



Animal &
Plant Health
Agency

Year End Descriptive Epidemiology Report: Bovine TB in the Edge Area of England 2022 County: Derbyshire

TB Edge Area - DERBYSHIRE



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Introduction

The Edge Area was originally established in 2013. In 2014, the bovine tuberculosis (TB) surveillance strategy for this area was incorporated into the UK Government's Strategy to achieve Officially Bovine Tuberculosis-Free (OTF) status for England by 2038. A key action was to recognise the different levels of TB in different parts of the country and to vary the approach to control accordingly. The current aim is to obtain OTF status for the Edge Area as soon as possible.

This report describes the frequency and geographical distribution of TB in cattle herds in Derbyshire, an Edge Area county, in 2022. It examines what factors are likely to be driving TB in this area, and the risks the disease in this county may pose to neighbouring areas.

TB in cattle and other mammals is primarily caused by the bacterium *Mycobacterium bovis* (*M. bovis*), and the disease is subsequently referred to in this report as TB. Although other sources may refer to TB 'breakdowns', this report will use the term 'incidents' throughout.

This report is intended for individuals involved in the control of TB, both locally and nationally. This includes, but it is not limited to, farmers, veterinarians, policy makers and the scientific community.

Details of the data handling methodology used in this report, a glossary of terms, and the TB control measures adopted in the Edge Area, can be found in the [explanatory supplement for the annual reports 2022](#).

Types of TB incident

Unless otherwise specified, this report includes all new TB incidents detected during the reporting period (1 January to 31 December 2022). This includes both 'Officially Tuberculosis-Free Status Withdrawn' (OTF-W) and 'Officially Tuberculosis-Free Status Suspended' (OTF-S) incidents.

OTF-W incidents are those involving at least one skin test reactor positive to the Single Intradermal Comparative Cervical Tuberculin or SICCT test, in addition to either typical lesions of TB identified at post-mortem (PM) meat inspection, or at least one animal with an *M. bovis*-positive culture result from tissue samples collected from carcasses during the PM inspection (or both).

OTF-S incidents are triggered by reactors to the skin test, but without subsequent detection of TB lesions or positive culture results in any of those animals.

TB incidents in [Approved Finishing Units](#) (AFUs) without grazing are not included in the prevalence and incidence calculations in this report due to the limited epidemiological impact of these incidents.

Furthermore, the number of TB incidents and designation of those incidents as OTF-W or OTF-S may differ in this report compared to other official TB statistics due to differences in the information available at the time datasets are accessed.

Cattle industry

Appendix 1, Table 1 provides cattle industry demographics in Derbyshire, where cattle herd size varies. The highest proportion being small herds of up to 50 cattle. The predominant cattle enterprises in Derbyshire are suckler and fattening beef herds. There is however a large proportion of medium to large dairy herds (Appendix 1, Table 2) mostly in the south and west of the county.

In 2022, one AFU without grazing ceased to operate, taking the total number of licensed AFUs in the county to 13. In 2022, there was one livestock market in the county at Bakewell. Additionally there was a market in Leek, Staffordshire close to the Derbyshire border.

Derbyshire was originally divided between 2 TB risk areas: High Risk Area (HRA) in the west, mid and south, Edge Area in the north and east.

The whole of Derbyshire was fully incorporated into the Edge Area in January 2018. Herds in the original HRA part of the county undergo routine surveillance TB testing every 6 months, whilst herds in the original Edge Area of the county are routinely tested annually.

Herds within the 6-monthly surveillance testing area of Derbyshire that meet certain criteria and thus are identified as having a lower risk of TB incursion, can benefit from "[earned recognition](#)" whereby they are tested annually.

In April 2022, 32% (526 of 1,639) of cattle herds in Derbyshire were regarded as having a lower risk of contracting TB, and thus eligible for annual testing. This was a small decrease of 18 herds from 2021.

New TB incidents

There were 85 new TB incidents in 2022 compared to 115 in 2021, as shown in Figure 1. This was the lowest annual number of new TB incidents reported in this county since before 2013. The number of OTF-W incidents more than halved to 30, from 63 incidents in 2021, maintaining a descending trend recorded in 2021. The number of OTF-S incidents increased to 55, from 52 in 2021.

The decline in incidents is encouraging and it is likely to be due to the various control measures and education options in place across Derbyshire.

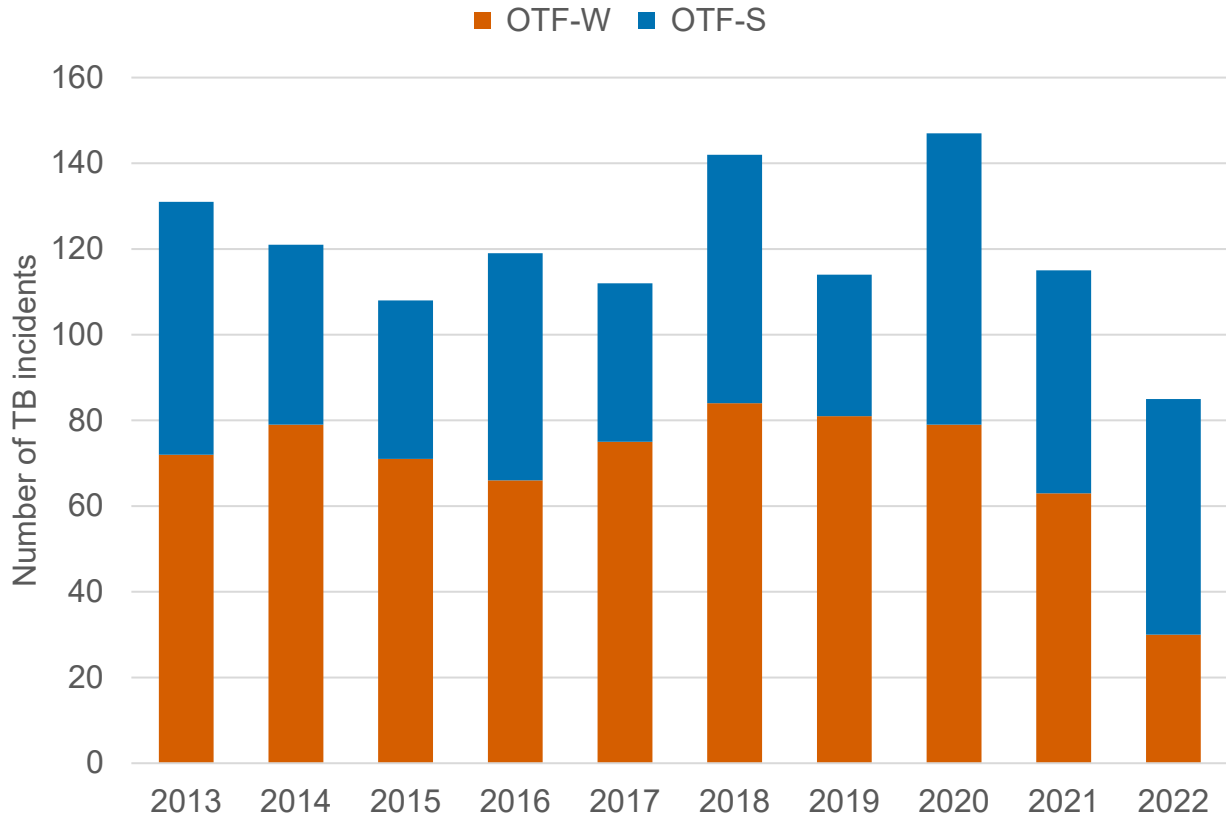


Figure 1: Annual number of new TB incidents in Derbyshire, from 2013 to 2022.

Disclosing test types

As in previous years, whole-herd (6 or 12-monthly routine surveillance) testing continued to detect the most incidents of TB in Derbyshire (52), followed by 6 month post-incident testing (16) as shown in Figure 2. This highlights the ongoing importance of compliance with testing schedules.

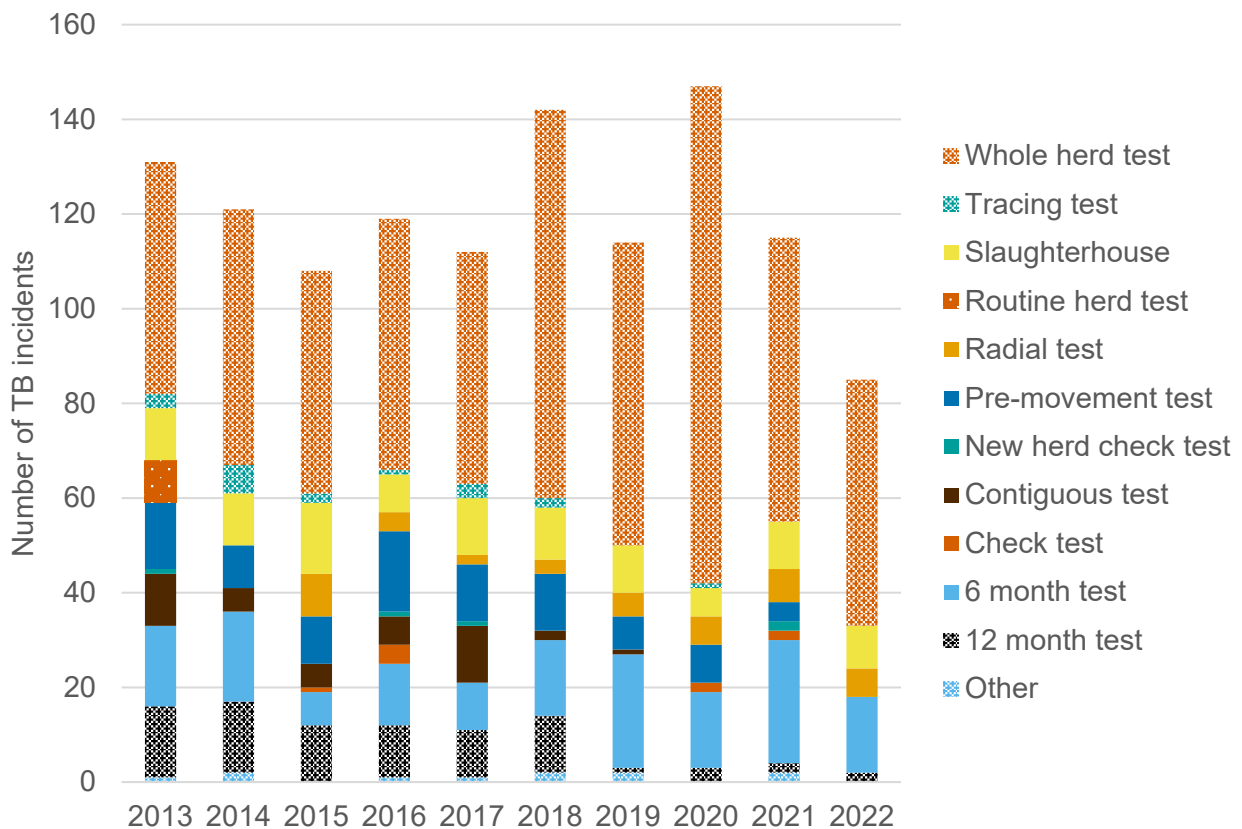


Figure 2: Number of new TB incidents (OTF-W and OTF-S) in Derbyshire in 2022, according to the surveillance methods that detected them.

Duration of TB incidents

A total of 108 TB incidents were resolved in Derbyshire during 2022. Of these, 45 were new TB incidents that started in 2022, 58 started in 2021, 3 were from 2020 and 2 started in 2019.

The median duration for OTF-W incidents that ended in 2022 was 214 days (interquartile range (IQR) 167 to 294). Most OTF-W incidents were resolved within 550 days (48 out of 54).

Most OTF-S incidents that ended in 2022 (49 out of 62) were resolved within 240 days. Twelve took between 241 and 550 days to resolve, and the median was 174 days (IQR 152 to 209).

There was one OTF-W and one OTF-S incident still open at the end of 2022 that were under movement restrictions for more than 550 days.

The median duration for all incidents that ended in 2022 was 180.5 days (IQR 158 to 238). This is shorter than the duration of incidents that ended in 2021; 196 days (IQR 167 to

266). For the whole Edge Area, the median duration of TB incidents that ended in 2022 was 182 days (IQR 157 to 286).

Unusual TB incidents

Two chronic incidents (one OTF-W and one OTF-S incident) were still open at the end of 2022. The OTF-W incident had been ongoing for 5 years and finally ended in May 2023 after the affected herd completed the required number of consecutive tests with negative results. It was a mixed beef and dairy farm of almost 1,000 cattle. The keeper was compliant with testing, and the length of the incident was due to reactors being found at short-interval tests. The most likely pathways of incursion were purchased cattle from the high-risk area and the local wildlife reservoir.

The chronic OTF-S incident was on a suckler herd and ended in June 2023 after 3 years' duration. The longevity of the incident was mainly due to non-compliance with testing. Enforcement action by APHA and local Trading Standards led to the testing being completed and the risk of onward spread removed.

TB in other species

There is no statutory routine TB surveillance of non-bovine species, apart from Post Mortem Examination (PME) of animals slaughtered for human consumption. Targeted TB testing takes place in non-bovine herds with laboratory confirmed *M. bovis* infection, and in specific herds of camelids, goats and captive deer at an elevated risk of infection.

There were no reports of TB incidents in Derbyshire occurring in non-bovine species during 2022.

Incidence of TB

Figure 3 provides the annual incidence rate in Derbyshire for all new incidents. Derbyshire had the fifth lowest incidence of TB per 100 herd-years at risk (6.5) out of the 11 Edge Area counties in 2022. This was below the Edge Area overall (7.7). TB incidence per 100 herd-years at risk decreased in the whole county in 2022, from 8.6 in 2021 to 6.5 in 2022. This is the second consecutive year that the incidence rate has decreased in Derbyshire and may be the beginning of a continuing downward trend.

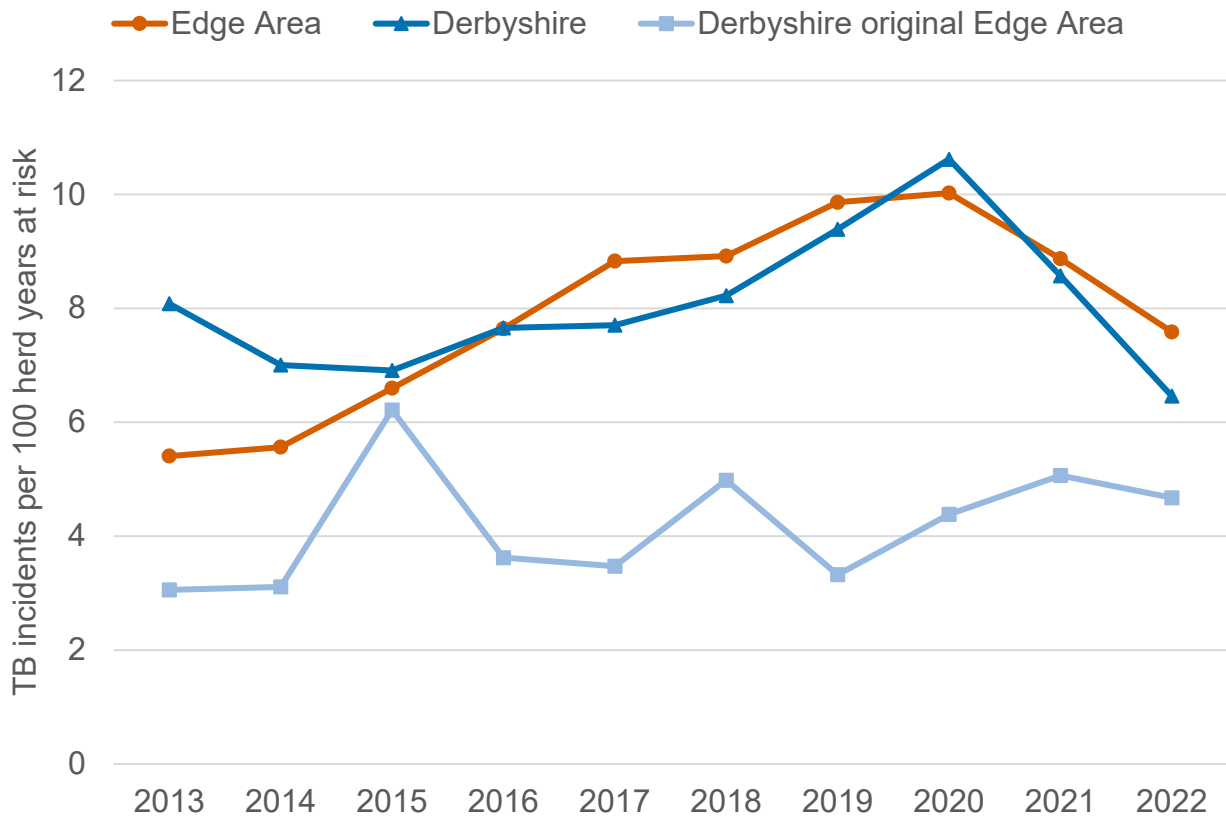


Figure 3: Annual incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Derbyshire from 2013 to 2022.

Prevalence of TB

Figure 4 shows the annual end-of-year prevalence in Derbyshire. A fluctuating pattern has been observed in the herd prevalence over the past 10 years. In 2022, end-of-year prevalence for the whole county of Derbyshire declined to 2.8% from 4.3% in 2021. This may be due to a combination of factors such as:

- increased awareness of herd biosecurity
- increased knowledge of TB and risk pathways through visits by private veterinary surgeons, APHA and the TB Advisory Service
- more sensitive testing of herds affected by TB incidents
- compliance with TB control measures with prompt removal of infected cattle
- 6 monthly routine herd testing in much of the county (the original HRA section)

However, the pattern change is most likely due to the reduction in OTF-W incidents, which normally have a longer duration.

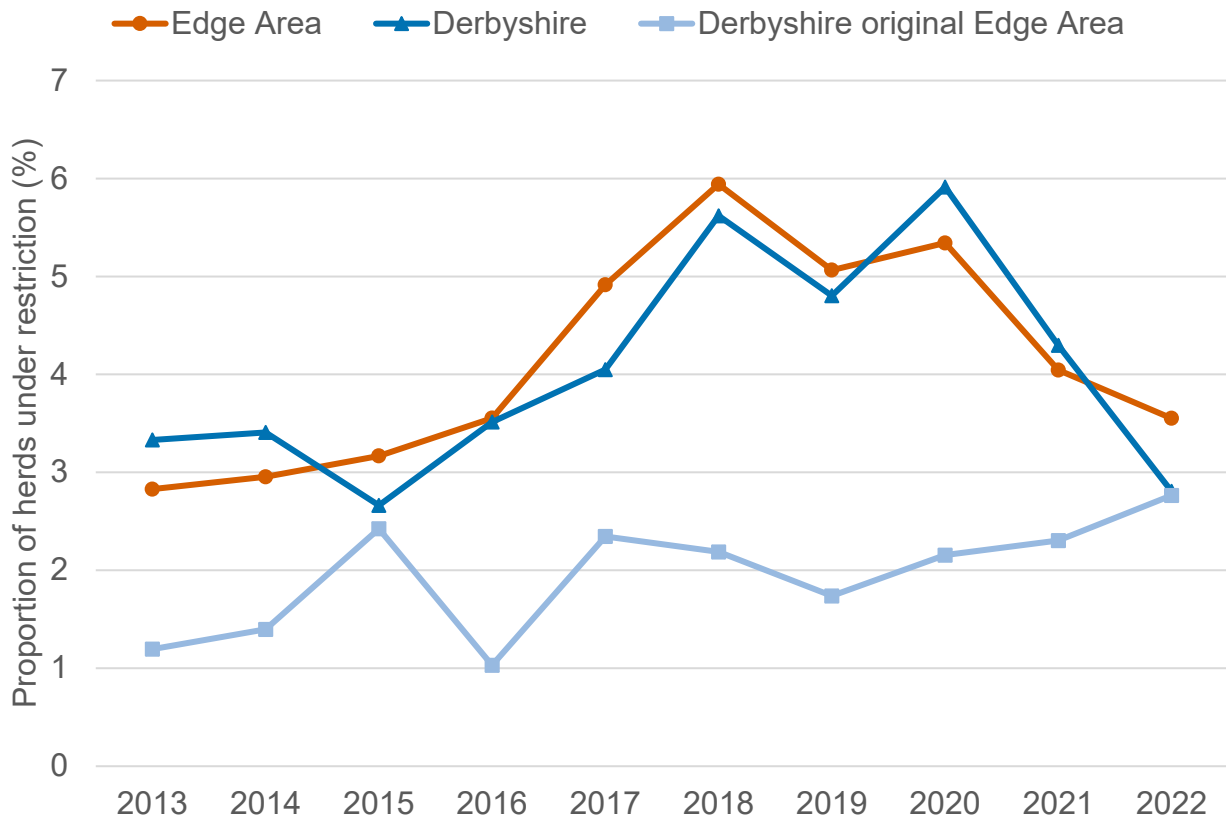


Figure 4: Annual end of year prevalence in Derbyshire, from 2013 to 2022.

Re-occurring TB incidents

In Derbyshire approximately half (51%) of all new TB incidents in 2022 occurred in herds that had another TB incident in the past 3 years, as shown in Figure 5. This was the same for OTF-W as for OTF-S incident herds. This was similar to the proportion of re-occurring TB incidents for the whole of the Edge (50%). This highlights the problem of re-occurrent infections in Derbyshire herds. The reasons for this are unclear and may be multi-factorial and is likely to include herd type, wildlife populations, farming practices and proximity to the HRA county of Staffordshire.

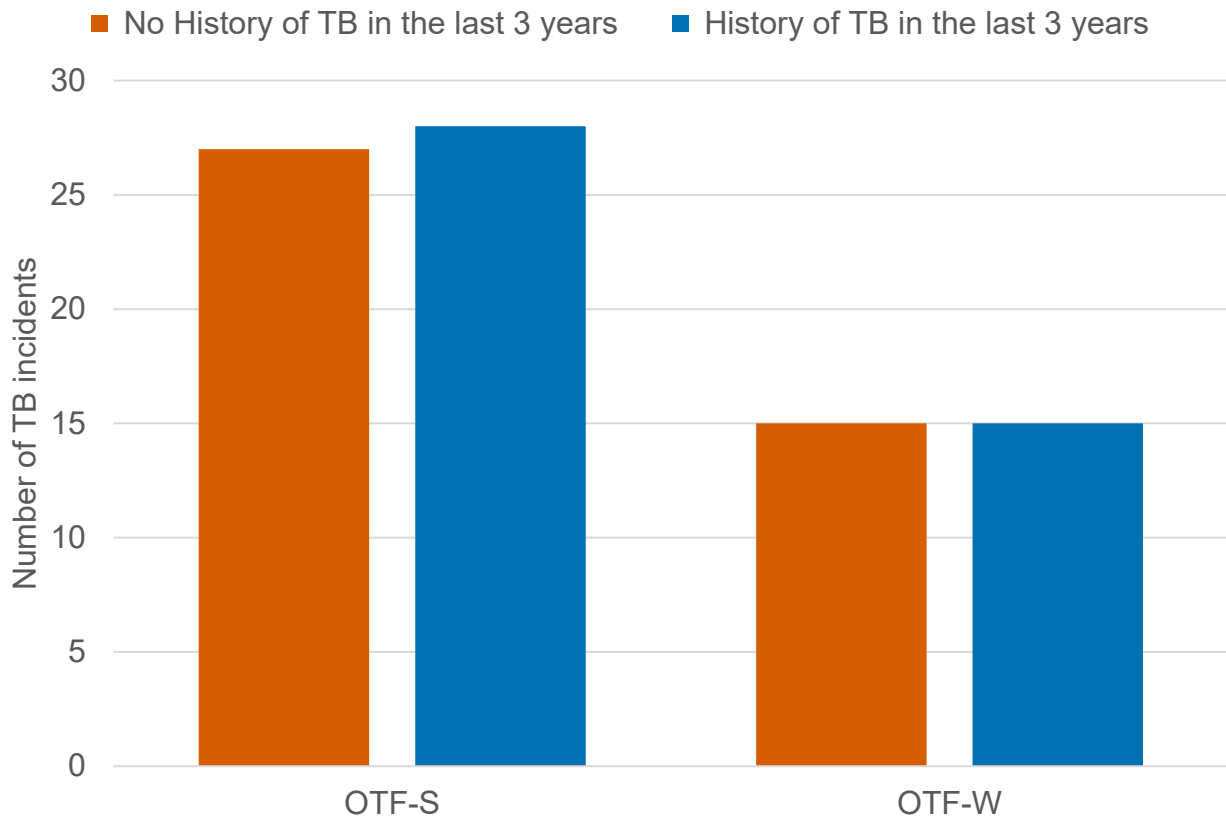


Figure 5: Number of herds with a TB incident (by OTF-W and OTF-S) in Derbyshire in 2022, with and without a history of any TB incident in the previous three years.

Geographical distribution of TB incidents

As in previous years, TB incidents in Derbyshire in 2022 were concentrated in the original HRA portion in the south and west of the county adjoining Staffordshire (HRA) and Cheshire (Edge Area). This also mirrors the higher density of cattle holdings, as shown in Figure 6.

The incident rate in Derbyshire for 2022 is 6.5 incidents per 100 herd years at risk (seventh highest in Edge area), in spite of being surrounded by HRA and Edge Area counties with much higher incidence rates.

An area of concern was identified in 2021 with multiple OTF-W incidents surrounding Bakewell recorded a decrease in the number of incidents.

Most TB incidents in 2022 were caused by Whole Genome Sequencing (WGS) clade B3-11 of *M. bovis*, with an even split between high and medium movement risk.

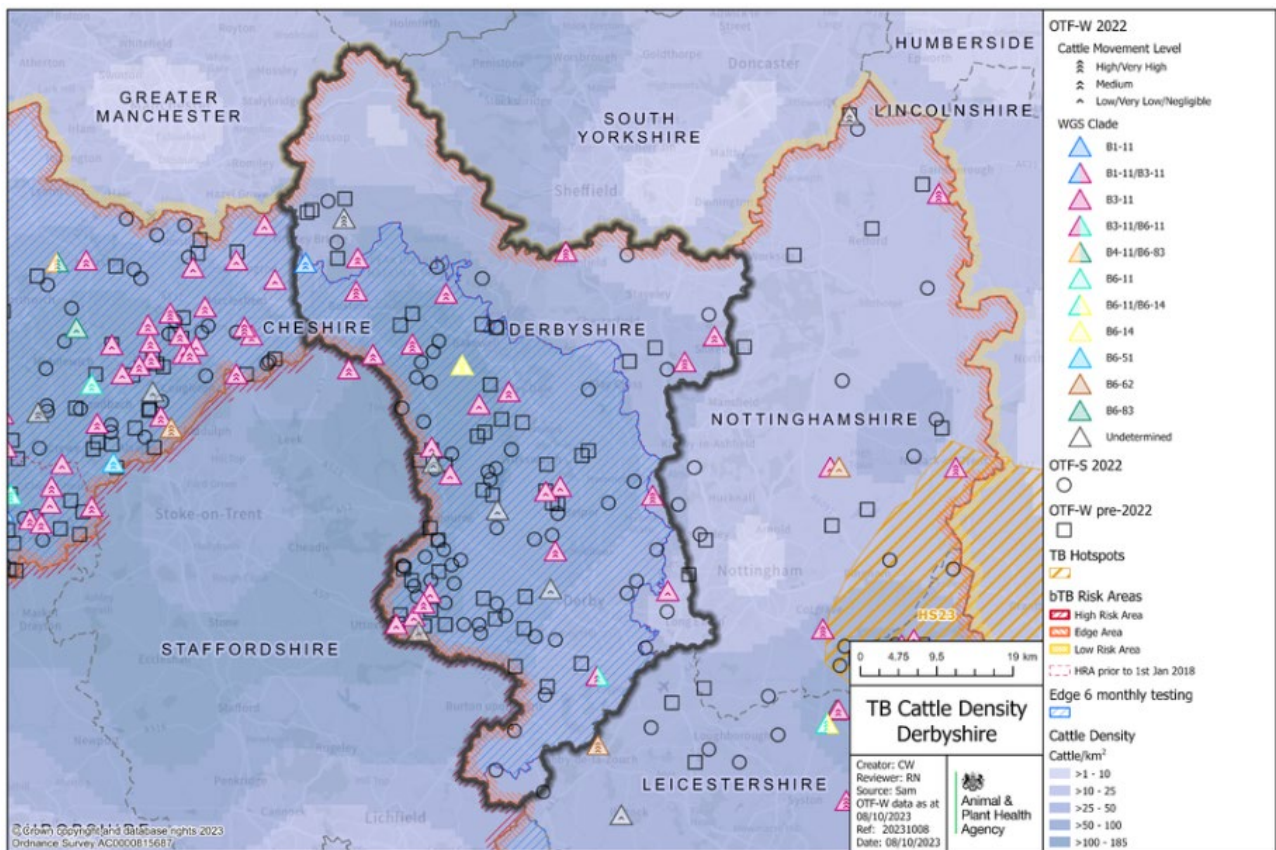


Figure 6: Location of cattle holdings in Derbyshire with new TB incidents (OTF-W and OTF-S) in 2022 and cattle holdings with pre-2022 OTF-W incidents still ongoing at the beginning of 2022, overlaid on a cattle density map. The movement score for each farm is symbolised with 3 chevrons for cattle movements associated with a high likelihood of infection, 2 chevrons for medium likelihood and one chevron for a low likelihood.

Skin test reactors and interferon gamma test positive animals removed

Appendix 2 provides a summary of headline cattle TB statistics in Derbyshire. A total of 408 cattle were removed from TB incidents during 2022, of which 341 were detected by the tuberculin skin test and 67 through the interferon gamma (IFN- γ) blood test, as shown in Figure 7.

This is a decrease of 721 cattle since 2021, due to a reduction in the number of IFN- γ test positive animals to 67 in 2022, compared to 614 in 2021. This reduction may be due to a variety of factors, including:

- the change in IFN- γ testing policy introduced in the Edge Area in July 2021, whereby only recurrent and persistent OTF-W incidents are automatically eligible for mandatory sampling. This includes herds that have had a new incident within 18 months of the previous incident

- the diversion of field resource to the highly pathogenic avian influenza (AI) outbreaks which occurred in 2021 and 2022
- a reduction in the number of OTF-W herds in 2022 compared to 2021

The total number of test positive animals removed from herds has been decreasing since a peak of 1,290 animals in 2019.

The TB skin test, by its nature, has an increased risk of variation in both performance of the test and interpretation of the results. APHA continues to quality assure the delivery of TB skin testing by official veterinarians to maximise disclosure within infected herds.

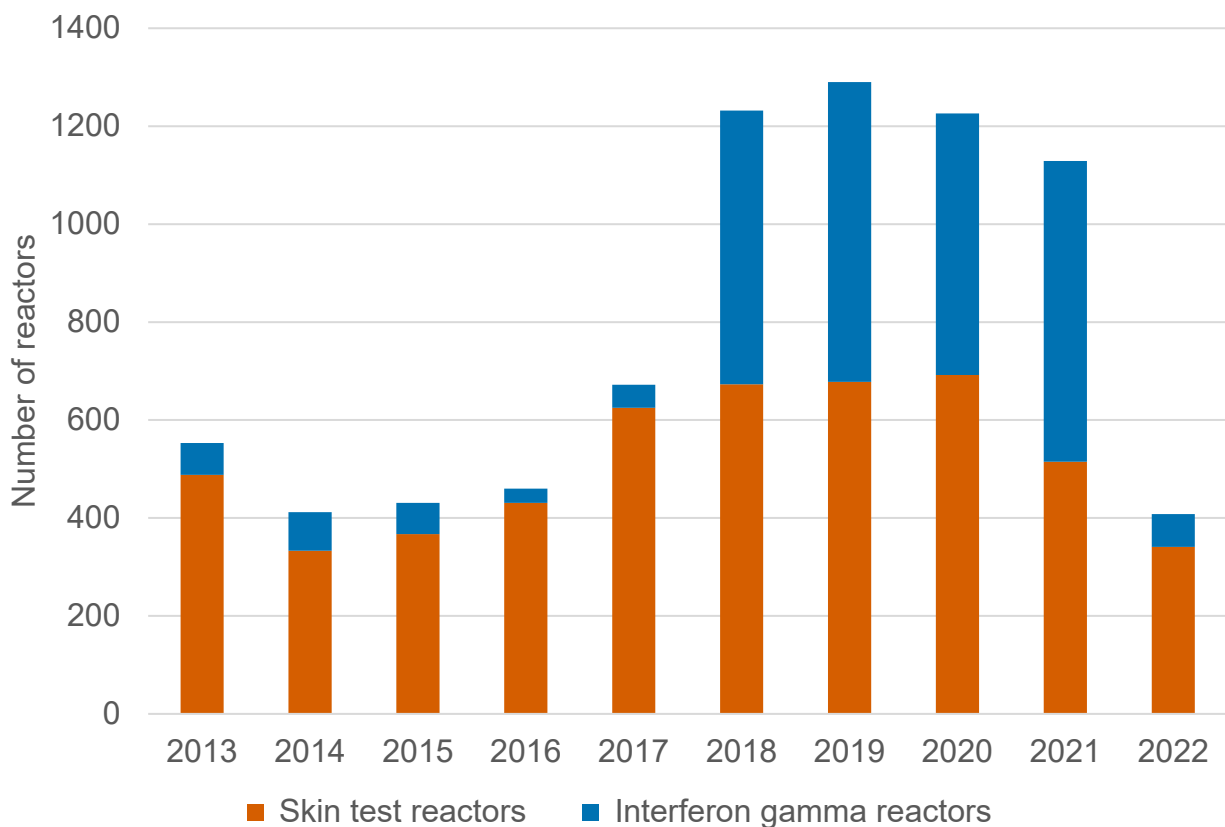


Figure 7: Number of skin test reactors and interferon gamma IFN- γ test positive cattle removed by APHA for TB control reasons in Derbyshire, from 2013 to 2022.

Main risk pathways and key drivers for TB infection

It is important to try to understand the risk pathways and key drivers that are likely to have introduced TB infection into a herd. This information can help identify mitigations that may reduce TB risk for individual businesses.

Implementing practical measures can help to reduce the risk of TB incursion into a herd that is TB free ([biosecurity](#)), as well slowing disease spread within a herd where TB is present ([biocontainment](#)).

Furthermore, the [ibTB](#) online tool can be used to inform purchasing choices, reducing the risk of introducing undetected infection when moving cattle into a herd.

In 2022, 5 out of 85 (6%) new TB incidents in Derbyshire received a preliminary or final APHA veterinary investigation to identify the source of infection. The results of these investigations can be found in Appendix 3. The small number of investigations carried out in 2022 was mainly due to the diversion of field resource to the large avian influenza outbreaks which occurred in 2021 and 2022.

New data driven methods to quantify the likelihood of risk pathways for TB infection have been developed by APHA. These include the:

- Cattle Movement Algorithm
- WGS Local Reservoir Indicator

The Cattle Movement Algorithm uses cattle movement data to identify individual animals that were moved into a TB incident herd as having a negligible, very low, low, medium, high or very high likelihood of being the source of the TB infection. At the herd level, the cattle movement score is dictated by the highest ranked animal movement into that herd. Herds are classified as having either:

- cattle movements associated with a high likelihood of infection (a herd with any movements scored as a high or very high likelihood)
- no cattle movements with a high likelihood of infection (the highest likelihood score was negligible, very low, low or medium).

The WGS Local Reservoir Indicator uses whole-genome sequence (WGS) data from cattle *M. bovis* isolates to identify TB incidents that are linked by genetics, time and space. A TB incident where at least one other TB incident is identified that satisfies all the following 3 criteria is considered to have evidence of a local reservoir of infection:

- it has a WGS with no more than three single nucleotide polymorphism (SNP) differences relative to the TB incident of interest
- it is within 4 years before or 6 months after the start date of the incident of interest
- it is within a 9km radius of the incident of interest.

Further details about the methodology used can be found in the [explanatory supplement to the annual reports 2022](#).

There is always a variable degree of uncertainty about the estimated true routes of TB infection into a herd. The absence of a local reservoir, or cattle movements associated with a high likelihood of infection does not completely negate these pathways. Nonetheless, the evidence provided by the cattle movement and WGS data, when combined, can provide valuable insights into the possible risk pathways. Figure 8 provides

the percentage of herds where each risk pathway combination was identified. The spatial distribution of these categories are presented in Figure 9. Each category is described in greater detail in the following text.

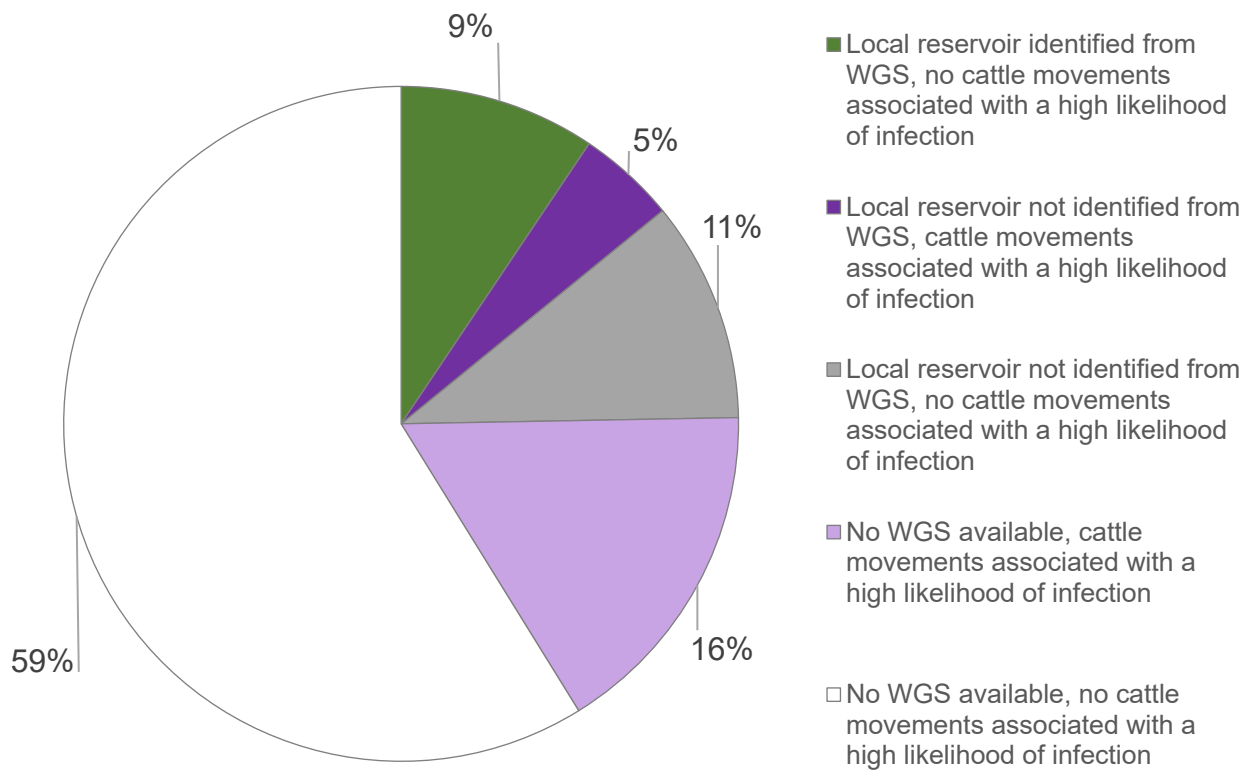


Figure 8: Risk pathway combinations identified by the WGS local reservoir indicator and cattle movement algorithm for all 85 new TB incidents in Derbyshire in 2022.

WGS data was available for 21 (25%) of all new TB incidents in Derbyshire. The WGS Local Reservoir Indicator identified a local reservoir of infection for 8 (9%) of new TB incidents in 2022, all without evidence of cattle movements associated with a high likelihood of TB infection. These are the dark green symbols in Figure 9. For these incidents, a broad spectrum of local pathways cannot be ruled out, including:

- residual infection in the herd
- contiguous contact with infected cattle
- direct or indirect contact with potentially infected wildlife
- location close to HRA Staffordshire.

In Derbyshire, 4 TB incidents (14%) had cattle movements associated with a high or very high likelihood of TB infection, and no evidence of a local reservoir where WGS was available. For those herds it was considered more likely than not that cattle movements played a part in the introduction of infection (dark purple symbols, Figure 8).

A further 14 TB incidents (16%) had cattle movements associated with a high likelihood of TB infection, but WGS data was not available to look for a local reservoir. These are depicted in light purple in Figure 9 due to the lack of genetic evidence.

For 9 TB incidents (11%) the WGS Local Reservoir Indicator did not find evidence of a local reservoir and there was no evidence of cattle movements associated with a high likelihood of TB infection. The source of infection is unclear for these incidents (grey symbols).

There was no evidence of cattle movements associated with a high likelihood of TB infection and no WGS available to explore the presence of a local reservoir for 50 of the 85 (59%) TB incidents. It can be difficult to differentiate between residual cattle infection in the herd, suspected local wildlife infection or local cattle movements. These are shown as white dots in Figure 9, as there is insufficient evidence to determine a likely infection pathway.

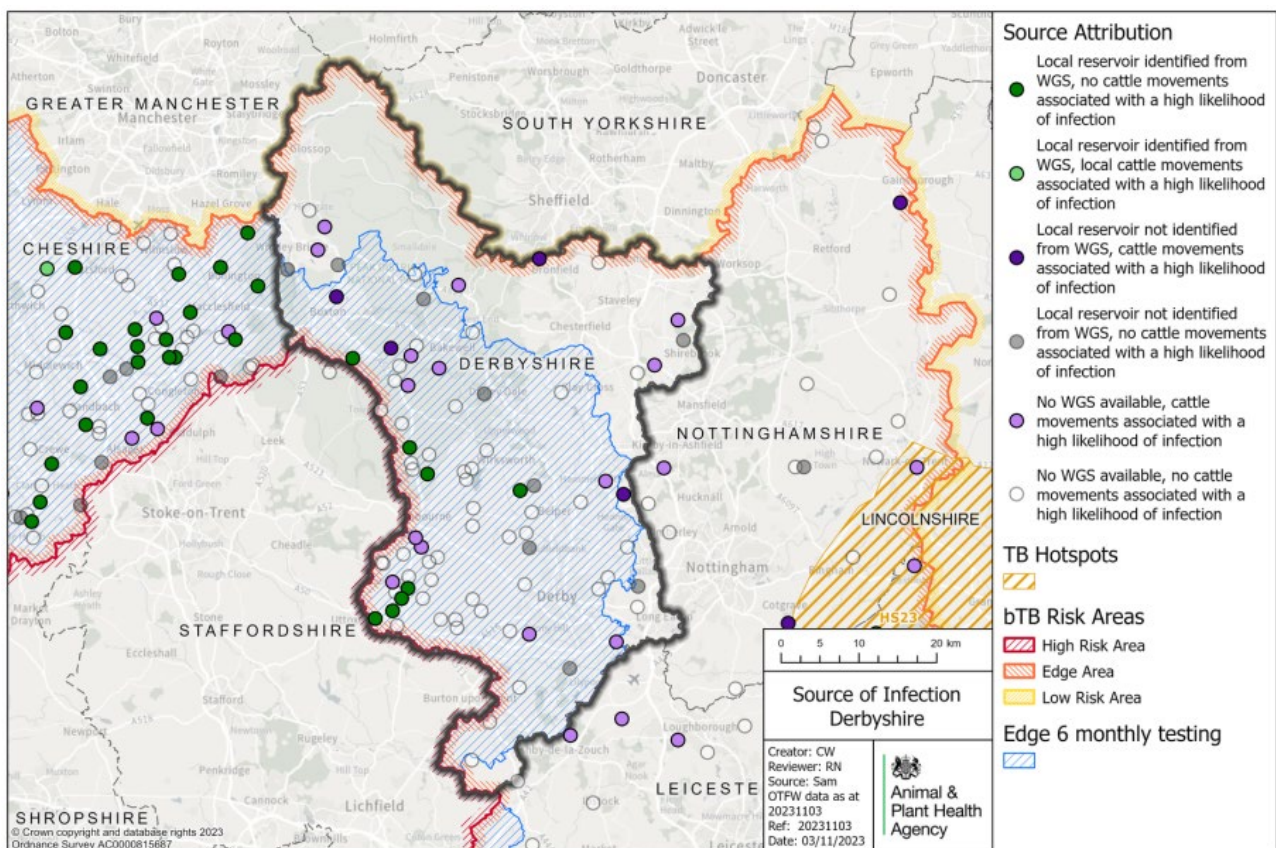


Figure 9: Map of the available evidence for risk pathways of TB infection into the herd, for all TB incidents (OTF-W and OTF-S) in Derbyshire that started in 2022.

Figure 10 shows Whole Genome Sequence (WGS) clade B3-11 was the predominant strain of *M. bovis* isolated in Derbyshire in 2022. Previous annual reports refer to

spoligotypes or genotypes; there has been no change in the predominant strain of *M. bovis* found in Derbyshire (WGS clade B3-11, genotype 25:a).

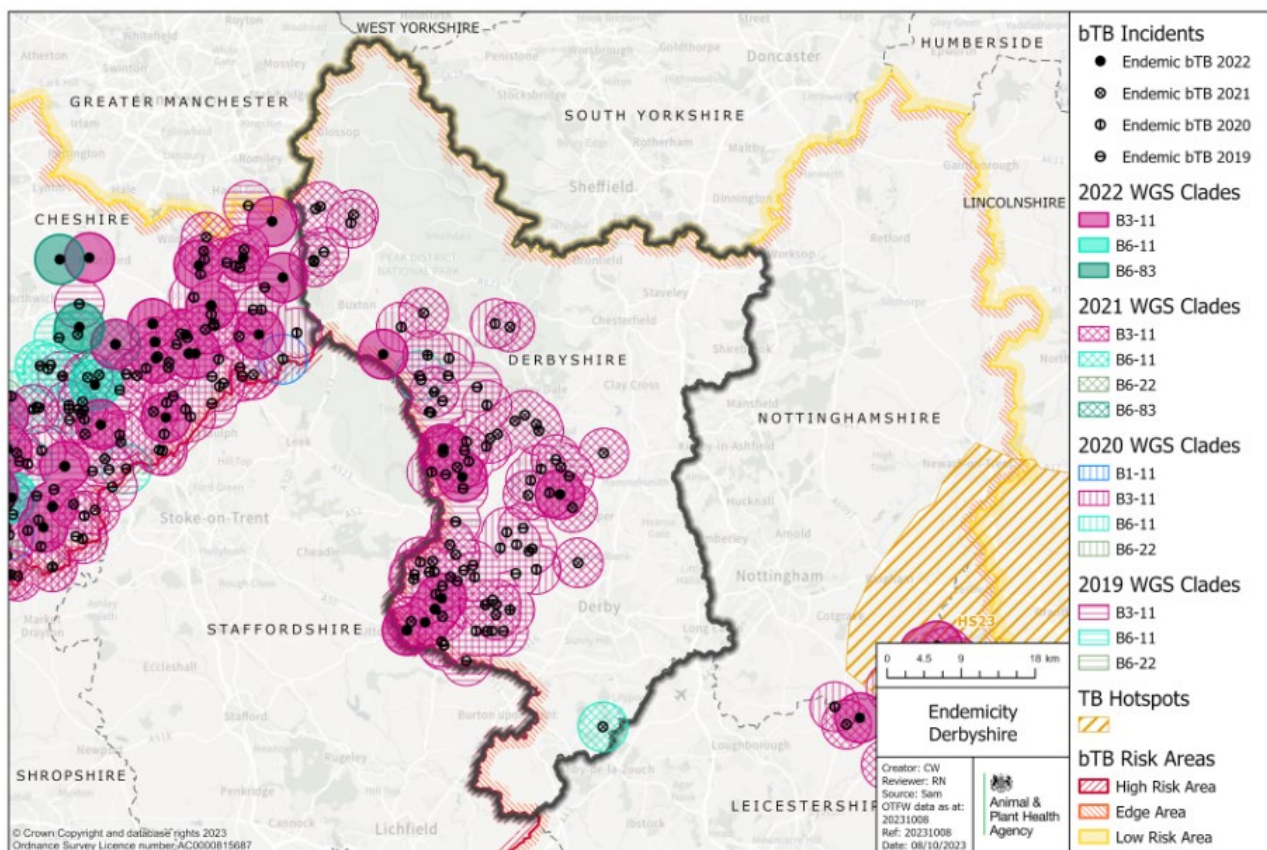


Figure 10: WGS clades of *M. bovis* detected in Derbyshire between 2019 and 2022, where the WGS identified in the infected herd was within 3 SNPs of another TB incident in the past 4 years and 9km (OTF-W incidents only).

Forward look

The 2014 [Strategy for achieving Official Bovine Tuberculosis Free Status for England](#) set out a target to reduce herd prevalence to below 1% overall in the Edge Area by 2025.

Based on current information, this is not conceivable for Derbyshire by 2025.

Practical measures that would help address the main risk pathways for TB infection in Derbyshire include:

- incentivising the uptake of effective biosecurity measures
- increasing awareness of the imperfect sensitivity of the TB skin test - approximately one in five TB-infected cattle are not identified by a single round of testing; a pre-movement TB skin test with negative results does not guarantee freedom from infection, therefore, statutory TB movement testing should be

used in combination with other methods when screening cattle to purchase, such as assessing the frequency of TB herd incidents in the area of origin of the incoming cattle through [ibTB](#)

- encouraging informed cattle trading
- continuation and further adoption of disease control measures to prevent the spread of TB between cattle and wildlife, including biosecurity, badger culling or vaccination, and local control of the wild deer population, where appropriate
- increased awareness of TB in deer and encouragement to report suspect lesions in culled deer

Appendix 1: cattle industry demographics

Table 1: Number of cattle herds by size category in Derbyshire as of 31 December 2022 (RADAR data)

Size of herds	Number of herds in Derbyshire
Undetermined	13
1 to 50	675
51 to 100	263
101 to 200	242
201 to 350	137
351 to 500	69
501+	46
Total number of herds	1,445
Mean herd size	114
Median herd size	56

Table 2: Number (and percentage of total) of animals by breed purpose in Derbyshire as of 31 December 2022

Breed purpose	Number (and percentage of total) cattle in Derbyshire
Beef	92,074 (55%)
Dairy	66,841 (40%)
Dual purpose	6,502 (3%)
Unknown	1 (0.001%)
Total	165,418

Appendix 2: summary of headline cattle TB statistics

Table 3: Herd-level summary statistics for TB in cattle in Derbyshire between 2020 and 2022

Herd-level statistics	2020	2021	2022
(a) Total number of cattle herds live on Sam at the end of the reporting period	1,737	1,642	1,653
(b) Total number of whole herd skin tests carried out at any time in the period	2,258	2,267	2,134
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	1,428	1,429	1,400
(d) Total number of OTF cattle herds at the end of the report period (herds not under any type of Notice Prohibiting the Movement of Bovine Animals (TB02) restrictions)	1,542	1,508	1,545
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	1,632	1,569	1,603
(f.1) Total number of new OTF-S TB incidents detected in cattle herds during the report period (including all Finishing Units)	68	52	55
(f.2) Total number of new OTF-W TB incidents detected in cattle herds during the report period (including all Finishing Units)	79	63	30
(g.1) Of the new OTF-W herd incidents, how many can be considered the result of movement, purchase or contact from or with an existing incident based on current evidence?	18	11	N/A
(g.2) Of the new OTF-W herd incidents, how many were triggered by skin test Reactors or 2xIRs at routine herd tests?	57	31	N/A

Herd-level statistics	2020	2021	2022
(g.3) Of the new OTF-W herd incidents, how many were triggered by skin test Reactors or 2xIRs at other TB test types (such as forward and back-tracings, contiguous or check tests)?	15	23	N/A
(g.4) Of the new OTF-W herd incidents, how many were first detected through routine slaughterhouse TB surveillance?	6	9	9
(h.1) Number of new OTF-W incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	2	4	4
(h.2) Number of new OTF-S incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	4	3	2
(i) Number of OTF-W herds still open at the end of the period (including any ongoing OTF-W incidents that began in a previous reporting period, but not including non-grazing Approved Finishing Units)	60	40	22
(j) New confirmed (positive <i>M. bovis</i> culture) incidents in non-bovine species detected during the report period (indicate host species involved)	0	0	0
(k.1) Number of grazing approved finishing units active at end of the period	0	0	0
(k.2) Number of non-grazing approved finishing units active at end of the period	12	13	14
(k.3) Number of grazing exempt finishing units active at end of the period	1	1	1
(k.4) Number of non-grazing exempt finishing units active at end of the period	2	1	0

Table 4: Animal-level summary statistics for TB in cattle in Derbyshire between 2020 and 2022

Animal-level statistics (cattle)	2020	2021	2022
(a) Total number of cattle tested in the period (animal tests)	314,947	320,196	297,985
(b.1) Reactors detected by tuberculin skin tests during the year	692	515	341
(b.2) Reactors detected by additional IFN- γ blood tests (skin-test negative or IR animals) during the year	534	614	67
(c) Reactors detected during year per incidents disclosed during year	8.3	9.8	4.8
(d) Reactors per 1,000 animal tests	3.9	2.5	1.4
(e.1) Additional animals slaughtered during the year for TB control reasons (dangerous contacts, including any first time IRs)	9	26	1
(e.2) Additional animals slaughtered during the year for TB control reasons (private slaughters)	14	3	7
(f) Slaughterhouse (SLH) cases (suspect tuberculous carcasses) reported by Food Standards Agency (FSA) during routine meat inspection	14	25	19
(g) SLH cases confirmed by culture of <i>M. bovis</i>	6	12	13

Note (c) Reactors detected during year per incidents disclosed during year, reactors may be from incidents disclosed in earlier years, as any found through testing during the report year count here.

Note (g) SLH cases confirmed by culture of *M. bovis*, not all cases reported are submitted for culture analysis. All cases reported are from any period prior to or during restrictions.

Appendix 3: suspected sources of *M. bovis* infection for all the new OTF-W and OTF-S incidents identified in the report period

In 2022, 5 out of 85 (6%) new TB incidents in Derbyshire received a preliminary or final APHA veterinary investigation to identify the source of infection. The small number of investigations carried out in 2022 was mainly due to the diversion of field resource to the large avian influenza outbreaks which occurred in 2021 to 2022.

Each TB incident could have up to 3 potential risk pathways identified. Each risk pathway is given a score that reflects the likelihood of that pathway bringing TB into the herd. The score is recorded as either:

- definite (score 8)
- most likely (score 6)
- likely (score 4)
- possible (score 1)

The sources for each incident are weighted by the certainty ascribed. Any combination of definite, most likely, likely, or possible can contribute towards the overall picture for possible routes of introduction into a herd.

Each TB incident could have up to 3 potential risk pathways identified. Each risk pathway is given a score that reflects the likelihood of that pathway bringing TB into the herd. The score is recorded as either definite (score 8), most likely (score 6), likely (score 4) or possible (score 1). The sources for each incident are weighted by the certainty ascribed. Any combination of definite, most likely, likely, or possible can contribute towards the overall picture for possible routes of introduction into a herd. If the overall score for a herd is less than 6, then the score is made up to 6 using the 'Other or unknown source' option. Buffering up to 6 in this way helps to reflect the uncertainty in assessments where only 'likely' or 'possible' sources are identified.

Table 5 combines the data from multiple herds and provides the proportion of pathways in which each source was identified, weighted by the certainty that each source caused the introduction of TB. The output does not show the proportion of herds where each pathway was identified (this is skewed by the certainty calculation). WGS of *M. bovis* isolates can be a powerful tool in identifying a likely source of infection, however WGS clades are not determined for OTF-S herds. As a result of varying levels of uncertainty, only broad generalisations should be made from these data. A more detailed description of this methodology is provided in the [explanatory supplement for the annual reports 2022](#).

Table 5: Suspected sources of *M. bovis* infection for the 5 incidents with a preliminary of a final veterinary assessment in Derbyshire, in 2022

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	2	0	5	0	89.9%
Cattle movements	1	0	0	0	3.0%
Contiguous	0	0	0	0	0.0%
Residual cattle infection	0	0	0	0	0.0%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	0	0	0	0	0.0%
Fomites	0	0	0	0	0.0%
Other wildlife	0	1	0	0	7.3%
Other or unknown source	0	0	0	0	0.0%

Please note that each TB incident could have up to three potential pathways so totals may not equate to the number of actual incidents that have occurred.



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