Cheshire.

Figure 2 illustrates that there are more premises with beef than with dairy breeds and that some premises keep both types of cattle. The fact that 68% of the cattle are dairy but the majority of holdings are beef shows that the dairy cattle are kept in larger herd sizes on fewer premises than beef cattle.

Although there are still many smaller traditional family farms in the county, there has been a gradual trend for dairy herds to increase in size. There are 102 herds (8%) in Cheshire keeping more than 500 cattle (Figure 1) and a large proportion of these are dairy units, some with over 1000 milking cows. There are a number of dairy farms which do not graze some or all of their cattle all year round. Cows on these farms may be 'zero grazed' for some of the year, where fresh grass is cut daily and fed to the cattle indoors, or they may be fed a grass silage based diet all year round. At the other end of the spectrum there are also many herds on the 'New Zealand' style grazing system keeping cattle outdoors for as much of the year as possible, using small paddocks to keep grazing tight, and maximise yields from the grassland.

Some of the very large herds present their own challenges to TB management as they generally operate over multiple premises under the same ownership. There are also many smaller and medium sized dairy farms following a more traditional management system utilising pasture grazing in the summer and feeding conserved forage in winter. Each of the system types differ in their risk factors for TB infection with the more intensive units vulnerable to contamination of stored feedstuffs by wildlife and the increased potential for horizontal spread of cattle infection in housed animals in close proximity.
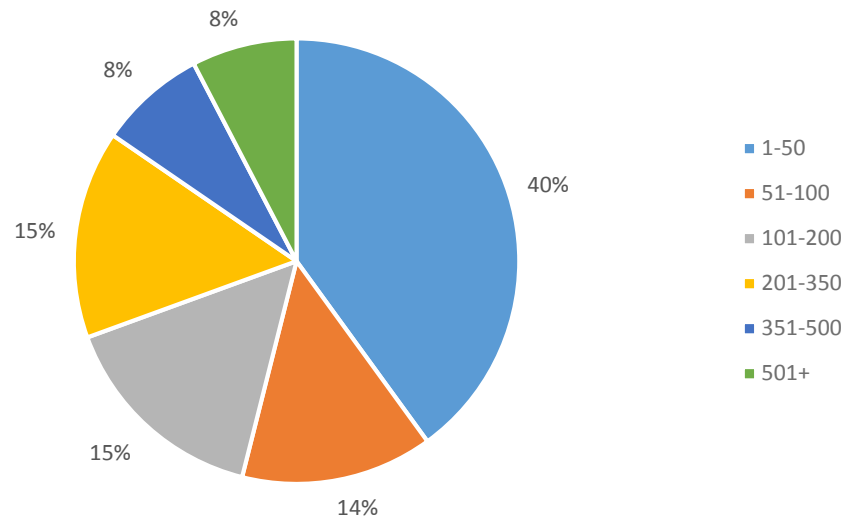
Figure 1: Proportion of cattle holdings by herd size in Cheshire in 2018 (n=1347)
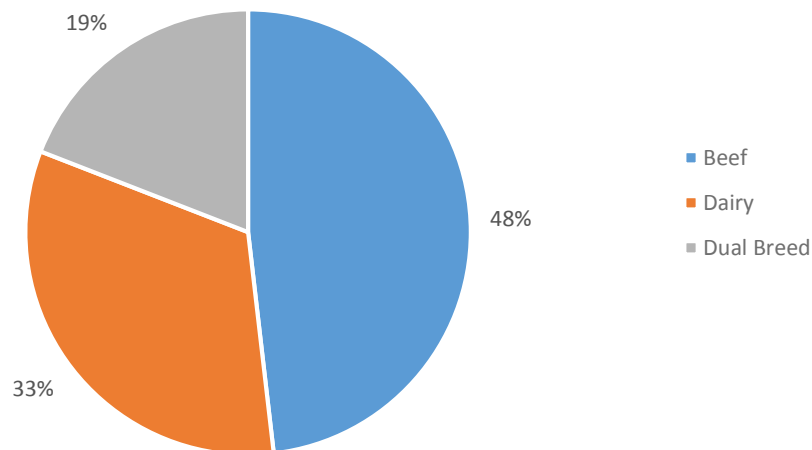

Figure 2: Proportion of cattle holdings by breed purpose in Cheshire in 2018 (n=2612)
(Note: the total number of holdings in Figure 1 varies from the total number of holdings in Figure 2 because holdings are counted more than once when cattle with different breed purposes are present.)

There was only one livestock market operational in Cheshire in 2018, located at Beeston Castle Auction near Tarporley. There was one regular sale day for all types of cattle which includes herd dispersals, stores, beef, cull cows and calf sales. The market also offered farm-to-farm sales and on-farm herd dispersals. Many farmers in Cheshire also use markets in neighbouring HRA counties including Market Drayton and Shrewsbury (Shropshire), and Leek (Staffordshire), which offer a combination of outlets for TB-restricted cattle as well as unrestricted cattle. Purchases from the HRA markets potentially come with increased risk of TB although all cattle from the HRA or Edge Area are required to be pre-movement tested (PRMT) before sale.

There were 27 Approved Finishing Units (AFUs) and seven Pre-movement Testing Exempt Finishing Units (EFUs) active in Cheshire in 2018 which have increased in number since 2017. In 2018, there were 11 TB Isolation Units (TBIUs) which is fewer than in 2017. The AFUs and TBIUs are all non-grazing units and should present little risk of spread of infection as long as the biosecurity conditions are adhered to by the operators.

There are no areas of common grazing for cattle in Cheshire.

Overview of the bovine TB epidemic in Cheshire

History of bovine TB in Cheshire

Three measures are used to explore the level of bovine TB in this report.

Firstly, the number of new herd breakdowns that were disclosed in each year.

Secondly, the annual herd incidence rate, reported as the number of new incidents per 100 herd-years at risk (100 HYR). This is the number of new TB incidents detected in the year, divided by the time those herds were at risk of contracting TB. The 100 HYR incidence rate is used in this report as it accounts for different intervals between tests in herds that other incidence measures, such as new TB incidents per number of herds or tests do not[4].

Thirdly, the annual end of year herd prevalence. This is the number of herds under restriction due to a TB incident at the end of the reporting year, divided by the number of active herds at that same point in time, and provides a snap shot of the burden of TB on the local cattle industry.

For all three measures, both breakdowns where lesions at post-mortem or *M. bovis* in tissue samples have been identified in one or more animals (officially tuberculosis free status withdrawn, OTFW) and breakdowns where lesions at post-mortem or *M. bovis* in tissue samples have not been identified (officially tuberculosis free status suspended, OTFS) are included. However, TB incidents in AFUs without grazing are not included in the prevalence and incidence calculations in the Edge Area reports due to the limited epidemiological impact of these cases. Furthermore, herds restricted due to an overdue test rather than a TB incident are also excluded from calculations.

Cheshire was a split HRA/Edge county until the beginning of 2018. Prior to that, the majority of the county comprised the Edge Area with a relatively small portion of Cheshire south of Nantwich classed as HRA.

The overall number of new TB breakdowns, and herd incidence and prevalence for the whole county is described below in Figures 3 to 6.

Overall, there appears to be very little change in the number of new breakdowns, with a 2% reduction from 2017 (182) to 2018 (179). This gives an impression of a plateau effect (Figure 3a). However, separation of the county into the original Edge Area and HRA portions shows a very different situation (Figure 3b). In 2018 there were 124 new breakdowns disclosed in the original Cheshire Edge Area compared to 149 in 2017, representing a decrease in new incidents of 17.6%. The original Edge Area figures for 2018 are approaching similar levels to those disclosed in 2016. However, in the former HRA there were 55 new breakdowns disclosed in 2018 compared to 33 in 2017, representing an increase of 67%. This can be partly explained by the introduction, in January 2018, of more frequent (six monthly) herd surveillance testing in this area compared to the annual testing frequency in 2017. Increased testing frequency leads to earlier detection of TB in herds.

---

[4]The 100 HYR incidence rate measure is described further in 'Bovine tuberculosis in Great Britain in 2018: Explanatory supplement to the annual reports' https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2018
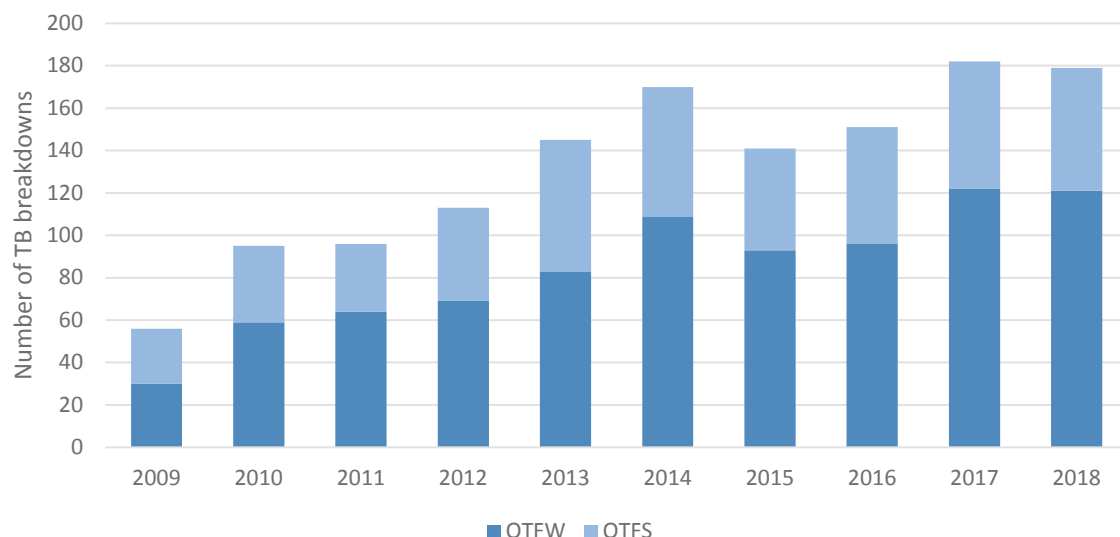
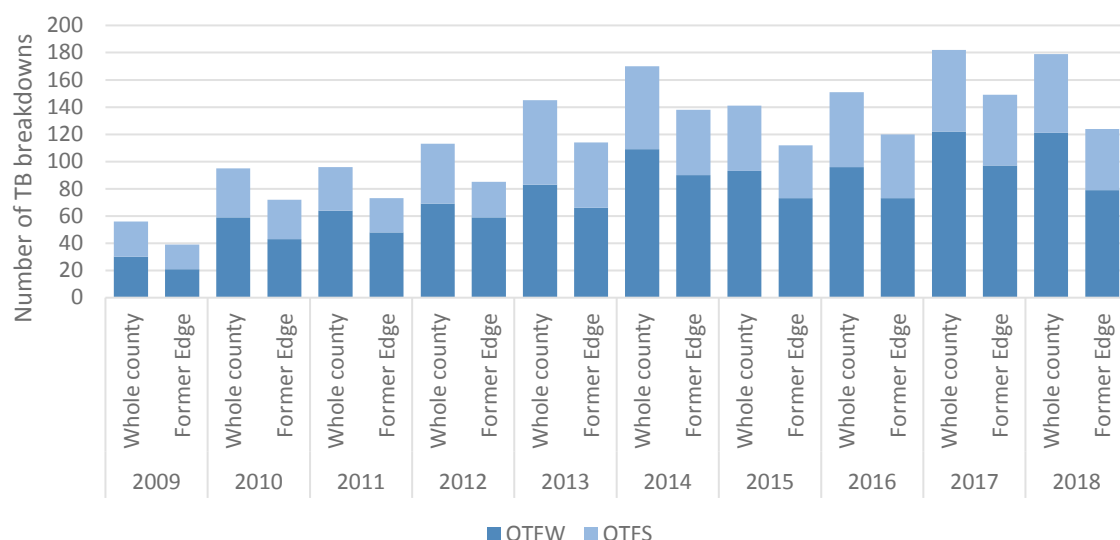Figure 3a: Annual number of new TB breakdowns in Cheshire, 2009-2018

Figure 3b: Annual number of new TB breakdowns in the original Edge Area
section and whole of Cheshire 2009-2018

The annual herd incidence rate has dropped slightly compared to 2017 (see Figure 4a). However splitting the county for comparison into the original areas of Edge Area and HRA show a different picture to the overall view (see Figure 4b). The former Edge Area has shown a decrease in incidence from 15.3% in 2017 to 13.2% in 2018. The whole county incidence has decreased from 15.4% to 15% only, due to the effect of increased herd incidence in the former HRA portion of the county. The increased frequency of surveillance testing and TB control measures being utilised in the former HRA portion of the county may have resulted in an increase in incidence compared to previous years although there could be other factors to consider. The whole county figures show a much smaller improvement in herd incidence but this is still a positive occurrence in view of the increased surveillance testing.
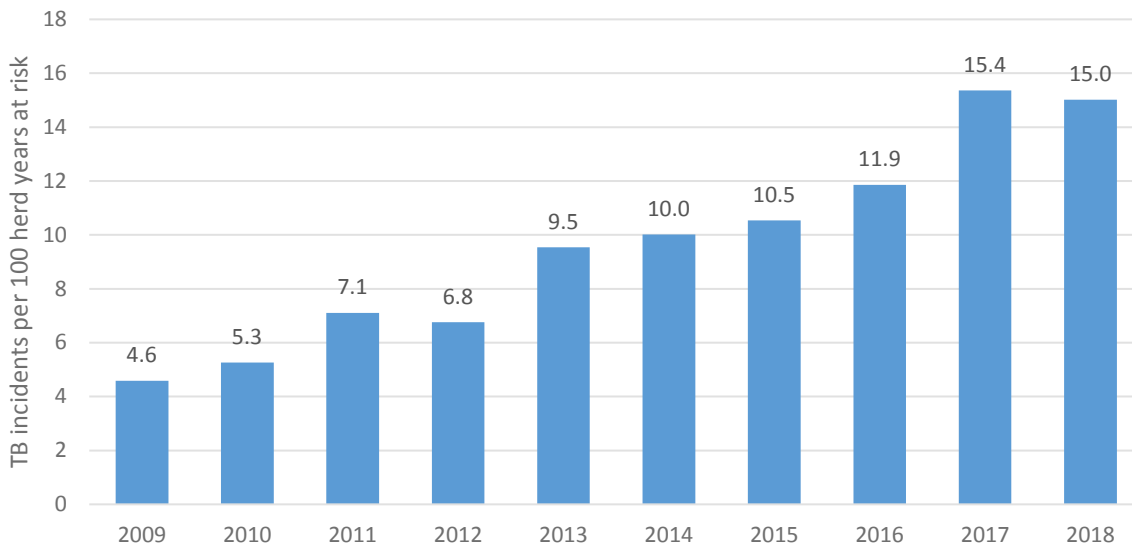
Figure 4a: Annual incidence rate (per 100 herd-years at risk) for all
New breakdowns (OTFW and OTFS) in Cheshire, 2009-2018
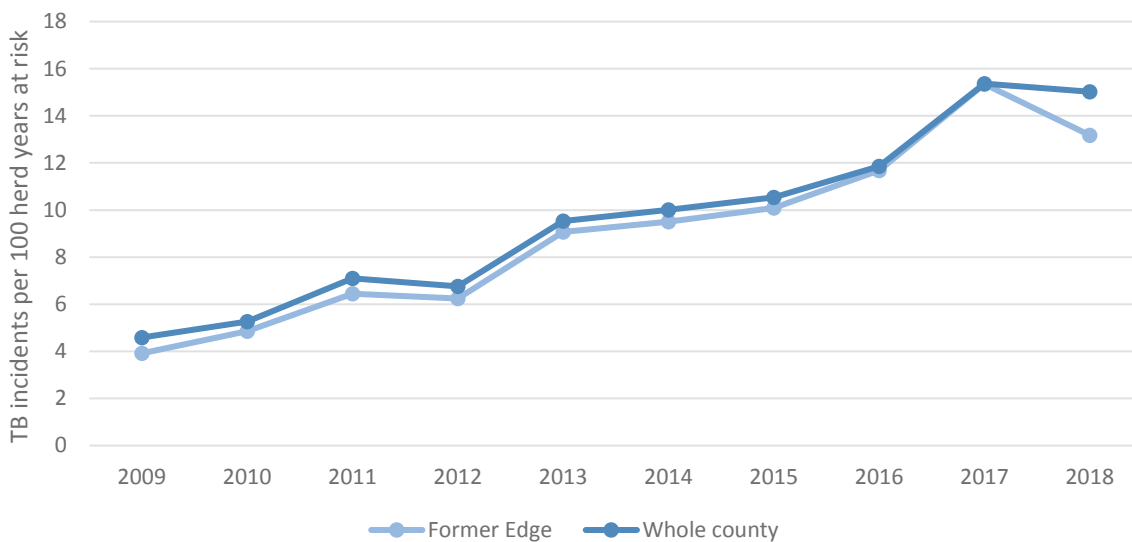
Figure 4b: Annual herd incidence rate (per 100 herd-years at risk) for all new breakdowns
(OTFW and OTFS) in the original Edge Area section and whole county of Cheshire, 2009-2018

The herd prevalence figure takes into account new and existing TB incidents at a point in time (end of 2018) and this shows a slight increase from 2017 (see Figure 5a). At the end of 2018, 8.87% of all cattle herds in Cheshire were subject to TB movement restrictions because of a TB incident.

However, comparing the original Edge Area portion with the whole county of Cheshire, as shown in Figure 5b below, illustrates that the prevalence in the original Edge Area portion of Cheshire has decreased from 8.41% in 2017 to 7.63% in 2018. This decrease may be the result of the widespread use of mandatory interferon gamma testing in OTFW incidents allowing earlier detection and removal of infected cattle potentially leading to a shorter duration of restrictions.

Figure 5a: Annual end of year prevalence of restricted herds in Cheshire, 2009-2018
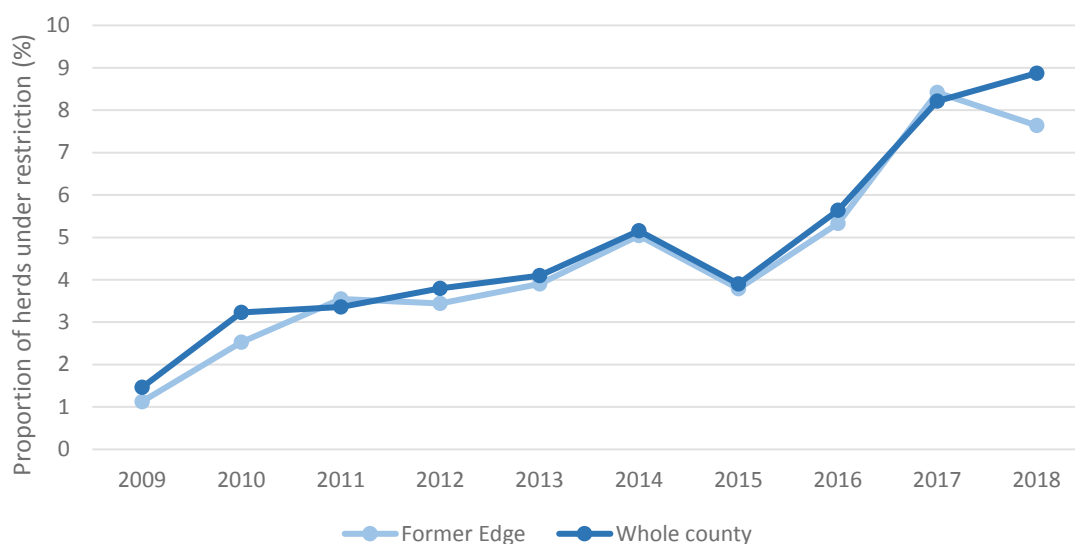
Figure 5b: Annual end of year prevalence of restricted herds in the former Edge and whole county of Cheshire, 2009-18

In summary, the above graphs, charts and figures illustrate that Cheshire is not on track to be declared OTF by 2025.
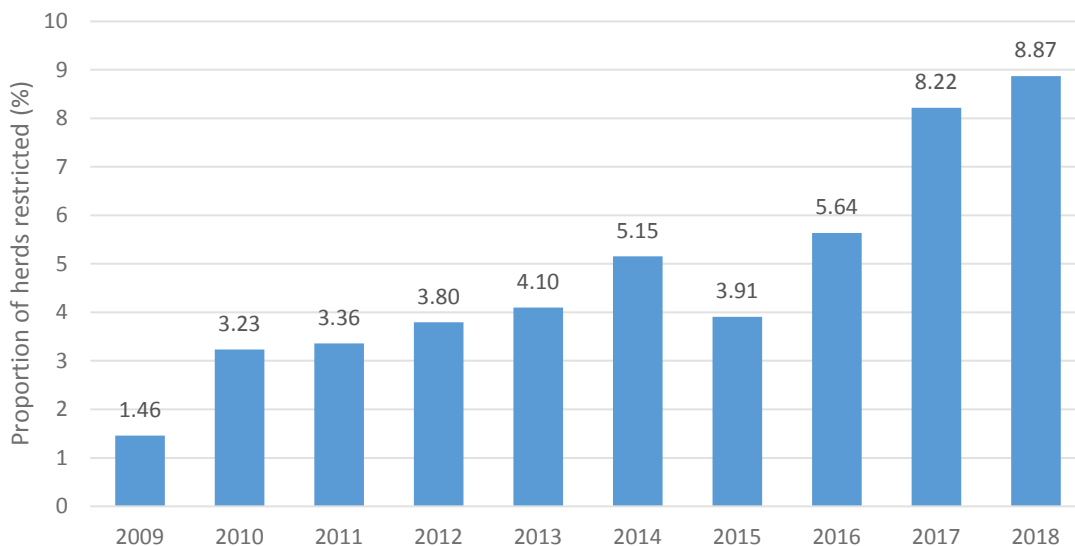
Geographical distribution of bovine TB cases (new and ongoing) in Cheshire

Figure 6 below shows the distribution of existing and new incidents in 2018 and their associated spoligotype. The distribution and density of incidents appears to be concentrated mainly in the south and east of the county as in previous years, mirroring the highest density of cattle holdings towards these areas, which is to be expected. However, there was an extension towards the west and central Cheshire in 2018 which was more prominent than in 2017. Many of the incidents in the east appear to have been carried over from 2017 and there were relatively fewer new incidents in the area in 2018 compared to 2017. The reason for this could be due to multiple factors such as increased knowledge of badger ecology on farms, increased awareness of biosecurity and risks from cattle movements, the establishment of the badger control programme in this area entering the second year, and increased use of interferon gamma testing leading to a decreased number of infected cattle remaining in herds.

It is not known whether this is a temporary effect and it will be important to compare with subsequent years' analyses.
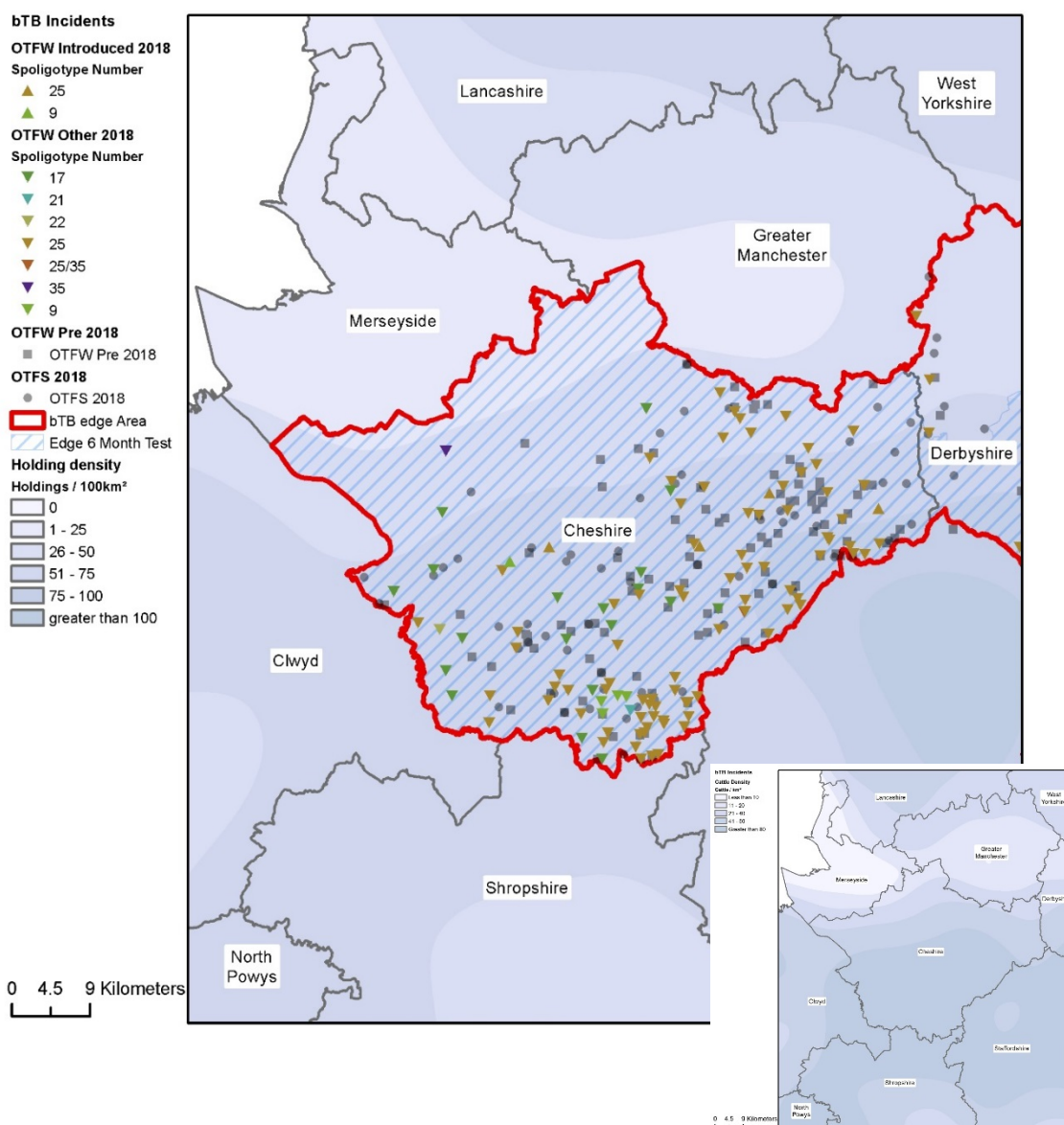
Figure 6: Geographical distribution of all new TB breakdowns (OTFW and OTFS) in 2018 and pre 2018 OTFW breakdowns still ongoing at the end of the report period overlaid on a cattle holding density map, with a cattle density map for the area inset

In the south (former HRA) of the county there has been a large number of new incidents with clusters of spoligotypes 9 and 25, which are not thought to be due to movements of undetected infected cattle. The cluster of genotype 9:d in this area has developed over several years and in 2018 has shown expansion further north in Cheshire. The farms are not related nor connected by cattle movements, there has been no contiguous cattle contact. Infected badgers are suspected to be the source of infection. In total there have been ten herds known to have been affected.

The two most northerly of these isolates are ten miles from the original breakdown south of Nantwich but there may be other breakdowns between them which have not yet been genotyped or identified.

The use of Whole Genome Sequencing (WGS) is a recent development in APHA and will aid epidemiological analysis of outbreaks. The WGS database continues to expand and current data show that there are over ten clusters within Cheshire currently with identical individual strains.

Figure 7 below shows the incidents most likely associated with a wildlife source from information gathered at the disease investigation visit, looking at farm activity and lack of cattle movements. This reveals clustering of TB incidents to the east and south of Cheshire which correspond with the highest cattle densities, and with previous findings of infection in 21% Cheshire badgers submitted in the 2014 University of Liverpool survey[5]. In that survey, the same strains of TB were found in cattle and badgers. However, it could not be determined which direction the transmission occurred in this sample. In 2016-17 a Defra-funded 'found dead' badger survey was carried out in the county. These results are yet to be published.

The available evidence strongly suggests that there are endemically infected badger populations in Cheshire. Further studies and whole genome sequencing will greatly add to our knowledge.

---

[5] https://www.nature.com/articles/s41598-018-35652-5.pdf
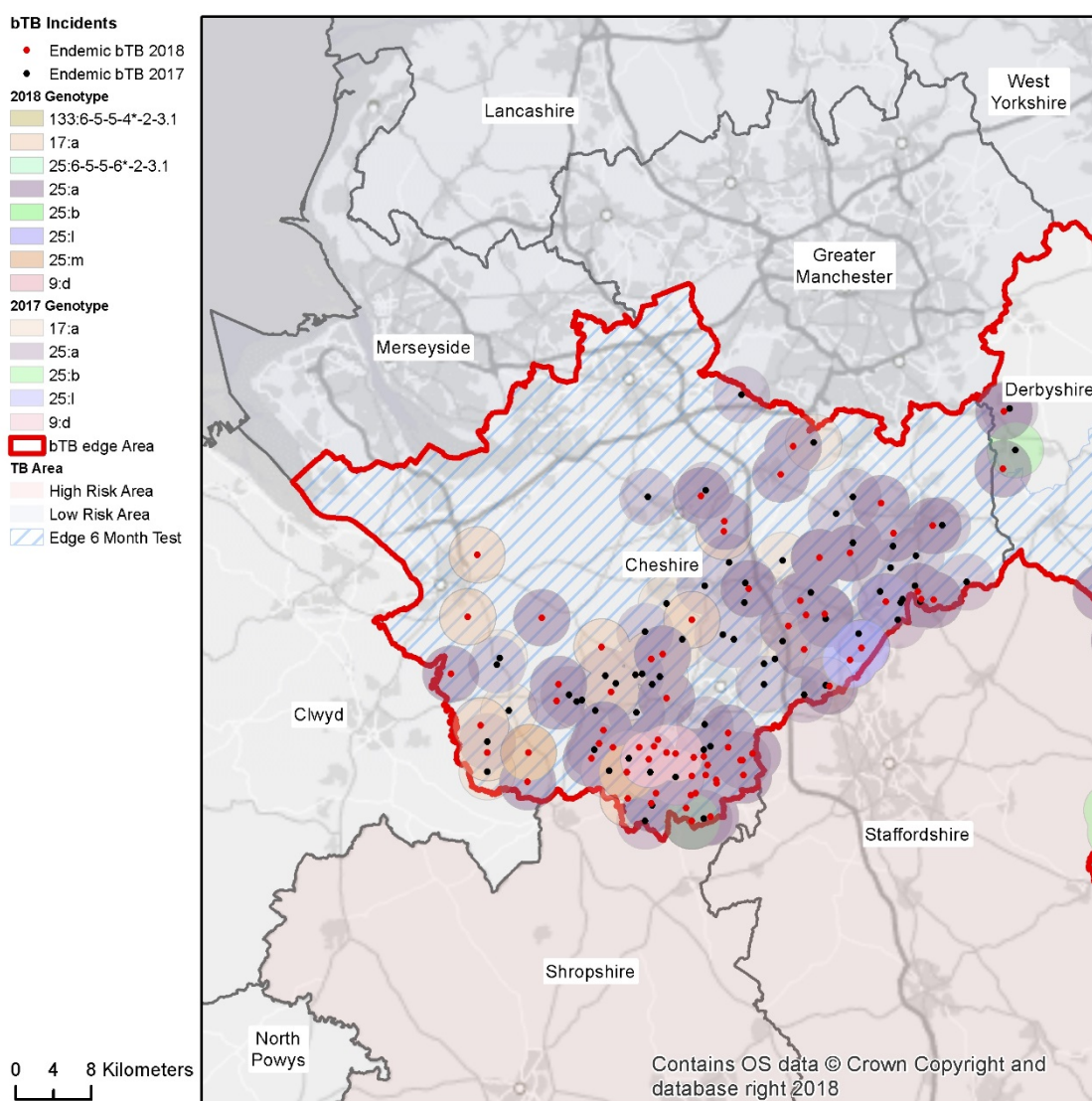
Figure 7: Genotypes detected in Cheshire, where a wildlife source was attributed with a 75% certainty or above, as an indication of endemicity within local wildlife populations (OTFW breakdowns only)

From the map in Figure 8 below, there appears to be an abundance of incidents attributed primarily to wildlife (green) especially in the south Cheshire area. There are also some to the east of the county, although fewer than in previous years. The locations appear to be consistent with the published University of Liverpool survey findings in the Edge showing the infected badger locations There are relatively fewer breakdowns attributed to movements of undetected infected cattle (red) which are more sporadic in nature as expected, and a few attributed to local cattle movements. Some are undetermined sources (grey) and this may be due to the fact that the breakdown is not yet concluded or no single source could be attributed. For example, there may have been a previous breakdown with the same genotype, it may be an OTFS breakdown with no genotype information, or it could be equally weighted to multiple sources. If the genotype is the same as in previous breakdowns the source/risk pathway can be unclear and residual infection, cattle movements or infected wildlife could be equally attributed.
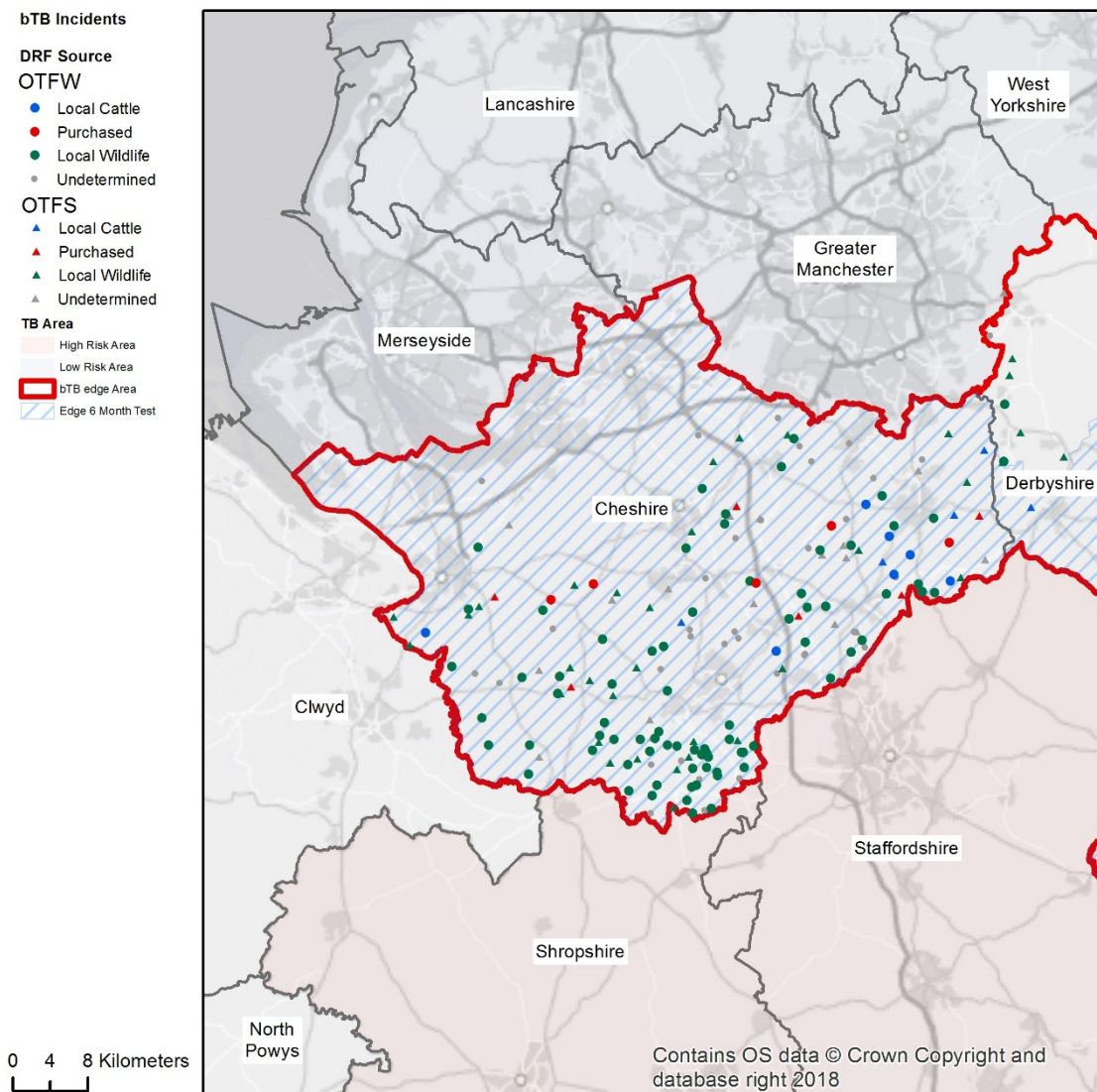

Figure 8: The source of infection recorded with the highest level of certainty,
for all TB breakdowns (OTFW and OTFS) that started in 2018

Descriptive epidemiology of bovine TB in Cheshire

Characteristics of bovine TB in Cheshire:

In Figure 9 below, 71.5% of the total number of TB breakdowns occurred in dairy herds. This is consistent with the demographic cattle populations in Cheshire of smaller numbers of very large dairy herds. Herds with 201 or more cattle were responsible for 64% of the breakdowns compared to 36% of breakdowns in herds with 200 or fewer cattle.

Beef fattener herds accounted for 13% of all breakdowns in Cheshire in 2018 but these figures include incidents in AFUs. If AFU breakdowns are excluded from the calculation, 11% of breakdowns occurred in beef fattener herds. Dairy herds accounted for 73.6% of breakdowns and beef suckler 14.3%. This could also reflect the longevity of certain cattle types such as beef suckler and dairy cattle which have increased longevity compared to fattening beef cattle. Exposure to contaminated pasture may also be a factor as beef fattening units tend not to graze cattle but instead finish cattle indoors on a blended diet with silage. In contrast, the majority of beef suckler and dairy herds graze their cattle, which potentially exposes them to contaminated areas of the farms. Zero grazing may also increase risk if cattle are fed freshly cut grass which may be contaminated with TB, however there is evidence that ensiling grass reduces this risk
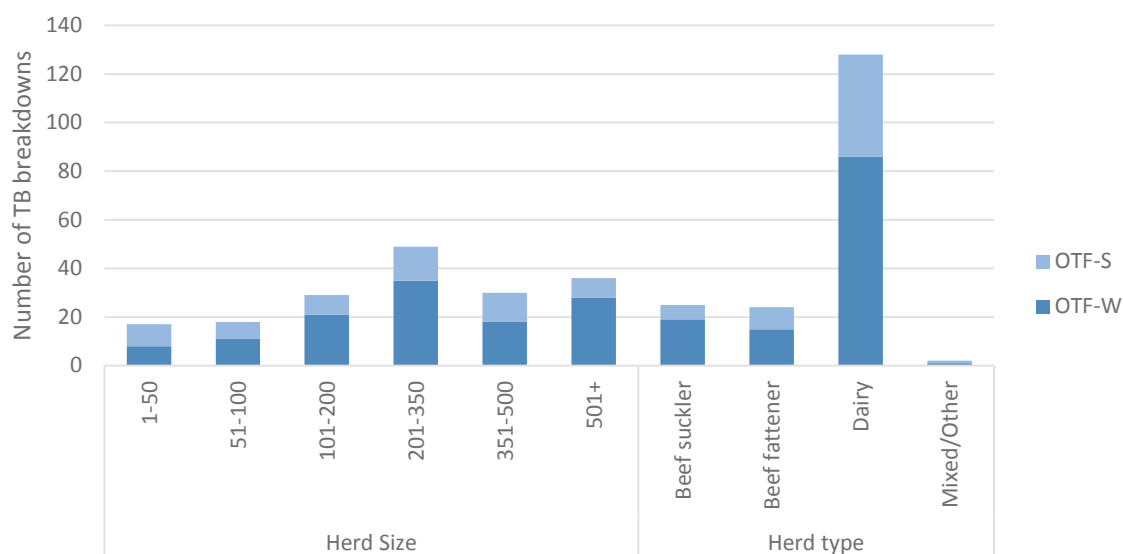
Figure 9: Number of new TB breakdowns (OTFW and OTFS) in Cheshire by cattle herd size and type.

Figure 10 shows the disclosure of new TB incidents per month. There is an apparent decrease in April and December but this is most likely to be due to the seasonal holidays of Easter and Christmas when less TB testing was completed due to the number of available testing days. There was an increase in the number of new incidents from September leading to a peak in November which corresponds with the end of the grazing period when infection may have been acquired as in previous years. The summer of 2018 was especially arid and grass growth was slow. Supplementary feeding at pasture may have given rise to increased cattle-badger interaction. The autumn peak would also correspond with the likely second round of six-monthly surveillance testing in the former HRA portion of the county. Other than this the effects of seasonality have largely diminished in Cheshire due to the continuation of routine six-monthly herd testing.
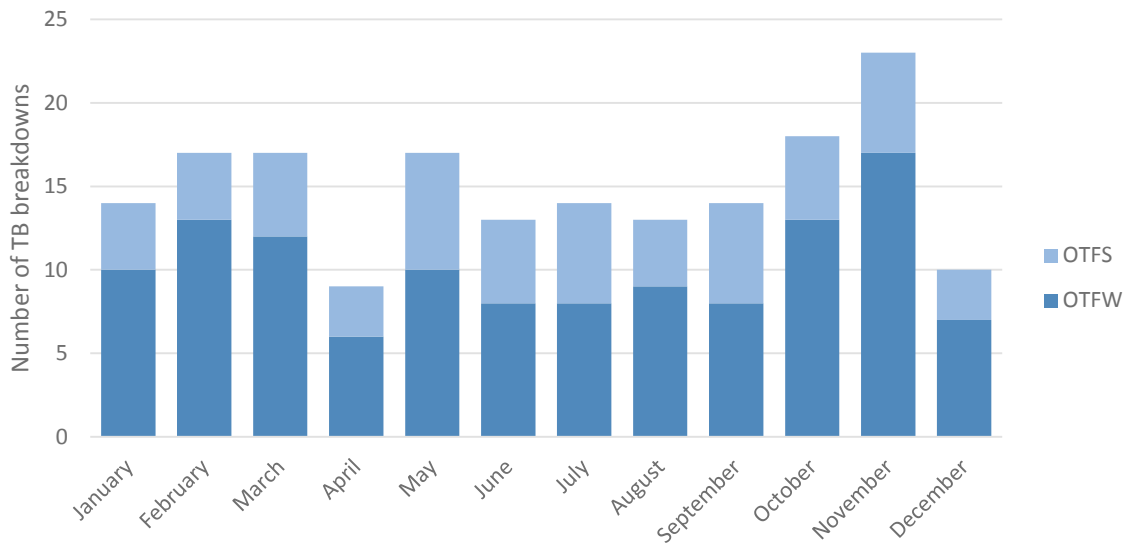
Figure 10: Number of new TB breakdowns (OTFW and OTFS) in Cheshire by month of disclosure

Figure 11a below shows the predominant genotypes isolated from new OTFW incidents in Cheshire in 2018. Approximately 78% of the new incidents were genotype 25:a; 17% were genotype 17:a and 4% were genotype 9:d. This is consistent with 2017 data. However, it must be noted that only one genotype is routinely isolated from each new incident therefore these figures do not account for mixed infections.
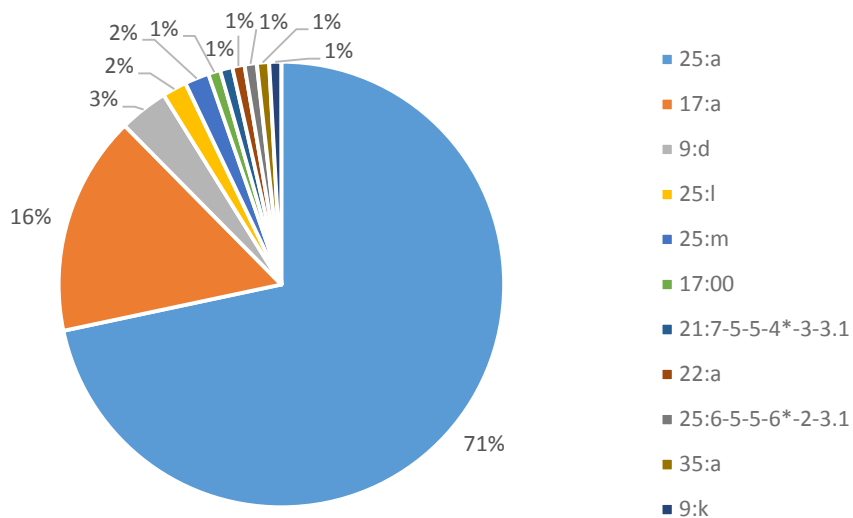
Figure 11a: Genotypes of *M. bovis* (OTFW only) identified in Cheshire in 2018 (n=113).

The following maps in Figures 11b and 11c are derived from APHA's Spatially Interactive Disease Atlas (SPIDA) and show the apparent regression of homeranges for genotype 25:a (see Figure 11b) and for genotype 17:a (see Figure 11c) over the past four years.
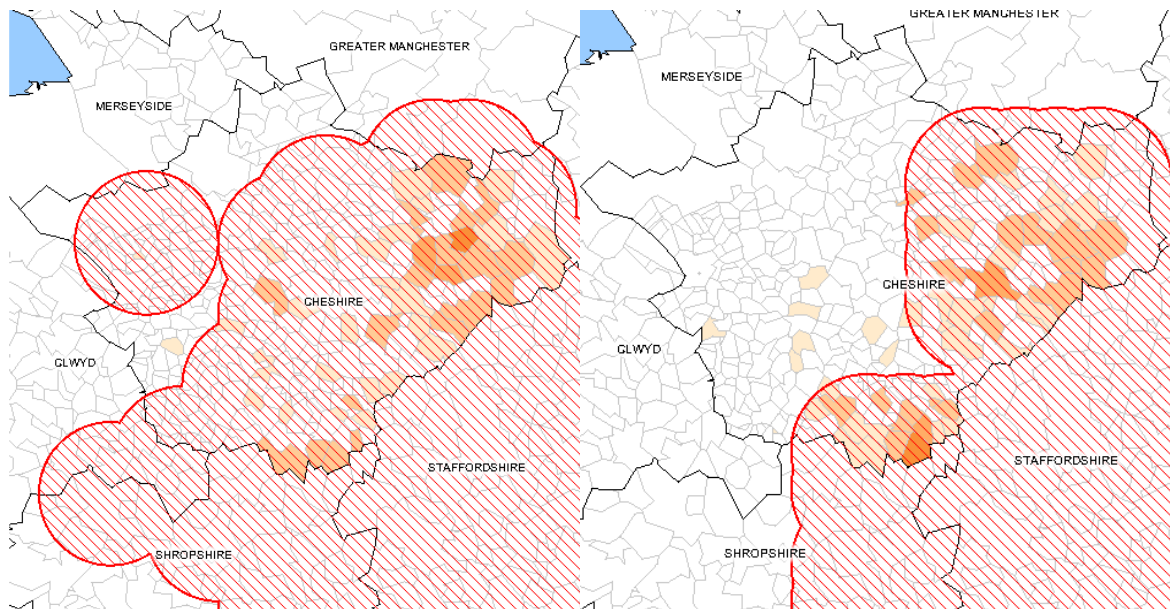
Figure 11b: Maps showing the regression of the homerange of genotype 25:a between 2014 and 2018
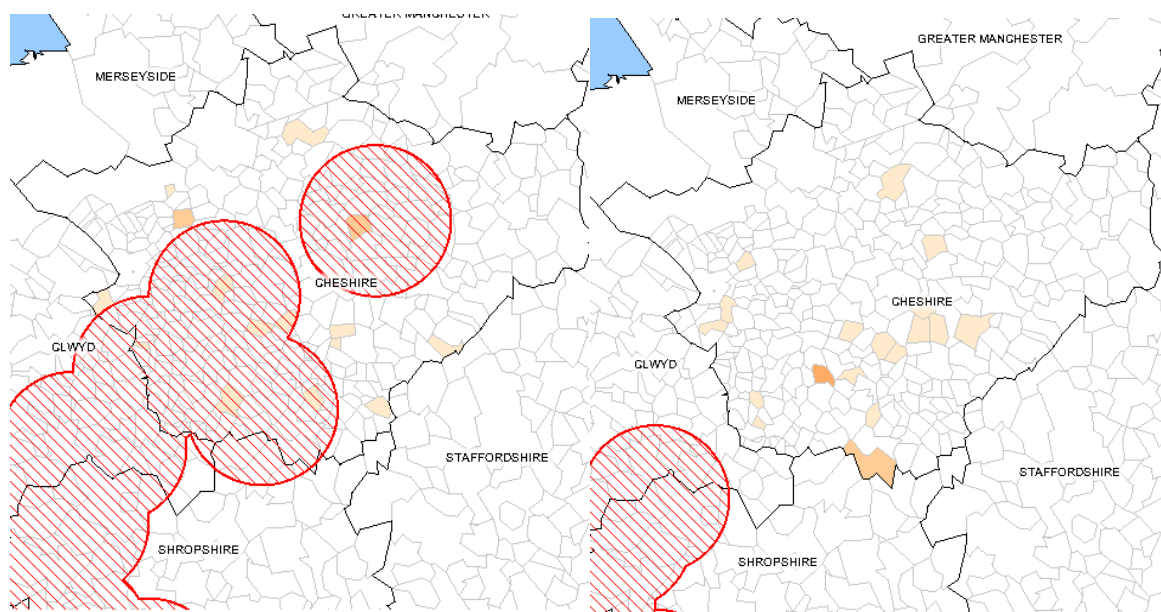
Figure 11c: Maps showing the regression of genotype 17:a between 2014 and 2018

The relative incidence of new breakdowns within Cheshire has changed which has resulted in these apparent regressions in both genotypes 17:a and 25:a according Figures 11b and 11c. In 2014, there was a much higher incidence of genotype 25:a in the east of the county compared to 2018 when more incidents were disclosed in the former HRA portion of Cheshire south of Nantwich, as illustrated by the darker shading of the parishes. A similar effect has been seen with genotype 17:a breakdowns where there has been a higher incidence in the south of Cheshire since 2014. The incidence of TB in other counties will also affect the homeranges. The relatively stable homeranges for *M. bovis* in GB are not reflected in cattle movement patterns, which suggests that the geographical localisation of genotype homeranges could be caused by wildlife reservoirs of infection. The apparent marked regression is much larger than expected and requires cautious interpretation.

Figure 12 shows that, of the 120 OTFW breakdowns which closed in 2018, the mean duration was 334 days and for 62 OTFS breakdowns it was 196 days. Of the OTFW breakdowns the median length of breakdown was 232.5 days. The duration has increased slightly from previous years.

There were two herds experiencing persistent infection (those with a breakdown duration of 18 months or more), and where undergoing enhanced case management in Cheshire in 2018. For one of these cases, several measures were undertaken including bespoke biosecurity advice by the TB Advisory Service, restriction on restocking licensing, and delivery of TB testing by APHA personnel (skin and interferon gamma testing). This herd regained its OTF status in 2018. Similar measures except for in-house (APHA) testing have been utilised in the other breakdown and some progress was made in 2018. This herd is a grazing herd which is on pasture all year and has fragmented premises.

At the end of 2018 there were 99 herds under TB restrictions and this included some incidents which began in previous years. This is similar to 2017 (103) but still much higher than 2016 where 65 herds were still under TB restrictions at the end of the year.
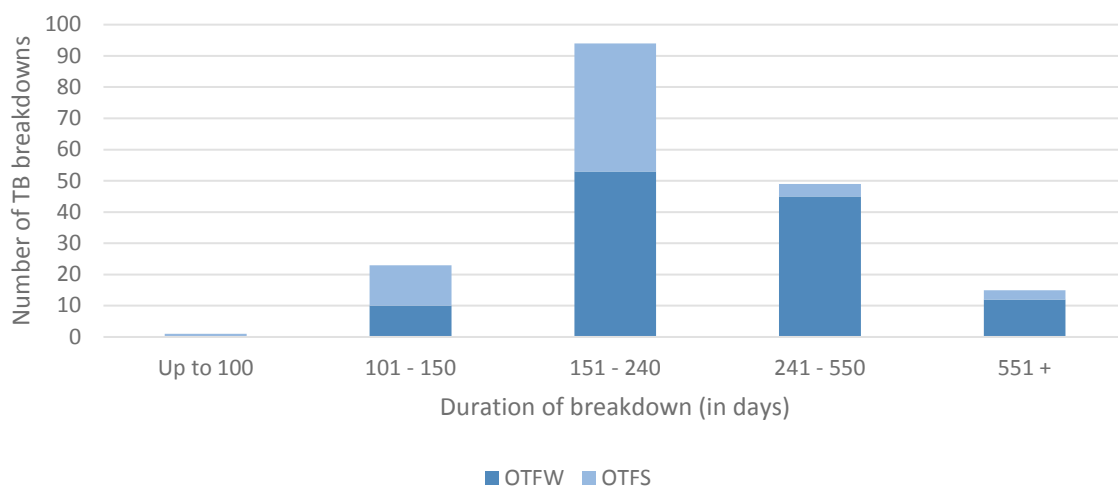
Figure 12: Duration of TB breakdowns (OTFW and OTFS) closed in Cheshire in 2018

Risk pathways for TB infection in Cheshire

Establishing the route of entry of infection into a herd experiencing a new TB incident can be challenging. The Animal and Plant Health Agency (APHA) aims to complete an epidemiological assessment of all TB incidents in the Edge Area (both OTFW and OTFS), including a thorough on-farm investigation. However where resource constraints exist, as many new incidents as possible are randomly selected or triaged for an investigation visit. Scrutiny of routinely collected data such as cattle movements and *M. bovis* genotypes (available for OTFW incidents only), combined with data from the on-farm investigation and knowledge of the local area epidemiological situation provides information which enables APHA case vets to assess and then rank the possible disease pathways.

A mathematical algorithm based on risk pathway data was used for the 2018 period to determine the relative contribution of different sources for each breakdown herd. However, this methodology also included those incidents where certainty about risk pathways was lower because of gaps in the epidemiological evidence. The effect of uncertainty has been increased by the inclusion of OTFS herds, where by definition, no genotype was determined. Therefore the relative proportions of each risk pathway are very approximate, and broad generalisations only can be made from these data.

A more detailed description of this methodology is provided in the Explanatory Supplement.

As shown in Figure 13, approximately 66% of all incidents in Cheshire in 2018 were attributed to contact with infected badgers, with almost 15% attributed to cattle movements either locally or purchased from other risk areas. Almost 10% were attributed to residual infection in the herd usually due to the new incident occurring at the 6M post-breakdown herd test with an identical genotype isolated.

The reason for attributing many of the incidents to infected wildlife is due to the absence of other relevant factors, such as cattle movements and the presence of infected badgers in the 2014 found dead survey across Cheshire. The genotypes identified are within homerange for the strains and there is no evidence of disease entering from other areas of the UK. The use of interferon gamma testing has reduced the likelihood of leaving residual infection on farm and also makes the herd-level testing more sensitive when used in combination with the skin test. All of these factors provide evidence to attribute the source of infection more accurately. The use of WGS will also contribute to providing more robust information in the future.

Only 5% of breakdown infection sources were attributed to contiguous cattle contact (where neighbouring cattle groups may have nose-to-nose contact). This appears to be less of a risk as farmers are now more aware of reducing cattle-to-cattle contact due to the risks posed by other diseases in addition to TB. Many will not graze cattle in contiguous fields and prefer to have an arable break between holdings or may use paddock rotations to avoid cattle being on contiguous fields at the same time.

Occasionally it is impossible to differentiate between several possible sources such as residual infection, infected wildlife, or movements of undetected infected cattle as all three may be suspected. This is often classed as an obscure source.
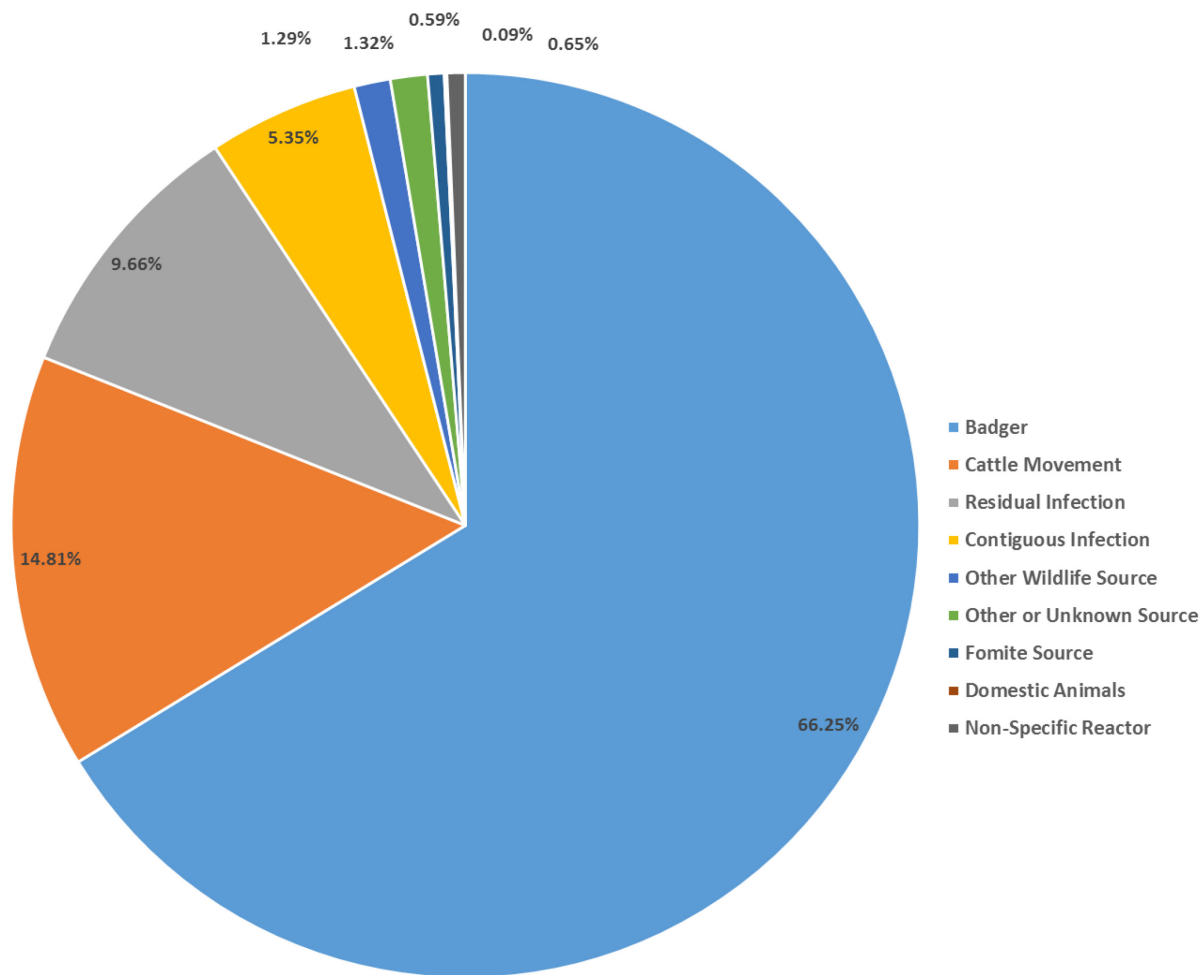
Figure 13: Summary of the weighted source of infection attributed for all incidents (both OTFW and OTFS) in Cheshire that started in 2018

As shown in Figure 14, in beef fattener herds (excluding AFUs without grazing), wildlife was the most commonly attributed source (50%) as these holdings may graze or floor feed cattle through feed barriers which can be accessed by badgers or other wildlife. Local cattle and movements of cattle account for almost 38% of all incidents. This is to be expected as most of these will be flying herds which purchase all replacements.

In beef suckler herds, wildlife sources were attributed in 73% of all incidents with 13% attributed to cattle movements. This is consistent with the husbandry of these herds where there are fewer purchases and cattle are grazed.

In dairy herds, 76% of all incidents were attributed to wildlife and only 5% attributed to cattle movements. Again, this shows consistency with dairy herd management such as minimal or no purchase of cattle by many herds, and intensive paddock grazing or zero grazing (potentially leading to increased indirect contact with badgers).
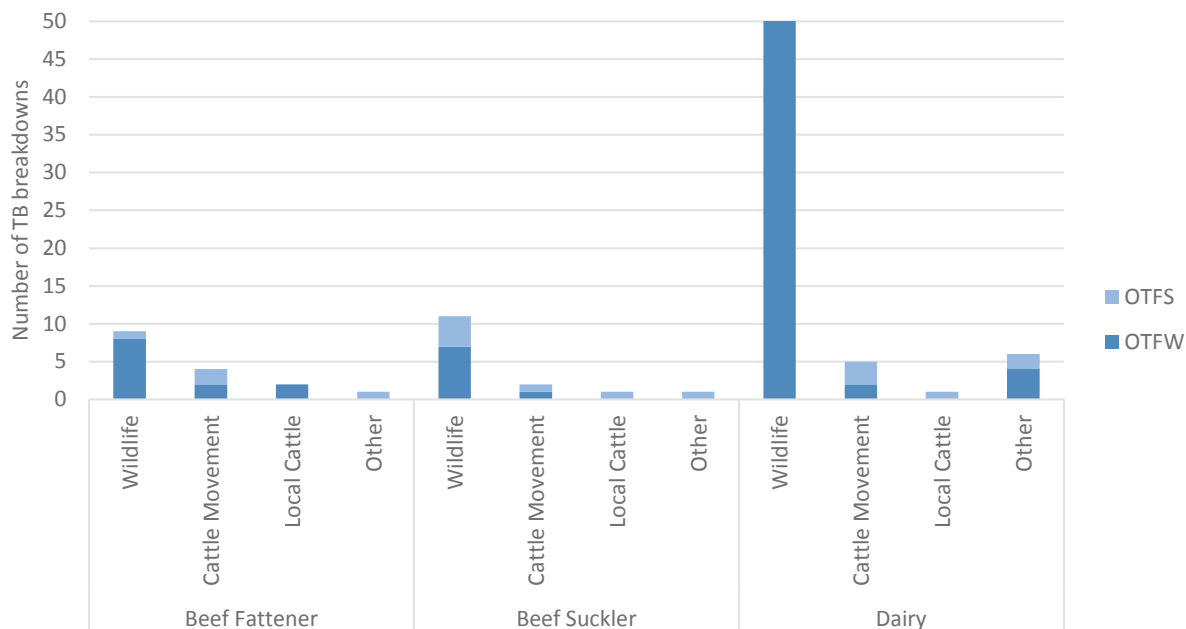
Figure 14: Source of infection recorded with the highest level of certainty
for all TB breakdowns (both OTFW and OTFS) in Cheshire, by herd type

Role of other species in Cheshire:

Badgers and other wildlife

Anecdotal evidence suggests that Cheshire has a high density badger population. The majority of farmers report observations of badger activity on farm and on surrounding land. Knowledge of badger ecology and awareness on farms has been vastly increased since the beginning of licenced badger control in Cheshire during 2017. As shown in Figures 7 and 8 above, many of the incidents in 2018 were attributed to infected badgers due to the evidence from previous badger found dead surveys and the level of observed badger activity on farm, after infected cattle sources had been ruled out.

It is considered that badgers play a role in TB transmission in parts of Cheshire due to the lack of evidence of inward high risk cattle movements in some herds and lack of contact between neighbouring herds. For example, there were new incidents in herds with no history of TB where all replacement cattle were homebred and artificial insemination is used. WGS analysis is also adding to the evidence of spatial separation of cattle herds with identical strains of TB in the absence of evidence of cattle movements between areas. Some badgers have been vaccinated under licence with BCG vaccine on discrete premises in Cheshire for several years through private arrangement with landowners and the Defra-funded Badger Edge Vaccination Scheme (BEVS). BCG vaccine was not available for at least 12 months during 2016-2017 due to a worldwide shortage.

Wild deer are present north of Congleton and Macclesfield and may play a role in some cases, although no new incidents of TB have been reported in wild deer recently.

Incidents due to wildlife infection were reported in the neighbouring Edge Area county of Derbyshire as shown in Figure 8. This is a potential concern to the neighbouring parishes in Cheshire where there were suspected wildlife sources reported in 2018 in OTFS incidents.

Other domestic species

There were no reported cases of TB infection in other animal species in Cheshire in 2018.

Detection of cases in Cheshire:

With six-monthly whole herd testing in the original Cheshire Edge since 2016, infection is disclosed quicker relative to other regions on lower frequency herd testing. This allows less time for disease to spread within the herd and reduces transmission to other cattle herds and wildlife.

In Figure 15a below, the majority (117, 65%) of new incidents in 2018 were disclosed at routine herd surveillance testing (WHT) which has been performed at six-monthly intervals in the original Cheshire Edge Area since 2016 and since January 2018 in the former Cheshire HRA. In 2018, fewer incidents were disclosed at the WHT than in 2017. The 6M herd check test, which is carried out six months after a breakdown has ended, disclosed 29 (16%) new incidents. This may reflect residual infection in a herd or an ongoing source on the premises. More incidents were disclosed in 2018 using this test type than in 2017. Another reason for disclosure was passive surveillance at slaughterhouses (SLH). A total of 37 suspect slaughterhouse cases were reported by the Food Standards Agency and of these, 19 were culture positive for *M. bovis.* Not all were found in cattle from OTF herds: of the 19 confirmed cases, 14 led to the disclosure of new incidents in Cheshire in 2018.
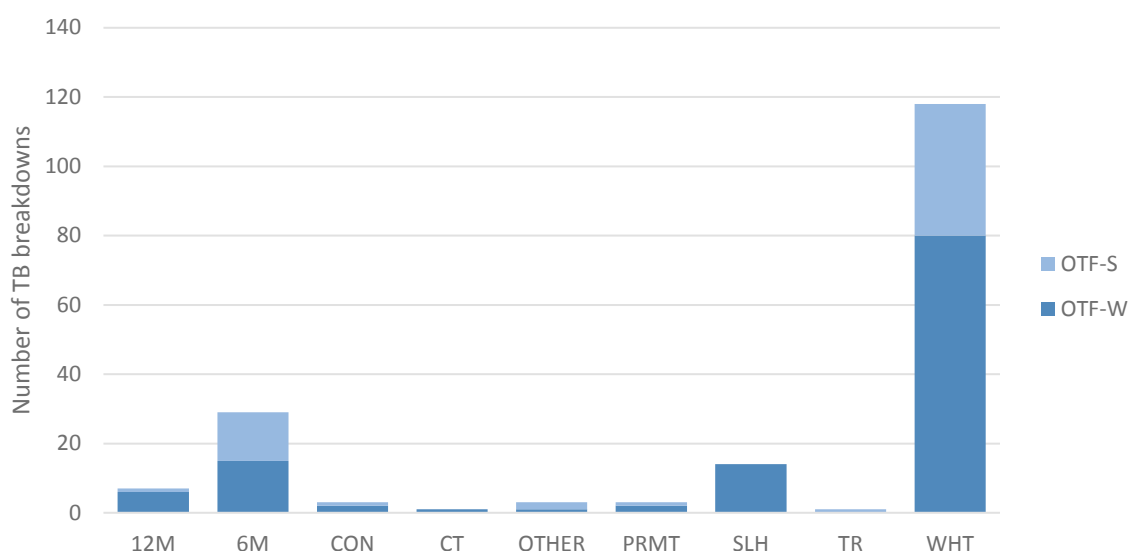
Figure 15a : Number of TB breakdowns (OTFW and OTFS) in Cheshire
in 2018, disclosed by different surveillance methods

Figure 15b shows an increase in new incidents disclosed as a result of post-breakdown TB testing (6M) and a slight decrease due to routine surveillance.

Trace testing appears to have resulted in fewer new incidents. The detection of cases by passive surveillance in slaughterhouses appears relatively consistent with previous years. There is very little contiguous testing (CON) and only residual 12M testing in Cheshire now due to the six-monthly surveillance testing frequency. However there would have been some incidents in 2018 which occurred due to residual contiguous testing and post-breakdown testing in the former HRA.

The increased frequency of detection of disease has several advantages such as decreased spread of infection within and betweens herds leading to lower numbers of skin test and interferon gamma

reactors in the long term; less environmental contamination due to decreased numbers of reactors, and less risk of transmission to wildlife.
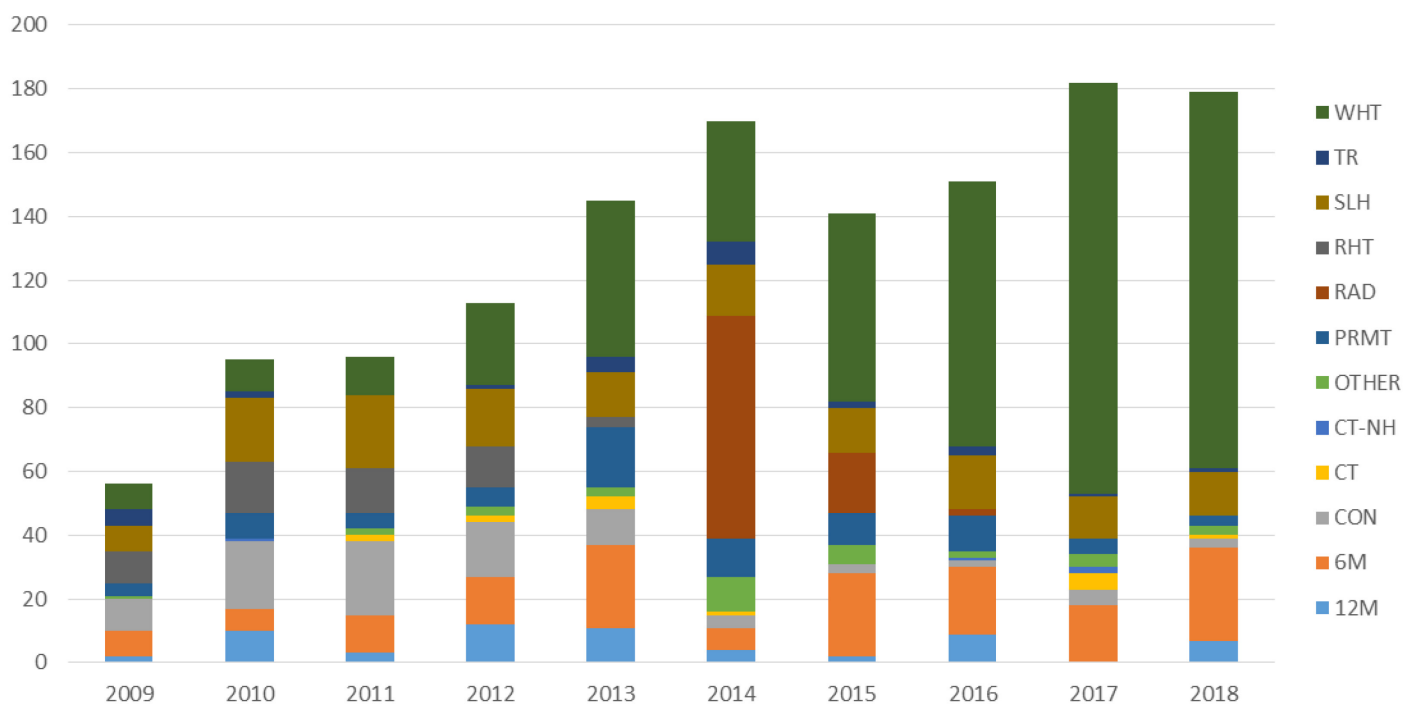
Figure 15b: The relative method of disclosure of new incidents in Cheshire from 2009-2018

In 2018, 1065 herds in Cheshire were classed as Officially TB Free (OTF) with no history of a TB breakdown in the previous three years. There were an additional 226 herds classed as OTF in 2018 but which did have a history of TB within the previous three years.

As shown in Figure 16, of the herds with new breakdowns in 2018, there similar numbers with either no TB history in the previous three years or with a history of having had an OTFS or OTFW breakdown in the previous three years. A breakdown was just over three times more likely to occur in herds in Cheshire which had experienced a history of either an OTFS or OTFW breakdown within the last three years (82/308, 27%) compared to those herds which had no history of TB in the prevous three years (91/1156, 8%) in 2018.

The reasons for recurrence can be variable depending on herd activity and distribution within Cheshire. Using more than one round of combined testing in breakdown herds further reduces the likelihood of residual infection in cattle. Infected cattle, the contamination of feed or the contamination of the environment can lead to re-infection within a herd and further spread. In areas of high incidence of TB, badgers can play a role in maintaining TB in cattle herds through environmental contamination. When a herd regains OTF status, cattle purchases may be made which may also increase risk of TB or there may be cattle movements between holdings under the same ownership within large enterprises.
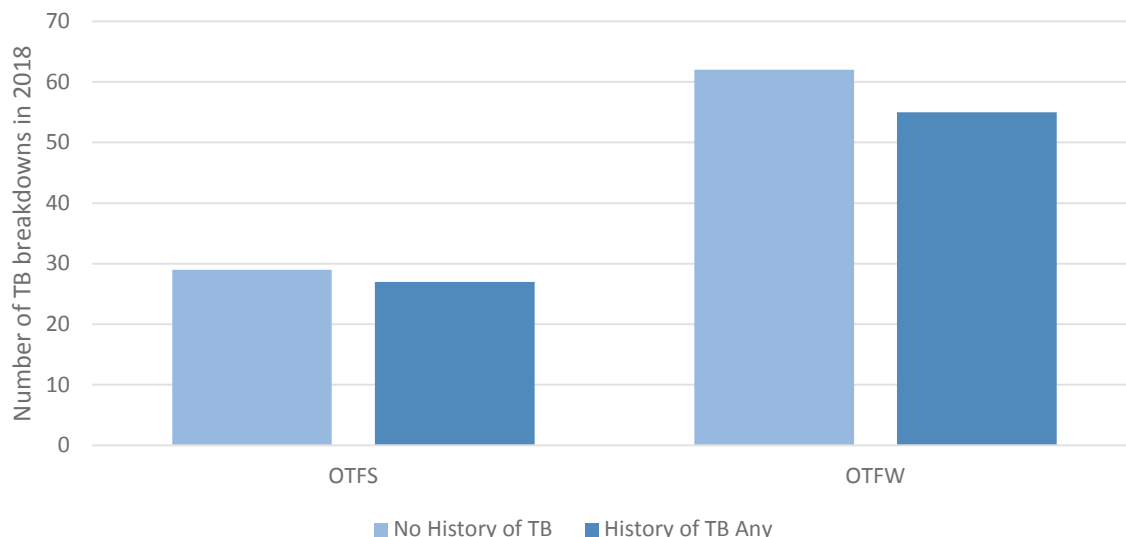
Figure 16: Number of TB breakdowns (OTFW and OTFS) in Cheshire
which experienced a breakdown in the previous 3 years.

Burden of bovine TB

The burden of TB in Cheshire is considerable in terms of the number of breakdowns at any one time and the number of cattle being slaughtered. TB breakdowns impact on the ability to move cattle off the breakdown premises. Likewise, it can prove difficult to source cattle to replace reactors which have been slaughtered, especially following the removal of large numbers of reactors at disclosing tests when cattle are permitted to move on before the results of the first breakdown test have been assessed. The economic losses to dairy farms in the case of lost milk yield can be further impacted by financial penalties imposed by the dairies through breaches of contract and not meeting forecasted milk yields.

Many of the larger dairy farms in the county operate over several geographically discrete sites and TB breakdowns can make management of the herd complex. This can be exacerbated when separate heifer rearing premises are used, many of which may not be equipped to deal with calving or milking cattle. In winter, livestock housing capacity may be limited and many farmers do not have the funds to erect additional housing.

For beef herds that rely on selling stores rather than finishing, TB can have a significant economic impact resulting in cash flow problems and possible overstocking. The existence of Approved Finishing Units and TB Isolation Units can lessen the impact although full market prices are rarely available for TB restricted cattle.

Figure 17 illustrates that the proportion of skin test reactors compared to interferon gamma positive cattle, increased in 2018 compared to 2017 and previous years. This is probably due to the incorporation of the HRA portion of the county into the Cheshire Edge Area at the beginning of 2018, resulting in the increased compulsory use of the interferon gamma test. The interferon gamma test has a higher sensitivity than the skin test and so will disclose more infected cattle, often at an earlier stage.
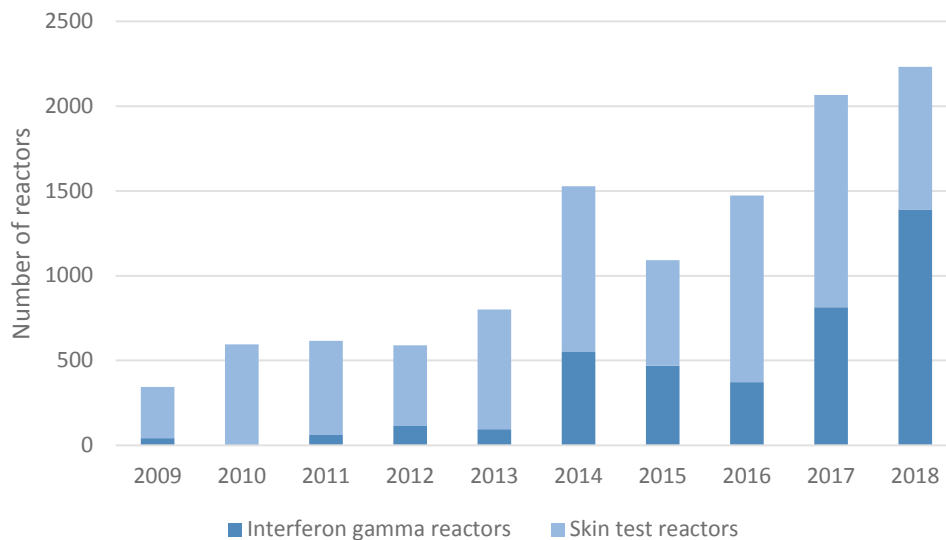
Figure 17: Number of reactors detected by interferon gamma and skin tests in Cheshire, 2014 to 2018

A total of 2,231 cattle were slaughtered due to TB in Cheshire during 2018. Of these, 62% (1,389 cattle) were interferon gamma reactors and 38% (842 cattle) were skin test reactors. This is in contrast to 2017 where 2,066 cattle were slaughtered and 40% were interferon gamma reactors and 60% were skin test reactors. A possible explanation for this change, as well as the incorporation of the HRA portion of the county into the Edge Area, is that larger numbers of interferon gamma reactors have been disclosed in incidents which have recurred at the 6M test, meaning that residual infection in cattle has occurred, and/or there is ongoing environmental contamination. Further analysis in forthcoming annual reports will help to ascertain whether this is a temporary effect or more permanent.

Key drivers of the bovine TB epidemic

A reservoir of infection in wildlife is one of the key drivers of the epidemic in Cheshire.

Another driver is undisclosed infection in cattle herds in the former HRA portion of the county where interferon gamma testing in OTFW breakdowns was not mandatory until 2018. The continued use of interferon gamma testing in combination with skin testing will maximise the chances of detecting cattle infection.

There are also many fragmented large herds in Cheshire which rely on frequent movement of cattle between sites. However, the analysis of breakdowns new in 2018 shows that infected wildlife is more likely to be the source of infection than cattle movements within these enterprises.

The use of markets appears to be a diminishing risk as many dairy replacements are sourced from outside the UK and farmers using markets are becoming more aware of the risks of buying cattle of unknown TB risk status. Many of the flying dairy herds source cattle from lower risk areas of the UK.

County summary

Cheshire is unlikely to achieve OTF status in the short term and certainly not by 2025 due to the herd incidence reported in 2018 and preceding years. However, the increased TB control measures in cattle and wildlife across the county will be beneficial in reducing the burden of infection. In addition, increased biosecurity both on- and off-farm will support these control measures and provide the best possible chance of success for reducing the overall incidence of TB in Cheshire in the long term.

Summary of the risk to the Low Risk Area (LRA) and any mitigating factors

There is a continuing risk to the LRA of Stockport and Greater Manchester from north east Cheshire, particularly in the bordering parishes of Mobberley, Wilmslow and Poynton.

There were fewer TB incidents in these bordering parishes in 2018 than in previous years. The most affected parish was Mobberley with three OTFW cases, all genotype 25:a, and one OTFS. Risk pathways included exposure at grazing to infected badgers or residual infection within the herd.

In 2016, a number of infected badgers were found in the bordering LRA parishes.Cattle may also move to the LRA from Cheshire via markets or directly from farm-to-farm. Post-movement TB testing is mandatory in the LRA and these cattle are also pre-movement TB tested if they are eligible which reduces the risk of movements of undetected infected cattle.

Summary of the risk to the Edge Area from the HRA

As shown in Figure 19, there are three main areas of threat from bordering counties, namely north east Wales; north Shropshire, and north StaffordshireAs evidenced by the darker shading of the bordering parishes in these other counties, there was a higher number of new breakdowns in some parishes compared to the number in the neighbouring parishes in Cheshire. There are no geographical barriers other than the River Dee between Cheshire and Wales for part of the border and this is often a flood plain. Main roads and bridges link the two areas in many places so there is potential for not only cross border cattle trade and movements, but also movement of infected wildlife if present on either side. There are no significant physical barriers between Cheshire and north Shropshire/Staffordshire. There is evidence of infection in badgers from the 2014 found dead badger survey in Cheshire especially bordering Shropshire and Staffordshire.
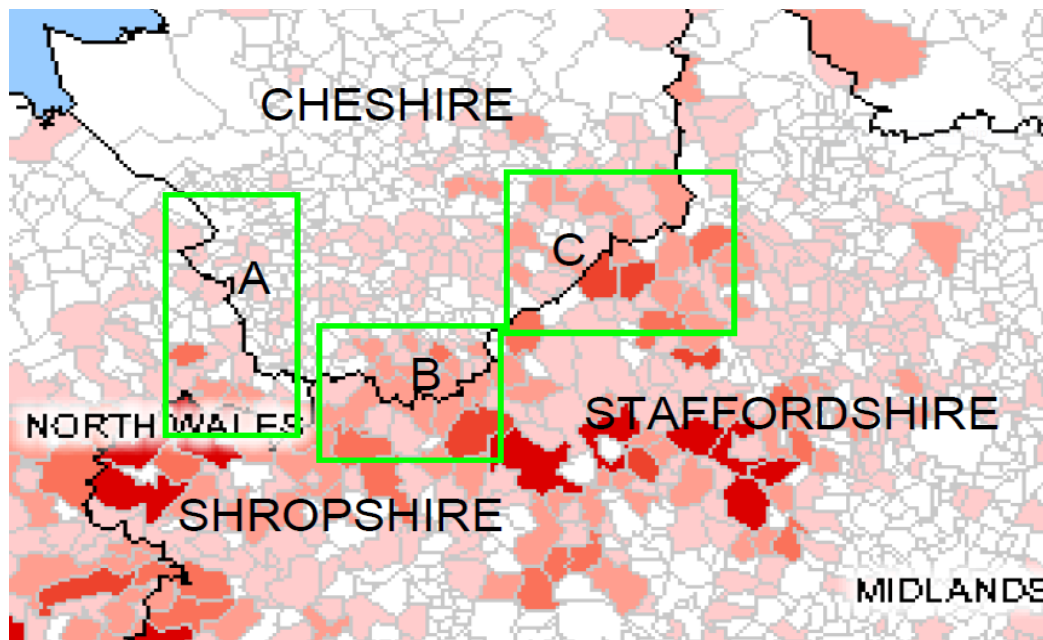
Figure 19: Map showing the TB incidents in 2018 in Cheshire North East Wales (area A), North Shropshire (area B) and North Staffordshire (area C).

Summary of the risk to Cheshire from the adjacent Edge Area counties

As shown in Figures 7 and 8 previously, and in Figure 20 below, there were new incidents disclosed as a result of likely wildlife infection on both sides of the Cheshire–Derbyshire border so there appears to be equal risk from both sides in this area either via cattle movements or infected wildlife movements.
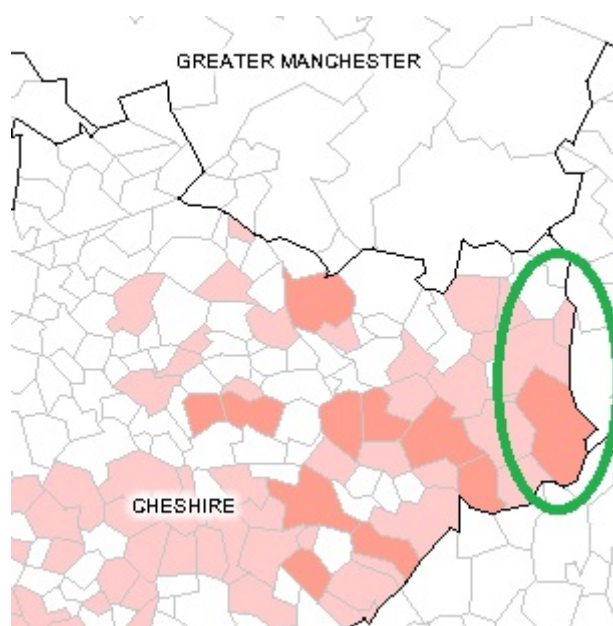
Figure 20: Map showing Cheshire–Derbyshire border highlighted by a green oval.

Assessment of effectiveness of controls and forward look

The incorporation of the former Cheshire HRA into the Edge Area in 2018 has resulted in an increased incidence in that area, potentially due to the increased surveillance testing frequency. There is also evidence of infected wildlife in this area. In cattle, the mandatory use of interferon gamma testing to support skin testing will help remove undisclosed cattle infection from herds. Continuation of any badger control measures will complement these increased TB control measures in cattle to reduce infection in the county. It is unlikely that an immediate effect will be seen and it will take some years before benefits are realised. The recommendation would be to continue to utilise all control measures for as long as possible to decrease the risks of disease spread to other parts of Cheshire.

Badger vaccination should be more efficiently utilised in areas of lower incidence in Cheshire and potentially once any licenced badger cull has concluded (Appendix 5).

Biosecurity awareness is increasing through communications with the farmers' own veterinary providers and the Defra-funded TB Advisory Service visits. Awareness of risks has also improved through the badger culls with increased knowledge of badger locations and the likely risks to and from livestock. The ibTB interactive TB mapping tool[3] and the TB Hub website[2] are valuable sources of information for farmers and stakeholders.

In 2018, there has been a significant decrease in new incidents in the original Cheshire Edge Area but it is too early to ascertain whether this will be sustained in coming years. However, with the current herd incidence rate of TB in Cheshire and the requirement for an incidence of less than 2% for six years, it is not likely to be possible to achieve OTF status by 2025.

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

High Risk Area

Type of measure	Current Measures
1	• Slaughterhouse surveillance • Annual or six monthly herd testing • Compulsory pre-movement testing
2	• Within herd: movement restrictions, isolation, slaughter and compensation, epidemiological investigation, tracing, additional skin tests and INF-γ blood testing • Additional skin testing in neighbouring herds
3	• Licensed injectable badger vaccination • Licensed badger culling
4	• Biosecurity measures • Risk-based trading

Control Measures

1	Surveillance
2	Breakdown management
3	Reduce risk of TB from badgers
4	Other disease prevention

Low Risk Area

Type of measure	Current Measures
1	• Slaughterhouse surveillance • Four-yearly testing(annual for high risk herds) • Pre-sale check tests • Compulsory post-movement testing for cattle from the annual or six monthly surveillance areas
2	• Within herd: movement restrictions, isolation, slaughter and compensation, epidemiological investigation, tracing, additional skin tests and INF-γ blood testing • Additional skin testing in herds within a 3km radius
3	• Licensed injectable badger vaccination • Licensed badger culling (in exceptional circumstances)
4	• Biosecurity measures • Risk-based trading

Edge Area

Type of measure	Current Measures
1	• Slaughterhouse surveillance • Annual or six monthly herd testing • Compulsory pre-movement testing
2	• Within herd: movement restrictions, isolation, slaughter and compensation, epidemiological investigation, tracing, additional skin tests and INF-γ blood testing • Additional skin testing in neighbouring herds • Additional skin testing in herds within a 3km radius (in annual herd testing areas only)
3	• Badger Edge Vaccination Scheme – Licensed injectable badger vaccination • Licensed badger culling
4	• Biosecurity measures • Risk-based trading

Map legend: High Risk Area | Edge Area (6 monthly) | Low Risk Area | Previous HRA | Edge Area (Annual)
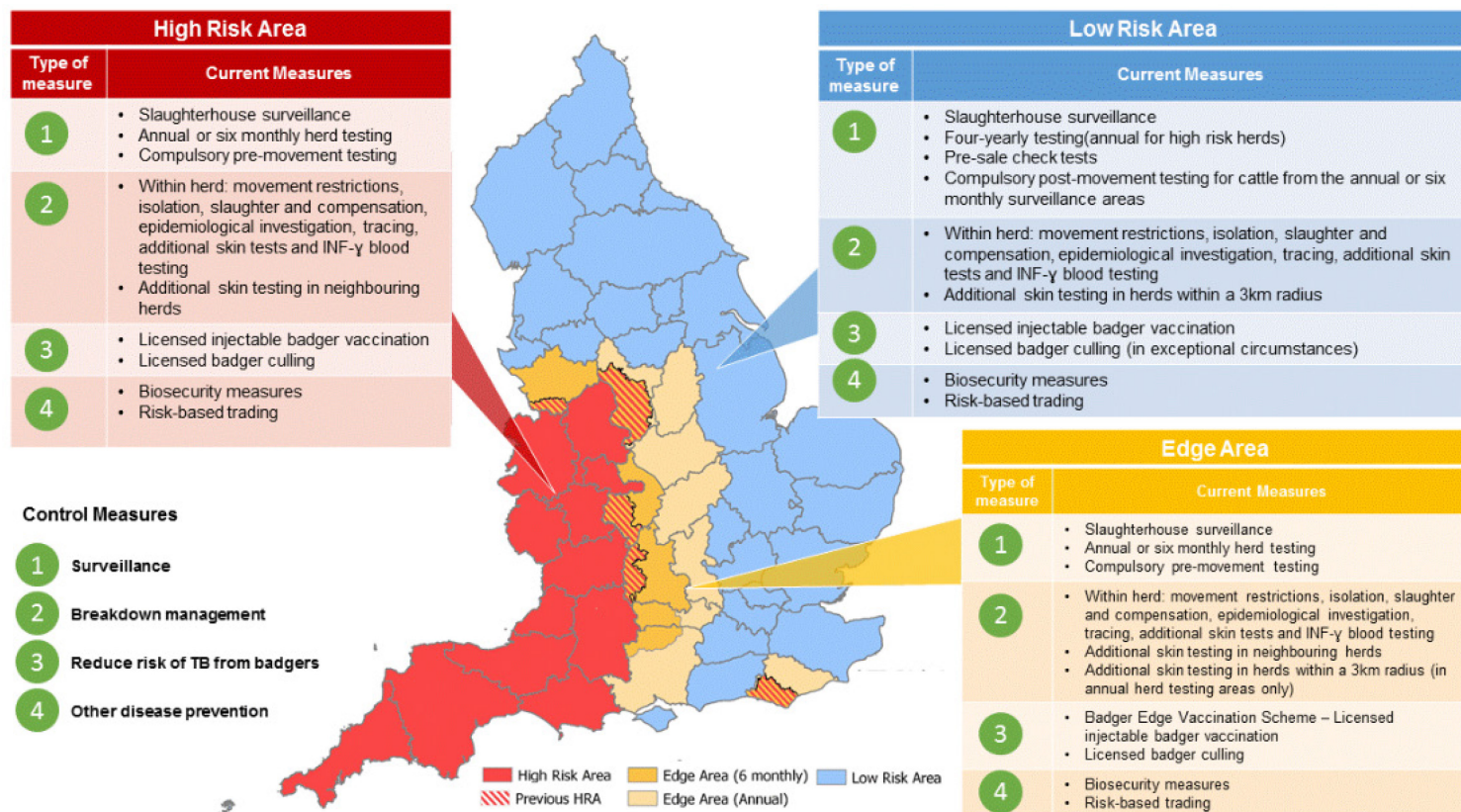
Figure A1: Bovine TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Tuberculosis-Free Status for England[6].

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 (crude incidence of indigenous OTFW herd breakdowns <0.1%) for the lowest incidence counties in the Edge Area.

1.2 Key Control Measures

Surveillance:
- six monthly or annual routine herd testing
- additional targeted surveillance of cattle herds located within a 3km radius of new OTFW breakdowns in annual testing sections of the Edge Area (radial testing)
- slaughterhouse surveillance

---

[6] http://www.tbhub.co.uk/wp-content/uploads/2017/09/infographic-TB-measures.pdf

Management of cases ('breakdowns'):
- increased sensitivity of breakdown herd testing:
  - all breakdown herds must pass two consecutive short interval skin tests at severe interpretation to regain OTF status, irrespective of post-mortem and bacteriological findings
  - mandatory IFN-gamma parallel testing of herds with OTFW breakdowns
  - enhanced management of herds with persistent breakdowns
- enhanced epidemiological investigation and data analysis
- information sharing - location of breakdown herds publicly available (via ibTB interactive mapping tool)[7]

TB controls in the wildlife reservoir (badgers):
- licensed badger culling in high incidence sections of the Edge Area
- Government grants for licensed voluntary badger vaccination projects using injectable badger BCG (Badger Edge Vaccination Scheme - BEVS)

Other measures:
- compulsory pre-movement skin testing of cattle moved between herds
- promotion of herd biosecurity measures to reduce the risk of new breakdowns

---

[7] ibTB interactive mapping tool - https://www.ibtb.co.uk/

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 2018 (RADAR data)

Cattle per premises	1-50	51-100	101-200	201-350	351-500	501+	All	Mean	Median
Number of premises	534	186	207	202	104	102	1347	175.6214	83

Finishing units registered in Cheshire:

	Grazing	Non-grazing
Number of Approved Finishing Units (AFUs)	0	27
Number of Pre-movement Testing Exempt Finishing Units (EFUs)	3	4

The number of AFUs without grazing has increased as some have converted from existing EFUs.

Common land in the County: There is no common land in Cheshire.

Cattle/herd purpose:

	Beef		Dairy		Dual purpose		Unknown		Total
	Number	%	Number	%	Number	%	Number	%	Number
Cattle	62589	26.5	161676	68.3	12280	5.2	17	0.0	236562
Holdings	1256		854		498		4		

Appendix 3: Summary of the Cheshire headline cattle TB statistics

Herd-level statistics	2016	2017	2018
Total number of cattle herds live on Sam at the end of the reporting period	1672	1594	1537
Total number of herd tests carried out in the period	2686	2724	2774
Total number of OTF cattle herds TB tested during the period for any reason	1386	1338	1278
Total number of OTF cattle herds at the end of the report period (i.e. herds not under any type of TB02 restrictions)	1499	1396	1337
Total number of cattle herds that were not under restrictions due to an ongoing TB breakdown at the end of the report period.	1576	1457	1403
Total number of new TB breakdowns detected in cattle herds during the report period	151	182	179
OTF status suspended (OTFS)	55	60	58
OTF status withdrawn (OTFW)	96	122	121
Of the OTFW herd breakdowns:			
How many can be considered the result of movement, purchase or contact from/with an existing breakdown based on current evidence?	1	10	6 (includes 5 AFU cases)
New OTFW breakdowns triggered by skin test reactors or 2xIRs at routine herd tests	43	84	81
New OTFW breakdowns triggered by skin test reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, etc.)	30	24	26
New OTFW breakdowns first detected through routine slaughterhouse TB surveillance	13	16	14
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)			
OTFS	n/a	n/a	n/a
OTFW	n/a	n/a	n/a
Number of OTFW herds still open at the end of the period (including any ongoing OTFW breakdowns that began in a previous quarter)	65	103	99
New confirmed (positive *M. bovis* culture) incidents in non-bovine species detected during the report period (indicate host species involved)	2 cats	2 cats	0

Animal-level statistics (cattle)	2016	2017	2018
Total number of cattle tested in the period (animal tests)	497,501	545,733	587,904
Reactors detected:			
tuberculin skin test	1101	1251	824
additional IFN-gamma blood test reactors (skin-test negative or IR animals)	373	815	1389
Reactors per breakdown	9.8	11.4	12.5
Reactors per 1000 animal tests	3.0	3.8	3.8
Additional animals identified for slaughter for TB control reasons (DCs, including any first-time IRs)	80	75	42
Private slaughters	8	6	12
SLH cases (tuberculous carcases) reported by FSA	34	26	37
SLH cases confirmed by culture of *M. bovis*	17	14	19

Appendix 4: Suspected sources of M. bovis infection for all the new OTFW and OTFS breakdowns identified in the report period

Source of infection	Possible	Likely	Most likely	Definite	Weighted contribution
Badgers	65	64	89	2	66.2%
Cattle Movements	49	4	6	1	14.8%
Contiguous	25	1	1	0	5.3%
Residual Infection	33	5	8	0	9.7%
Domestic Animals	1	0	0	0	0.1%
Non-specific Reactor	1	0	0	0	0.6%
Fomites	1	2	0	0	0.6%
Other Wildlife	7	0	0	0	1.3%
Other or Unknown Source	4	0	0	0	1.3%

Appendix 5: Overview of the bovine TB Control Programme in Cheshire

Summary of TB control measures specific to Cheshire:

5.1   Edge Area Testing Policy

- Six-monthly herd surveillance testing is now effective across the whole county of Cheshire. Previously the original Edge Area had been subject to six monthly testing since 2015 but the former HRA portion had been annually tested until January 2018.
- No radial testing requirement.
- All breakdowns in Cheshire require at least two consecutive short interval tests at severe interpretation with negative results before OTF status can be regained.
- Mandatory interferon gamma testing is deployed in all OTFW breakdown herds in the Edge Area
- Slaughter of inconclusive reactors is encouraged in OTFW breakdown herds along with removal of higher risk in contact cattle as direct contacts (DCs) where appropriate.
- Exemptions to the interferon gamma testing are applied where there is clear epidemiological separation of certain groups of cattle within the herd after the initial round of testing thus making it more targeted and cost-effective.
- Two herds with persistent infection were subject to enhanced case management measures and one resolved in 2018.

5.2   Unusual TB breakdowns

- Four incidents in the former HRA portion of the county with a large number of skin test reactors at the disclosing test.

5.3   Other Testing Measures
- Any fattening herds exempted from routine surveillance testing must meet a strict set of criteria:
  - All animals sold direct to slaughter or via a slaughter gathering.
  - No animals to be resident on the holding for more than 12 months.
  - No births in the unit.
  - No breeding activity in the unit.
  - All cattle must be permanently housed.
- No contiguous testing in Cheshire as all farms are on routine six-monthly surveillance testing
- Compliance with TB testing in Cheshire is good.

5.4   Other Control Measures

- Farmers are encouraged to take advantage of free of charge TB Advisory Service visits[1.]
- Targeted APHA auditing of Official Veterinarian (OV) delivery of skin testing is undertaken with corrective actions being taken as necessary.
- The Cheshire TB Eradication Board is active with input from farmers, the NFU, APHA and local OVs as well as wildlife groups and other stakeholders.
- There is a good working relationship between APHA and Local Authority officers regarding any TB compliance and cattle identity issues.

- Licensed badger culling took place in 2018.
- Licensed badger vaccination took place over several discrete areas in 2018.