BADGER INTERVENTION – OPTIONS ANALYSIS PAPER.

1. Strategic Case: Need

1.1 Bovine Tuberculosis (bTB)

1.1.1 Bovine Tuberculosis (bTB) is a devastating chronic, highly infectious, disease of cattle caused by a bacterium called *Mycobacterium bovis* (*M. bovis*). Beyond cattle, the disease can also affect badgers, deer, camelids, goats, pigs, dogs and cats. Bovine TB can also pass from animals to humans; however, it is no longer a major public health risk in the UK, due to national control plans which include:

- Routine surveillance testing to identify and remove infected cattle;
- Post-mortem examinations supervised by Official Veterinarians in slaughterhouses;
- Strict criteria to determine when animals can enter the food chain;
- Pasteurisation of national milk supplies; and
- Risk-based vaccination.

1.1.2 Humans can be infected by drinking raw (unpasteurised) milk from infected cattle or inhaling infective droplets, so those most at risk are individuals working closely with infected animals, for example farmers, veterinary surgeons and slaughterhouse staff.

1.2 Legal responsibility for the eradication of bTB

1.2.1 DAERA, as the Competent Authority (CA), is legally required by European Union[1] (EU) legislation to design and deliver an eradication programme[2] for Mycobacterium tuberculosis complex (MTBC) in cattle[3]. EU legislation applies

[1] REGULATION (EU) 2016/429 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2016 on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law'). EUR-Lex - 02016R0429-20191214 - EN - EUR-Lex. As per Article 5(1) (b), bTB is a listed disease in Annex II.
[2] Article 9(1) (b) (i); Article 31(1) of Reg. (EU) 2016/429.
[3] MTBC is listed as a category B disease under the Animal Health Law (AHL) for that species – Regulation (EU) 2016/429.

in Northern Ireland under Annex 2 of the Windsor Framework. The European Commission most recently approved the Northern Ireland (NI) bTB Eradication Plan in early 2022, with that approval valid for six years.

1.3 Official bTB Free Status (OTF)

1.3.1 In line with Commission Delegated Regulation (EU) 2020/689 (CDR 2020/689), NI may be granted OTF status when, during the past three years, at least 99.8% of the establishments keeping bovine animals, representing at least 99.9 % of the bovine population, have maintained their status free from infection with MTBC and the incidence rate of establishments confirmed infected during the year did not exceed 0.1%. CDR 2020/689 also sets out the surveillance requirements needed to gain and maintain that status.

1.3.2 Table 1 sets out the legal rules for herd testing at key disease levels. Currently, Northern Ireland has a relatively high herd bTB incidence of around ~10%[4]. To qualify for less frequent testing, this would need to fall to below 1% and stay at that level for at least two consecutive years. At that point, testing could move from annual to every two years.

1.3.3 More generally, herd testing in Northern Ireland can become less frequent as bTB levels are reduced and kept low over time. The longer low levels are maintained, the more testing intervals can be safely extended. In areas where the disease is fully cleared, testing may no longer follow a fixed schedule and instead be based on risk, such as local wildlife infection, herd history, or links to higher-risk farms. This allows testing to ease over time while still keeping appropriate safeguards in place.

[4] https://www.daera-ni.gov.uk/publications/tuberculosis-disease-statistics-northern-ireland-2026

Table 1: Legislative rules for herd testing

Herd bTB incidence rate	Period this achieved for:	Testing interval
Greater than 1%	Not applicable	Annual
1% or less	At least 2 consecutive years	Biennial
0.2% or less	At least 4 consecutive years	Triennial
Officially bTB free criteria:		
0.1% or less	At least 6 consecutive years	Every 4 years **or** can dispense with intradermal tuberculin testing (subject to conditions)

1.4 Importance of access to external markets for the NI cattle industry

1.4.1 The bTB eradication programme underpins the ability of NI's livestock sectors to trade with the EU and internationally. At the time of writing, the most recent data available shows that NI had sales of processed food to external markets worth ~£5.1 billion (i.e. 78% of total sales), of which external sales of milk and milk products were estimated to be ~£1.3 billion, and external sales of beef and sheep meat products were £1.4 billion[5].

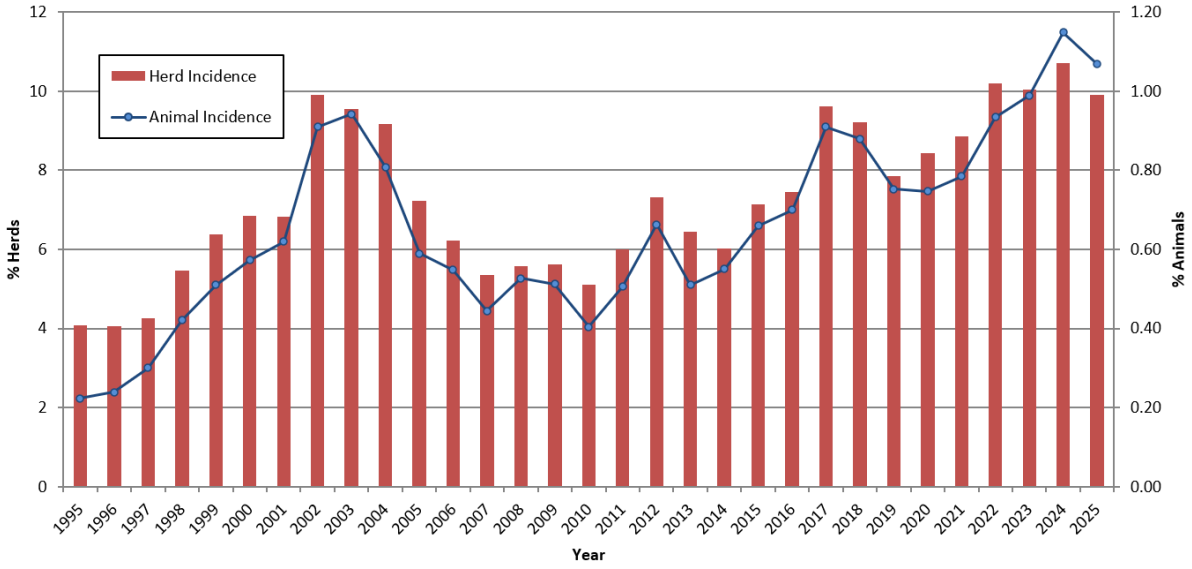
1.5 Increasing bTB incidence

1.5.1 Bovine TB is one of the most pressing domestic animal health problems in NI, especially given the marked increase in disease levels experienced in recent years (figure 1). For instance, in the calendar year 2010, annual herd incidence was 5.1%, and it fluctuated between ~6 - 7% for the next five years (2011 to 2015). From 2016 to 2021, it fluctuated between ~7.5% - 9%. Since then, it has increased further to between ~10 - 11%.

1.5.2 Switching to financial years (which align with spend financial years), annual herd incidence was 10.6% in 2024/25, and 9.6%[6] in 2025/26.

[5] NISRA (2025) "Northern Ireland Food and Drinks Processing Report 2022." Northern Ireland Food and Drinks Processing Report 2022.
[6] DAERA (2026) Tuberculosis: Statistics for March 2026 Tuberculosis - monthly statistics - March 2026.pdf

Figure 1: Annual herd and animal bTB incidence in Northern Ireland, 1995-2025.



1.6 Bovine TB's significant cost to the NI economy

1.6.1 Public expenditure on the disease has grown rapidly and is likely to continue to grow unless new action is taken. As part of this economic analysis, the cost of the programme was considered in detail. The calculations are outlined in the Badger Intervention Analyses – Calculation Assumptions (**appendix 1**). In 2024/25, the full economic cost of the bTB programme was £60.1m. However, for the purposes of this economic analysis, some extra costs that are outside the boundary of the published figure were also considered, namely, an estimate of the expenditure on bTB related research and development projects, and an estimate of the staff travel and subsistence cost which is not recorded separately for staff working on bTB. The addition of these cost estimates would increase the economic cost of the programme to around £61m. However, it was also noted that the staff cost within the published figure is underestimated as around 22 posts relating to bTB work were unfilled in 2024/25. If a full staff complement had been in place[7], then the government cost of the bTB programme in 2024/25 would have been around £63m[8]. Of this, £33m relates

[7] In 2024/25, of the total Full Time Equivalent Posts identified as part of the bTB programme, 13% were vacant. The estimate of the full economic cost of the bTB programme to government calculated for these analyses assumes that these posts are filled.
[8] Note that this estimate excludes the cost of senior management in disease branches of Veterinary Service's Animal Health Group.

to the "effort" in running the programme[9], with the remainder (~£30m) for net compensation[10] for animals compulsorily removed from farms. As regards the net compensation cost, more than 22,000 animals were compulsorily removed from farms and slaughtered prematurely in this financial year. This equated to a compensation bill of £43m, against which DAERA received £13m from processors for the salvage value of these carcasses, hence a net compensation cost of ~£30m.

1.6.2 In 2025/26, the number of Interferon-gamma (IFNG) tests carried out increased by 7,000 from around 17,000 per year to around 24,000 per year. In addition, the value of cattle increased, which resulted in the net compensation cost also increasing. Taking these factors into account alongside cost inflation, and if it is assumed that a full staff complement was in place **in 2025/26**[11], then the full economic cost of the bTB programme to government would be around **£76m**, of which £35m relates to programme effort, and £41m relates to net compensation. Assuming the same programme effort is required in 2026/27 but adding in the profiled additional 6,000 IFNG tests and taking account of cost inflation (and assuming all else equal), if a full staff complement was in place, then the full economic cost of the bTB programme to government would likely increase to around £78m in 2026/27. Of this estimate, £42m relates to net compensation.

1.6.3 The disease also brings significant costs to farmers: (i) compliance costs; and (ii) other costs.

1.6.4 In regard to (i) compliance costs, farmers are legally required to comply with the bTB programme requirements. As outlined in Table 1, while herd incidence rates are above 1%, all farms in NI must undertake at least one herd test per

[9] Includes testing via Private Veterinary Practitioners or DAERA staff, the cost of other DAERA staff in post as well as the cost of vacant posts (as if they had been filled in the period, as discussed); tuberculin for skin testing, IFNG (blood) testing, AfBI Veterinary Science Division laboratory analysis of tissues from animals with lesions found at routine slaughter, and of IFNG samples, etc., haulier costs for animals removed, carcass condemnation costs, miscellaneous expenditure and the extra costs discussed (R&D and T&S).

[10] Compensation minus salvage value. Compensation is paid at 100% of market value, where the market value assumes the animal is healthy.

[11] In 2025/26, of the total full time equivalent posts identified as part of the bTB programme, 13% were identified as vacant at the time the calculations were carried out.

year[12]. In addition, if disease is found or suspected on their farm, or on a neighbouring farm, or if animals recently bought in or sold test positive for the disease, farmers must comply with other testing requirements, e.g. herd or cohort or individual animal tests, complying with administrative requirements, etc. Where animals are compulsorily removed, farmers must present these for valuation and subsequently for collection for slaughter. It is estimated that the **farmer compliance cost** will be around **£20m** for the 2026/27 financial year.

1.6.5 In regard to (ii) other costs, DEFRA's analyses highlighted that farmers incur 'other costs' as a result of bTB which are in addition to compliance costs. These arise due to, for example, marketing issues and devaluation of animals from restricted herds, and residual costs. Although compensation is paid at 100% of the market value of the animals removed, there is a residual cost of finding replacement animals, and a temporary loss of output until the new animal is found, installed on farm, and starts to produce at the same level as the animal removed, etc. Using the DEFRA methodology to derive these costs but updating DEFRA cost estimates to 2026/27 prices and using NI animal numbers, the estimate for these **'other costs'** for 2026/27 is around **£13m**.

1.6.6 Therefore, with estimated **farmer costs totalling around £33m** (30%), and estimated **Government costs adding to approximately £78m** (70%), the total cost of the bTB programme in 2026/27 is likely to be **around £111m**.

1.6.7 Note that The Andersons Centre has recently published a report entitled "Review of the indirect costs borne by farmers as a result of bovine TB"[13] on the cost of bTB to farmers. However, this report was published after the calculations in these analyses were carried out. As such, note that the farmer costs discussed above use other sources of data, and they are significantly lower than the Andersons Centre's estimates.

[12] If herd incidence is 1% or less for 2 consecutive yrs., testing interval can be extended to biennial; if 0.2% or less for at least 4 consecutive yrs., triennial; at 0.1% or less for at least 6 consecutive yrs (bTB free status achieved), can test every 4 yrs. or dispense with tuberculin testing subject to conditions.

[13] The Andersons Centre (2026) "Review of the indirect costs borne by farmers as a result of bovine TB (BTB) – Final Report". Compiled for the Livestock and Meat Commission, the Dairy Council NI and the Ulster Farmers' Union. The aggregated estimate of total indirect bTB costs across all NI farms is £96.1m. Of this, £49.4m is the estimated cost incurred by farms with no breakdowns, and £46.7m relates to farms with breakdowns.

1.6.8 In addition to the economic cost, the compulsory removal of animals causes significant emotional and psychological distress amongst farmers. For the last three financial years, the number of cattle compulsorily removed from farms and prematurely slaughtered exceeded 20,000 per year[14]. Farmers care for their cattle daily. Those involved in cattle breeding generally take great pride in their breeding programmes. It takes almost 2 years for cattle to become mature enough to breed, and when pregnancy is established, there is a follow-on gestation period of around 9 months. It takes a further two years for offspring to become productive. Therefore, farmers are dealing with long breeding cycles, taking decisions now with a great deal of uncertainty about the prospects for economic return in two plus years' time. Bovine TB adds to the risk, and while it takes years to build up the genetic merit of a herd through each new generation of productive animals, it can be lost very quickly if bTB results in several breeding cattle being compulsorily removed from the farm.

1.7 Cost of a herd breakdown[15]

1.7.1 Of the estimated £111m bTB cost to the NI economy in 2026/27, around £88m (80%) is for herd breakdown and related work[16]. From this, it can be estimated that the average unique herd breakdown[17] costs the NI economy around £27,500[18] (see Badger Intervention Analyses – Calculation Assumptions **(appendix 1)** for further information). Therefore, for every breakdown avoided, there would be a saving to the NI economy of around £27,500.

1.8 Addressing the disease risk posed by badgers

1.8.1 DAERA is required by legislation to have a bTB eradication programme. The current programme needs to be strengthened to address all factors contributing

[14] E.g. 22,318 in 2024/25, of which 20,473 were skin test reactors; 427 were negative-in contact animals compulsorily removed, and 1,418 were Interferon-gamma positive (but skin test negative) animals. The compensation bill was £43m, against which £13m was received as a salvage value, resulting in a net compensation cost of £30m.
[15] See Box 1a for explanation of a herd breakdown.
[16] Calculations in chapter 3 of the Badger Intervention Analyses – Calculation Assumptions **(appendix 1)**.
[17] A unique herd breakdown is defined as a herd which has had at least one TB reactor during the specified calendar year irrespective of any TB reactors during the previous calendar year – See para 3.10.3 of Badger Intervention Analyses – Calculation Assumptions **(appendix 1)** for further information
[18] ~£88m / 3,216 unique herd breakdowns / yr. A TB unique herd breakdown is defined as a herd which has had at least one TB reactor during the specified calendar year irrespective of any TB reactors during the previous calendar year.

to the spread of bTB. As such, DAERA pledges that, by the end of the Assembly mandate in May 2027[19], it will have developed and brought forward new, effective and evidence-based solutions capable of reducing and ultimately eradicating bTB.

1.8.2 The current approach to bTB eradication rests mainly on cattle measures. However, as outlined in figure 1, the current programme has not been effective in reducing herd incidence.

1.8.3 Relatively recent reviews concluded that the bTB programme needs to be strengthened in relation to three pillars: People, Cattle and Wildlife[20,21]. As regards wildlife, the TBSPG in 2016 reviewed and summarised the available scientific evidence and it concluded that, in the context of Northern Ireland, badgers are an important maintenance host for M. bovis, acting as a reservoir of infection with spill-over to cattle, and posing a key constraint to bTB control or eradication. It also concluded that intervention to limit badger to cattle transmission is necessary as part of an integrated holistic approach to eradication[22]. More recently, the CVO Review explains that current scientific knowledge reveals unequivocally that badgers play a key role and are an important contributor in the epidemiology of bTB in cattle with the same strain types isolated from both cattle and badger populations sharing the same environment[23]. It is generally accepted that badgers can seed the infection into the cattle population where it is subsequently multiplied through cattle to cattle transmission[24].

[19] DAERA Business Plan 2025-26
[20] Chief Veterinary Officer Review of Bovine Tuberculosis in Northern Ireland November 2024 | Department of Agriculture, Environment and Rural Affairs
[21] TB Partnership Steering Group - Bovine TB in Northern Ireland: Blueprint for Eradication | Department of Agriculture, Environment and Rural Affairs
[22] https://www.daera-ni.gov.uk/publications/tbspg-bovine-tb-eradication-strategy-ni
[23] CVO Review (2024) which in relation to this point quotes: (i) Courcier, E.A., Menzies, F.D., Strain, S.A.J., Skuce, R.A., Robinson, P.A., Patterson, I.A.P., McBride, K.R., McCormick, C.M., Walton, E., McDowell, S.W.J., Abernethy, D.A. (2018). Mycobacterium bovis surveillance in Eurasian badgers (Meles meles) killed by vehicles in Northern Ireland between 1998 and 2011. Veterinary Record 182, 259-265; and (ii) Byrne, A.W., Allen, A., Ciuti, S., Gormley, E., Kelly, D.J., Marks, N.J., Marples, N.M., Menzies, F., Montgomery, I., Newman, C., O'Hagan, M., Reid, N., Scantlebury, D.M., Stuart, P., Tsai, M. (2024). Badger Ecology, Bovine Tuberculosis, and Population Management: Lessons from the Island of Ireland, Transboundary and Emerging Diseases, 8875146. https://doi. org/10.1155/2024/8875146
[24] CVO Review (2024) which in relation to this point quotes Griffin, J., Aznar, I., Breslin, P., Good, M., Gordon, S., Gormley, E., McAloon, C., Menzies, F., More, S., Ring, S., Wiseman, J. (2023). What is the proportional contribution of cattle-to-cattle, badger-to-cattle, and deer-to-cattle TB transmission to bovine TB in Ireland? TB Scientific Working Group. Food Risk Assess Europe FR-0009.

1.8.4 As badgers are known to play a key role in the epidemiology of the bTB disease, experts stress that both the role of infected cattle and that of badgers in spreading disease must be addressed to ensure progress towards eradication[25,26,27,28].

1.8.5 DAERA's veterinary experts prepared two reviews of the science. The first was published in 2019[29] and covered peer reviewed publications up to 2015, and the second was published in 2025[30]. The latter validates the previous opinions and adds further support and validation from the scientific papers and reports that have been published in the period 1 January 2015 to 30 November 2024. It considers the badger intervention options of Culling; Test and Vaccinate or Remove (TVR); Vaccination; and a Hybrid Option that combines these approaches. Some of the key points from the most recent Science Review (and a description of terminology) are highlighted in the boxes below.

Box 1a: Explanation of some terminology used

- **Herd breakdown** refers to a cattle herd that has Officially Tuberculosis Free (OTF) status removed for disease reasons.

  - OTF herd status is the default unrestricted legal status for cattle herds that have passed all mandatory TB tests, show no clinical signs or suspicion of disease and these herds are free to trade normally. When OTF status is removed, the herd status is downgraded to one of two non-free categories, either OTS (OTF Status Suspended) or OTW (OTF Status Withdrawn).

  - OTS is triggered when the TB status of a herd is uncertain, either because TB is suspected but has not been definitively confirmed, or because herd testing is not up to date. E.g. OTS status is given in the case of a herd with 1 skin test reactor which has not been confirmed with disease at post-mortem or lab testing and/or no more than 5 animals with unconfirmed lesions at routine slaughter (LRSs) .

[25] Abernethy, D.A., Denny, G.O., Menzies, F.D., McGuckian, P., Honhold, N. and Roberts, A.R. (2006), "The Northern Ireland programme for the control and eradication of *Mycobaterium bovis*". Veterinary Microbiology, Vol. 112 (2-4), p. 231-237.
[26] TBSPG (2016) TBSPG Bovine TB Eradication Strategy NI | Department of Agriculture, Environment and Rural Affairs
[27] Chief Veterinary Officer (2024) "Review of Bovine Tuberculosis in Northern Ireland. DAERA Nov. 2024. Chief Veterinary Officer - Review of Bovine Tuberculosis in Northern Ireland
[28] DAERA (2025) "DAERA scientific opinion on the peer reviewed evidence on badger intervention in relation to the control of bovine tuberculosis" Internal analysis. It is appended to the 2026 "Bovine Tuberculosis (bTB) Consultation on Potential Wildlife Intervention Options as part of the Bovine Tuberculosis in Northern Ireland: Blueprint for Eradication".
[29] See paper entitled: "Scientific Opinion on the Available Evidence on Badger Intervention" Hatch and Anderson, 30 August 2019
[30] See paper entitled: "Annotated scientific bibliography relating to badger intervention and bovine tuberculosis for the period 1 January 2015 to 31 May 2024 (with later extension to 30 November 2024)" O'Hagan M.J.H et al, 3 February 2025

- OTW status means the herd is being treated as a confirmed TB breakdown. E.g. a herd with more than 1 skin test reactor even if there is no postmortem of lab confirmation; or a herd with any animal where disease is confirmed; or if there is a total of more than 5 unconfirmed LRSs during the course of the breakdown; or when it is considered epidemiologically prudent; or when an animal shows clinical signs of TB; or when a herd test is overdue by a specified period[31].

In the context of badger intervention:
- Proactive means carrying out badger intervention across the entirety of a bTB hotspot area, not just around farms with herd breakdowns.

- Reactive means carrying out badger intervention in a localised area around farms with herd breakdowns.

- Non-selective means the removal of badgers regardless of their disease status, i.e. A "cull" intervention is non-selective as all badgers found are removed.

- Selective means the removal of badgers based on their disease status, i.e. the Test and Vaccinate or Remove (TVR) intervention is selective as only test-positive badgers are removed.

NB: In regard to the options discussed later in this document:
- Options 2-5 relate to Proactive and Non-Selective Culls. All badgers found/trapped are removed across the entirety of the large bTB hotspot area chosen for intervention;
- Options 6-8 relate to Proactive and Selective Culls using the TVR approach. Badgers are trapped, anaesthetised, tested for bTB, with test-positive badgers removed, and the remainder vaccinated, where this approach is carried out across the entirety of the large bTB hotspot area chosen for intervention; and
- Options 9-11 relate to Proactive Vaccination. Badgers are trapped and vaccinated across the entirety of the large bTB hotspot area chosen for intervention (no badgers are removed).

Box 1b: Some of the key points from the most recent Science Review

Badger intervention remains necessary
- Badgers and cattle form a two-host transmission system. Modelling and genomic evidence confirms bidirectional transmission of ***Mycobacterium bovis*** between them. However, to enable eradication of bTB in cattle within an area, the infection needs to be controlled in **all** *M. bovis* reservoir hosts connected to that area. Badger intervention is therefore an essential component of any bTB eradication strategy.

[31] See DAERA website for more information: TB Herd Statuses & TB Testing Requirements | Department of Agriculture, Environment and Rural Affairs

Cattle controls are equally critical
- There is a need for enhanced cattle bTB control measures alongside any badger intervention in an area. Cattle-to-cattle transmission appears to be a primary driver of cattle infections. Without strengthened parallel cattle measures, wildlife interventions alone are unlikely to achieve eradication.

[The strengthening of cattle measures, and new "people" (education) measures, are being taken forward under the evolution of the wider bTB programme. This paper focuses only on badger intervention.]

- Future policy must be multi-faceted
There is no one-size-fits-all solution. Effective bTB control in the Programme will require coordinated action across cattle and wildlife, tailored to local areas and conditions. Decision-making should be evidence-based, ethically sound, and flexible enough to integrate new tools and technologies.

[This paper considers only badger intervention. No specific area for intervention has been identified at this stage. It is likely that the size of any area selected will be >100km^2, however, for costing purposes a standard area of 100km^2 is assumed. This allows costs to be factored up later when actual areas are selected. Also, as part of the evolution of the wider bTB programme, enhanced cattle measures and people measures will be considered, including their applicability to specific areas later selected for badger intervention. This paper focuses only on assessing options for badger intervention].

- Biosecurity measures such as fencing off badger setts and latrines may make a significant contribution to reducing the risk of cattle infection by badgers.

[This is a consideration for the development of the wider bTB programme. This paper focuses only on badger intervention].

Vaccination is the long-term goal
The natural science evidence base is consistent with BCG vaccination reducing the susceptibility of badgers to *M. bovis* infection. England and ROI both commenced their badger interventions with culling approaches. Having pursued these approaches for several years, there is a stated desire in the UK and Ireland to pivot to badger vaccination, should disease surveillance support such a move. Various large- and small-scale BCG vaccination studies have been, and continue to be, undertaken in the UK and Ireland. Many of these studies report on vaccination logistics, rather than the field efficacy of BCG vaccination in badgers, and more importantly, the effect of badger BCG vaccination on bTB levels in cattle.

To inform this pivot, the ROI (which has been carrying out reactive culling of badgers around breakdown herds from the early to mid-2000s) undertook a well-controlled and powered "non-inferiority" trial. In this specific context (i.e.

where much of the landscape had already been subjected to reactive badger culling for several years), it showed that badger BCG vaccination was not inferior to (i.e. no worse than) targeted badger culling in most, but not all, trial areas. This informed a move to replace reactive badger culling with badger BCG vaccination in a >20,000km^2 area in Ireland (although limited culling is retained as an option in hotspot areas)[32].

Badger vaccination, as an initial intervention, is slow to act and less effective in areas with high infection prevalence unless preceded by a reduction in infection pressure (e.g. via culling or selective removal). Using the 'vaccination only' option would require many years of implementation and high coverage to achieve the same result as other options that include a lethal component. In this context vaccination is perhaps more suitable for deployment as an exit strategy from intervention with a removal component.

Proactive (non-selective) Culling to reduce infection pressure

The majority of previous studies have reported beneficial effects of culling strategies in terms of bTB prevalence in both badger populations and cattle herds. The largest study was the Randomised Badger Control Trial. While there continues to be disparity of analytical/statistical opinions on the outputs relating to the RBCT, new evidence suggests that the (proactive culling) Badger Control Policy (BCP) implemented in areas of England appears to have been effective in decreasing cattle bTB levels. However, the BCP included aspects over, and above direct badger intervention and additional, bTB cattle control measures have also been contemporaneously introduced within the high-risk area of England. Indeed, for any badger intervention to succeed in the longer term, bTB control measures in cattle also need to be effective in reducing or preventing bTB re-introduction to the area as well as limiting re-infections of the badger population (through badger movement or cattle-badger transmission).

Proactive culling is indiscriminate, removing both infected and uninfected badgers.

The potential effect of a proactive culling strategy on badger behaviour, such as increased ranging distance, also needs to be considered.

[This is called the perturbation effect. It was an effect found in England's Randomised Badger Control Trial (RBCT). This effect was not found in ROI's Four Area Trial. However, the areas chosen for badger intervention in the Four Area Trial were larger than those chosen in England, and made use of hard boundaries, such as major roads, rivers, etc. as far as possible. The perturbation effect in a NI context is unknown. Any risk may be reduced by application of design principles that are similar to those used in the ROI's

[32] DAERA (2025) Scientific opinion on the peer reviewed evidence on badger intervention in relation the control of bovine tuberculosis. Internal analysis. It is appended to the 2026 "Bovine Tuberculosis (bTB) Consultation on Potential Wildlife Intervention Options as part of the Bovine Tuberculosis in Northern Ireland: Blueprint for Eradication".

Four Area Trial. This is considered further in the sensitivity analysis of this options analysis paper.]

Reactive Culling to reduce infection pressure
Trials into reactive, localised culling (i.e. on land around breakdown herds) have shown significant negative effects, not on the land on which culling took place, but on adjoining lands and farms.

[This option is included in the extensive list of options in this paper but, for the reason above, it is not shortlisted for further analysis].

Selective culling via the Test and Vaccinate or Remove (TVR) approach to remove infection pressure.
This involves trapping badgers, rendering them unconscious with the application of anesthetic, drawing blood from the jugular vein, using the blood in a field-deployable bTB diagnostic test which determines if the badger is likely to have bTB. The diagnostic test used in the Banbridge Pilot was the Dual Path Platform test (DPP test) which has a median sensitivity of 69%, i.e. it will correctly identify approximately 69 out of every 100 infected badgers, while missing about 31 out of 100 infected animals (a false-negative rate of 31%). This test has median specificity of 98% using whole blood[33]. This means that 98 out of every 100 badgers without the disease will correctly test negative. 2 out of 100 will have an incorrect positive result (i.e. the test has a low probability of false positives). Where the test result is negative, the badger is vaccinated and released once it is revived. Where the test result is positive, the badger is removed via injection of an euthanising drug. A pilot of this approach in one area of Northern Ireland showed that this approach is feasible. The study showed that bTB prevalence in the badger population reduced over the period of the study. It found no signs of a perturbation effect with this approach (i.e. no increased badger ranging behaviours). It also left a legacy of a vaccinated badger population. However, these positives need to be considered along with the design deficiencies of lack of replicate and control areas, and also that the cattle herd bTB incidence did not reduce over the period studied. The results suggest that the main driver in the study area was cattle to cattle transmission, highlighting a need for enhanced cattle bTB control measures alongside an area-based badger intervention.

As this was only completed in one area of NI, the extrapolation of its results is limited. France is undertaking a similar pilot badger TVR intervention over a four-year period which started at the beginning of 2023 in a zone in the southwest with a serious TB problem to reinforce bTB control in wildlife[34].

[33] Arnold, M.E., Courcier, E.A., Stringer, L.A., McCormick, C.M., Pascual-Linaza, A.V., Collins, S.F., Trimble, N.A., Ford, T., Thompson, S., Corbett, D., Menzies, F.D. (2021). A Bayesian analysis of a Test and Vaccinate or Remove study to control bovine tuberculosis in badgers (Meles meles). PLoS One 16(1):e0246141. doi: 10.1371/journal.pone.0246141. PMID: 33508004; PMCID: PMC7842978

[34] Boschiroli ML. Animal tuberculosis control in a disease-free country, France: does the long and winding road really lead to eradication? Ir. Vet. J. 2023 Sep 26;76 (Suppl. 1):25. doi: 10.1186/s13620-023-00258-5. PMID: 37752587; PMCID: PMC10521394.

[From 2017, Wales deployed a localised selective culling programme (TVR) approach on a small number of chronically infected farms. This was phased out in 2021 and ended in 2024[35]. From around 2013, Wales has opened grant windows to allow farmers that are interested in taking an additional action to protect against TB on their holding to apply for a 50% badger vaccination grant[36].]

Hybrid strategy

The CVO Review says that if a decision is made not to cull, and should non-lethal interventions prove less effective (as the evidence would point to[37,38]), then progress towards eliminating the disease will be slower and complete elimination may be difficult. A potential novel wildlife intervention scenario worth giving consideration to is a hybrid approach where intervention commences with TVR, and the data obtained would enable the possibility of applying an adaptive management approach, which may vary across different sub-areas of the intervention area. For example, in some sub-areas, proactive culling or continuation of a TVR approach may be considered the best option due to the relatively high density of DPP test-positive badgers, while in other sub-areas it may be considered that vaccination should be employed.

[This was included in the long list of options in these analyses. However, this option was not shortlisted at this stage as it would be a novel approach, and its design would be complex and would require significant further exploratory work. However, if further work meant that a mixed option does become feasible at a later date, the information in this document provides the cost 'building blocks' that could be used to inform its analysis.]

Scientific Opinion Summary

- Based on the peer reviewed scientific evidence, all options, i.e. vaccination, proactive culling, and Test and Vaccinate or Remove (TVR), are considered scientifically viable options. Scientific viability should be assessed in parallel with ethical and welfare considerations. However, using the 'vaccination only' option would require many years of implementation and high coverage to achieve the same result as the other options that include a lethal component. In this context vaccination is perhaps more suitable for deployment as an exit strategy from intervention with a removal component[39].

[35] https://www.gov.wales/sites/default/files/publications/2022-07/bovine-tb-badger-trapping-and-testing-chronic-tb-breakdown-farms-2021.pdf
[36] gen-ld15228-e.pdf
[37] Smith, G. C., Delahay, R. J., McDonald, R. A., Budgey R. (2016). Model of selective and non selective management of badgers (Meles meles) to control bovine tuberculosis in badgers and cattle. PLoS ONE 11(11). DOI: 10.1371/journal.pone.0167206.
[38] Smith, G.C., Budgey, R. (2021). Simulating the next steps in badger control for bovine tuberculosis in England. PLoS One 16(3):e0248426. doi: 10.1371/journal.pone.0248426
[39] (DAERA 2025) scientific opinion on the peer reviewed evidence on badger intervention in relation the control of bovine tuberculosis. Internal analysis. Appended to the 2026 "Bovine Tuberculosis (bTB) Consultation on Potential Wildlife Intervention Options as part of the Bovine Tuberculosis in Northern Ireland: Blueprint for Eradication".

Welfare / ethical concerns

- All badger interventions require live capture or free shooting. Actual physical injuries seem to be minor in most of badgers captured by cages or stopped restraints. Published papers recorded that 16%[40] of badgers caught in restraints exhibited more than minor injuries compared with 3%[41] trapped in cages. Free shooting may carry a higher risk of suffering and is less reliable.

[The non-monetary analysis presents estimates of the number of premature cattle slaughters that modelling suggests may be saved under each option, as well as estimates of the number of badgers removed under each option, and the percentage of badgers removed that might otherwise be healthy; and potential injury information].

1.9 Badger intervention in England, Wales and Republic of Ireland

England

1.9.1 England's bTB problem is concentrated mainly in the South-West counties, referred to as the High-Risk Area (HRA). Adjacent to this is the Edge Area, which serves as a transitional zone between the HRA and the Low-Risk Area (LRA). The remainder of the country is classified as LRA.

1.9.2 England launched a pilot badger cull in 2013, followed by a wider rollout from 2015 across substantial parts of the HRA in the southwest and west of England. By 2019, 57% of the HRA was covered by licensed badger culling delivered by not-for-profit cull companies operating across continuous areas of at least 100 km².

1.9.3 The primary culling method involved night-time controlled shooting of free-roaming badgers, supplemented by cage-trapping and shooting where local geography, season, weather, cropping patterns, safety considerations, or levels of protestor activity made this more suitable. Licences were usually

[40] Monitoring trap-related injury status during large-scale wildlife management programmes: an adaptive management approach. AW Byrne. Springer-Verlag. Published online: 8 April 2015.
[41] Menzies, et al. (2021). Test and vaccinate or remove: Methodology and preliminary results from a badger intervention research project - Menzies - 2021 - Veterinary Record - Wiley Online Library

issued for four years, with the potential for extension. Generally, industry funded culling deployment, while government covered licensing and policing costs.

1.9.4 Where necessary, small-scale badger culling was authorised for areas around specific herd breakdowns in low-risk counties where the badger was deemed to play a role. The first licence was issued in Cumbria in 2018. Some badger vaccination was also conducted in the 'edge' area (i.e. areas adjacent to HRAs) with a view to reducing bTB spread from the HRA to the LRA. This was conducted via cage trapping.

1.9.5 On 30 August 2024, the UK Government announced the start of work on a new data-driven bTB Eradication Strategy for England, committing to end badger culling by the end of the parliamentary term. For intervention in new areas, DEFRA has moved to a vaccination only policy, with no new cull licences issued. Existing culling licences may be cut short after two years when supported by scientific evidence, and renewals will not be permitted. Work is also accelerating on the development of a cattle vaccine.

1.9.6 English legislation permits vaccination by "lay" (i.e. non-veterinary) vaccinators. As badgers are a protected species, a licence is required to capture them in cage traps before they are vaccinated, and a licence is also needed to temporarily mark a badger to show it has been vaccinated. These licences are issued by Defra and Natural England. Lay vaccinators must have permission from the landowner to access land for badger trapping and must provide proof of relevant training when they register for a licence to set cage-traps and/or mark badgers. A total of 4,110 badgers were vaccinated in 2024, of which 2,289 were vaccinated by APHA[42].

1.9.7 Under a DEFRA tender issued in September 2025, it is seeking one or more organisations to deliver and co-ordinate badger vaccination across parts of England's High-Risk and Edge Areas most affected by bTB (i.e. National Co-

[42] Summary of badger vaccination in 2024 - GOV.UK

ordinator and Delivery Lead for a Badger Vaccination Field Force[43]). The successful contractor will recruit and manage local delivery partners, oversee training, ensure quality control and provide detailed reporting to DEFRA. In contrast to farmer-led culls, the initial vaccination in England's target areas will be fully funded by government[44].

1.9.8 The new strategy also includes a national badger population survey[45]. There have been national badger surveys in England and Wales on three occasions[46] – the first in the 1980s, then 1990s and most recently between 2011-2013. As it has been over 12 years since the last surveys finished, DEFRA is carrying out an updated count, which commenced in 2024. This will also provide an estimate of the badger population following the culls in the south / southwest of England.

1.9.9 As part of the Strategy Refresh process, thematic working groups reported to an overarching programme team. The resulting strategy sets out a plan to achieve OTF status in England by 2038. As regards badger intervention, the proposals set out a transition from widespread badger culling towards targeted badger vaccination, with more than 4,000 badgers vaccinated in 2025 and further expansion planned alongside enhanced wildlife surveillance. The strategy does not rule out the future use of lethal badger control, but proposes a framework to guide decisions on when it may be used as a disease management tool[47].

Wales

[43] National Co-ordinator & Delivery Lead for a Badger Vaccination Field Force (BVFF) - Find a Tender
[44] Farmers Weekly 27/11/25: Bovine TB: Badger vaccination faces its defining test - Farmers Weekly
[45] Government to end badger cull with new TB eradication strategy - GOV.UK
[46] 1980s: Cresswell et al., 1989 (badger (Meles meles) in Britain: present status and future population changes | Biological Journal of the Linnean Society | Oxford Academic); 1990s: Wilson et al., 1997 (changes in the british badger population 1988to1997.pdf); and 2011-2013: Judge et al, 2014; 2017 (Abundance of badgers (Meles meles) in England and Wales | Scientific Reports).
[47] Bovine TB control strategy for England. As recommended by the Steering Group of the Bovine TB Partnership for England. 2026-Recommended-Bovine-TB-Strategy.pdf

1.9.10 From 2017, Wales deployed a localised selective culling programme (TVR) approach on a small number of chronically infected farms. This was phased out in 2021 and ended in 2024[48].

1.9.11 The Wales bTB Eradication Programme Delivery Plan 2023–2028 maintains the policy commitment to prohibit badger culling for bTB control. The Welsh Government is pursuing a badger vaccination approach, supported by biosecurity measures aimed at preventing badger access to buildings, feed, water sources, and reducing cattle exposure to badger latrines and setts.

1.9.12 The Welsh Government[49] says that independent evidence reviews by the Chief Scientific Adviser concluded that vaccinating badgers should help reduce the number of bTB breakdowns in cattle herds. From around 2013, Wales has opened grant windows to allow farmers that are interested in taking an additional action to protect against bTB on their holding to apply for a 50% Badger Vaccination Grant[50]. An election for the Senedd was held on 7 May 2026, resulting in the formation of a new government. It therefore remains unclear whether there will be any change in policy direction or in how bovine TB control measures will be delivered in the future.

Republic of Ireland

1.9.13 The Republic of Ireland historically operated a reactive[51] non-selective culling programme using stopped restraints to capture badgers, which were subsequently shot. Operations were delivered by a private contractor (Farm Relief Services) under supervision from DAFM as part of its bTB eradication programme.

1.9.14 Stopped restraints are anchored wire loops with a fixed minimum circumference to prevent over-tightening. They allow movement via a swivel joint and are secured to the ground with a bar.

[48] https://www.gov.wales/sites/default/files/publications/2022-07/bovine-tb-badger-trapping-and-testing-chronic-tb-breakdown-farms-2021.pdf
[49] Welsh Government (2023): Wales TB Eradication Programme Delivery Plan. Covers the period 2023-28
[50] Written Response by the Welsh Government to the report by the Economy, Trade and Rural Affairs Committee entitled Refreshing Wales' Bovine TB Eradication Programme. gen-ld15228-e.pdf
[51] Where badgers are culled only in the area around farms with a confirmed herd breakdown.

1.9.15 Since around 2002 / 2004, and following field trial evidence that badger removal provides an effective method to minimise badger to cattle transmission[52], the ROI's policy was to reduce badger densities from pre-cull levels of 2-3 badgers per km² normally found in grazed areas to 0.5 badgers/ km², and to maintain them at that level. Culling is licensed by the National Parks and Wildlife Service and is focused on farms with bTB breakdowns attributed to infected badgers. Main setts within 1.5 km and secondary setts within 2 km of an affected farm are included.

1.9.16 A 2014–2017 field trial across six counties showed that vaccinating and releasing badgers can effectively replace long-term culling, but only after targeted culling has first reduced badger density and bTB prevalence in the endemic area[53]. Routine BCG vaccination of badgers was introduced in 2018, initially in former vaccination research areas, with gradual expansion to new regions.

1.9.17 The 2019 Programme for Government committed to nationwide expansion of badger vaccination and to ending culling as soon as consistent with scientific and veterinary evidence. By 2021, over 20,000 km² was designated for badger vaccination. Previously culled areas have transitioned to vaccination as the default, with culling retained only for specific epidemiological reasons. The removal of badgers from areas with severe cattle TB outbreaks which are epidemiologically linked to badgers will continue where necessary to reduce the risk of TB to cattle and the level of TB in the badger population[54].

1.9.18 There is a mix of public and private sector funding for the ROI's bTB programme. DAFM collects around €8m annually in statutory animal disease levies, however these funds are not ring-fenced for wildlife intervention. The

[52] Olea-Popelka, F.J., Fitzgerald, P., White, P., McGrath, G., Collins, J.D., O'Keeffe, J., Kelton, D.F., Berke, O., More, S., and Martin, S.W. (2009), "Targeted badger removal and the subsequent risk of bovine tuberculosis in cattle herds in county Laois, Ireland.", Preventive Veterinary Medicine, 88(3), 178-184.
https://www.sciencedirect.com/science/article/pii/S0167587708001967
[53] https://www.gov.ie/en/department-of-agriculture-food-and-the-marine/publications/wildlife-and-tb/
[54] Wildlife and TB

wildlife intervention element is funded by DAFM and delivered by a private contractor under veterinary oversight.

1.10 Focus of analysis

1.10.1 There are two decisions relating to badger intervention:

(i) **Decision due now:** what should the initial intervention be? and

(ii) **Decision due later:** If /how should that initial intervention be followed up?

1.10.2 Both England and the ROI have undertaken badger culling at scale for several years in areas where cattle bTB is relatively high[55]. Both countries are now at the stage of considering their post cull follow-up strategy. However, as NI has not had any badger intervention deployed to date[56], the focus of the analysis in this report is on what the **initial** badger intervention should be in cattle bTB hotspots in NI. Later, consideration will be given to what, if any, intervention should follow. At that stage, any evidence emanating from England's and/or the ROI's follow up strategies will be considered, and further analyses undertaken, as appropriate.

[55] ROI – 2000-2002: limited culling in response to bTB herd breakdown; since 2004 the national strategy in the ROI's BTB Control Programme has included the targeted-culling of badgers from defined land areas around large (>2 standard interpretation SICTT reactors detected during the BTB episode) cattle-herd breakdowns of BTB (O'Keeffe, J.J. (2006) T3-5.4.3 – Description of a medium term national strategy toward eradication of tuberculosis in cattle. International Symposia on Veterinary Epidemiology and Economics Proceedings, Volume ISVEE 11. Publications » SciQuest). Intervention in the 'High Risk Area' of England – Industry-led culling began in Somerset and Gloucestershire between August and November 2013. A further area was licensed in Dorset in 2015, and seven new areas were licensed in 2016. Between 2013 and the present day, 72 areas of England have held a license for an intensive cull.

[56] Except for badger related research.

2. Strategic Case: Strategic Fit

2.1 Strategic fit of a potential badger intervention

2.1.1 The proposed project has a strong strategic fit with multiple DAERA reports / strategies (see appendix 2 for details).

2.2 Legislative cover for a badger intervention

2.2.1 There is currently no primary or secondary legislation in operation which explicitly provides for badger intervention in NI to address bTB disease levels and spread, whether that intervention is lay vaccination, or some form of badger removal.

2.2.2 The existing legislative options under which an intervention could be taken forward include powers under the Diseases of Animals (NI) Order 1981 and the potential use of licenses issued under the Wildlife (NI) Order 1985.

2.2.3 Following the DAERA Minister's future decision(s) on the option(s) to be implemented, steps will be taken to put in place the required legislative cover. This will require a Ministerial decision on whether to proceed with, for example, using an Article 13 Order by way of secondary legislation under the Disease of Animals Order 1981, or secondary legislation under the Wildlife (NI) Order 1985, or alternatively, begin the primary legislation process.

2.3 Windsor Framework

2.3.1 The Windsor Framework (Implementation) Regulations 2024 came into force on 12 April 2024, conferring powers upon the Secretary of State in relation to Articles 5, 6, 7 and Annex 2 of the Windsor Framework. However, effective from 17 May 2024, the Defra Secretary of State exercised his discretion to **not** retain direction and control over functions concerned with disease awareness, disease preparedness and disease control in respect of both animal and plant health[57]. Therefore, policy for dealing with bovine TB is devolved in the UK. The

[57] A list of legislation under the direction and control of the Secretary of State can be found in Annex B of The Windsor Framework (Implementation) Regulations 2024 DAERA Guidance document.

incidence of bTB in cattle and wildlife varies across the UK, and as such the control of bovine TB is approached differently among the devolved administrations.

2.4 State Aid

2.4.1 No state aid implications have been identified at this stage. However, this will be revisited when a preferred option is selected by the Minister, and the details of its delivery become clear.

2.5 Environmental and Climate Screening

2.5.1 The screening template is included in Appendix 3. Should it be decided to commence a badger intervention, it would impact a wildlife species, and this is an impact which is included in the screening category “wildlife, wild vegetation and / or soil quality”. This impact is considered “notable”, and the environmental and climate related impacts are considered further in the non-monetary factor analysis chapter.

3. Strategic Case: Objectives

3.1 Badger intervention objectives

3.1.1 There is currently no intervention in place in NI to address the role of the badger in the spread and persistence of bTB infection in cattle herds. In complex disease systems such as M. bovis infection in animal populations, experts have concluded that eradication will only be possible if **all** factors contributing to its spread and persistence are addressed[58,59,60].

3.1.2 Therefore, the immediate objective is to **introduce an intervention to address the reservoir of the disease in the badger population in bTB hotspot areas of NI. The timeline for this objective will depend on the option chosen and legislative path.**

3.1.3 By adding badger intervention into a package of cattle and people measures, the TB Partnership Steering Group, in partnership with DAERA, has set an objective to turnaround the current trend of increasing herd incidence levels in NI from the current level (~9-10%) to a level that is 2% lower by 2030. It is anticipated that this will place NI on a pathway to potentially halve current bTB levels by 2040.

3.2 bTB Programme's long-term objective

3.2.1 Badger intervention sits within the overarching bTB programme which pursues the longer-term objective of achieving Officially bTB-Free status[61] for Northern Ireland.

3.2.2 It is difficult to forecast when this might be achieved. The TB Strategic Partnership Group (TBSPG) in 2016 considered this issue in depth and

[58] DAERA (2024), "CVO Review of Bovine Tuberculosis in Northern Ireland". Review undertaken by DAERA's Chief Veterinary Officer. https://www.daera-ni.gov.uk/publications/chief-veterinary-officer-review-bovine-tuberculosis-northern-ireland-november-2024

[59] DAERA (2025), "Bovine Tuberculosis in Northern Ireland – Blueprint for Eradication". Report of the TB Partnership Steering Group. TB Partnership Steering Group - Bovine TB in Northern Ireland: Blueprint for Eradication | Department of Agriculture, Environment and Rural Affairs

[60] TB Strategic Partnership Group (2016), "Bovine Tuberculosis Eradication Strategy for Northern Ireland. An Integrated Eradication Programme". TBSPG Bovine TB Eradication Strategy NI | Department of Agriculture, Environment and Rural Affairs

[61] Requires herd incidence rate to be ≤0.1% for 6 years as per the EU definition.

concluded that **if** the NI bTB programme was adapted to simultaneously address all the factors that meaningfully contribute to the persistence and spread of the disease in all infected animal populations, then NI could hope to achieve eradication within the next 3-4 decades from programme commencement[62]. When this was reviewed by the TB Partnership Steering Group[63] (TBPSG) in 2025, it took the more optimistic view that eradication might be potentially possible by 2050, i.e. 2.5 decades from a significant programme update to ensure it is stronger on cattle measures, people aspects (behaviours) and also addresses the wildlife aspect.

3.3 Evolving approach to badger intervention

3.3.1 Any badger intervention will need close monitoring and regular reviews as it progresses. As the monitoring data becomes available, and in light of emerging scientific evidence, the approach is likely to evolve over time (as has been the case in England and the ROI where both are considering transitioning from badger culling to vaccination).

3.3.2 For this reason, it is important to understand that the current analysis considers the *immediate* wildlife intervention requirement to contribute to 'turning around' the persistent increasing disease trend exhibited over recent years. However, the case for evolutions / enhancements will be considered at regular intervals where they are considered capable of driving momentum to further reduce herd incidence.

3.4 Stakeholder engagement

3.4.1 Stakeholder engagement on this proposed new element of the bTB programme is important. Stakeholders will be given the opportunity to, not only consider the factors feeding into the department's decision-making, but also to present other evidence for DAERA's consideration as part of a public consultation process.

[62] https://www.daera-ni.gov.uk/publications/tbspg-bovine-tb-eradication-strategy-ni 2016 (Page 62)
[63] TB Partnership Steering Group - Bovine TB in Northern Ireland: Blueprint for Eradication | Department of Agriculture, Environment and Rural Affairs

3.5 Constraints and Dependencies

3.5.1 Table 2 outlines the main constraints and dependencies that impact upon the delivery of a badger intervention project.

Table 2: Constraints and dependencies

Dependencies	Constraints
Legislative amendments – As previously discussed, steps need to be taken to secure legislative cover for any wildlife intervention. Additionally, where appropriate, the Department must be willing to, and be capable of, progressing any new or amended NI legislation to close gaps in, or barriers to, delivery of the chosen intervention, thus ensuring delivery of this project's objectives.	**Legislative stipulations** – The wording / remit of the legislative cover secured may constrain the design of the intervention. **This will be kept under close review.**
Feasibility – the intervention must be practically deliverable/feasible.	**Feasibility** – the design of the intervention may be constrained by the availability and capability of labour for deployment and monitoring, particularly veterinary and other skilled labour.
Risk management – the project's success is dependent upon robust risk management.	**Risk management capability** – the intervention must be within the acceptable risk appetite of the Department.
Value for money - Any solution must be justifiable in terms of value for money.	**Resources / funding** – The project must be deliverable within the available resource and funding position. Securing additional resources may be difficult in the current budgetary environment amid many competing priorities across the Programme for Government. If additional resources are required, they must be sourced in line with Departmental policies and procedures.
Impact assessments – a Strategic Environmental Assessment and a Habitat Impact Assessment have been completed. In addition, if and when a preferred option is selected, it will be subject to Equality, Rural and	The impact assessments may highlight mitigations which might impact the final design of the intervention. **This will be kept under close review.**

Regulatory Impact Assessments. Consultation will be carried out.	
Training – Protocols for the delivery of any intervention will need to be drawn up, and implementing and monitoring personnel trained in relation to the protocol standards set.	**Labour skills** – depending on the preferred option, the department may adopt a "train the trainer" approach to deployment skill development. However, it may not have labour with the necessary skills to deliver the required training. If and where this is the case, it will need to explore contracting in the expertise from elsewhere.
ICT / Systems – Complementary technology and monitoring systems will need to be developed.	**ICT personnel availability** – The department will consider all options available to secure the necessary ICT and technology resources / systems required. Currently, it is envisaged that a system developed for a pilot research project which includes badger intervention will be transferred to this project.
Dept. of Finance (DoF) Procurement Assistance – It is likely that procurement advice will be required for this project. However, the extent of CPD involvement will depend on the nature of the option chosen. For instance, a public sector deployed option would require procurements for equipment; a government-led but privately deployed option would require procurement of service providers; a farmer-led and deployed option would have a lower procurement requirement. DAERA will ensure that there is early engagement with DoF's Central Procurement Division in relation to this.	

4. Economic Case: Options

4.1 Option analysis

4.1.1 A few issues (and related options) need to be considered. For instance:

a) **What** initial badger intervention option should be commenced in cattle bTB hotspot areas of NI? (e.g. a proactive non-selective cull; a proactive selective cull via a test and vaccinate or remove approach; or a proactive vaccination approach). Also, **how** should it be deployed? (e.g. by the public sector or by the private sector; catching badgers with cages or restraints, or using controlled shooting of free roaming badgers);

b) Given the preferred nature of the initial option to be commenced, and if there is private sector involvement, then how should the intervention be **managed**? (e.g. as a direct service procurement by the public sector as is the case in the ROI; by the private sector under the terms of a licence provided by the public sector, as is the case in England; etc.); and

c) Given the above, how should it be **funded**? (e.g. fully by the public sector; fully by the private sector; or a public and private funding approach).

4.1.2 The issue currently under consideration is **a)**, i.e. **the nature and deployment approach for the initial badger intervention.** Later, when DAERA becomes clearer on the nature of the preferred implementation option, it will consider in more detail b) how implementation should be managed; and c) how implementation should be funded.

4.2 Long list of options

4.2.1 Two badger control options mentioned in the scientific literature are deemed **unfeasible** and are not considered further at this stage: (i) gassing of badgers and (ii) the use of an immune-contraceptive vaccine. In regard to (i), gassing is not a feasible badger control option on welfare grounds. Badger setts often include a system of complex underground tunnels, and it is not feasible to calculate / administer the correct amount of gas for an effective and rapid cull. In regard to (ii), some preliminary studies have indicated the possibility of use of an immune-contraceptive vaccine for use in badgers which suppresses

fertility in both sexes. However, not all of these studies have been peer reviewed to date, and further work is required. If further work proves it to be effective and deliverable, then the administration of this contraceptive vaccine may become a feasible option in the longer term. This will be kept under review.

4.2.2 The long list of options currently considered feasible for an initial intervention in cattle bTB hotspot areas of NI are outlined in Table 3. As explained in that table, a reactive badger intervention, which involves carrying out an intervention in a small, localised area around breakdown farms, is **not** carried forward for further consideration as an English research project[64] found this approach to have significant negative effects on cattle herd breakdowns on neighbouring farms.

4.2.3 Therefore, the approaches carried forward are all "proactive", in other words they relate to carrying out an intervention over a large area (see para. 5.1.3). In terms of approach, the options are a **non-selective cull**, a **selective cull** via deploying a Test and Vaccinate or Remove (TVR) intervention[65], or **vaccination** (which has no badger removal).

4.2.4 In terms of the practicalities of deployment, all approaches (except for controlled shooting, as set out in paragraph 1.9.3) first **capture the badger**, and then apply the cull, TVR or vaccination treatment to the captured badger.

4.2.5 Two methods of badger capture are considered: (i) Cage trapping. NI used this capture method for its TVR feasibility pilot project and has detailed information on the effort and resources required for cage trapping; and (ii) Restraint trapping. The ROI deploys stopped restraints for its badger culling approach, and more recently in the areas chosen for post-cull badger vaccination.

4.2.6 The non-selective cull approach can also be deployed without routine badger capture using a "Controlled Shooting" approach. This was the predominant approach deployed to cull badgers in England. It was led by farmer-controlled

[64] England's Randomised Badger Control Trial (RBCT)
[65] Test Vaccinate or Remove (TVR) involves selective culling over large areas. Trapped badgers are anesthetised by a veterinarian, blood drawn from the jugular vein, this blood is tested for bTB using a sett-side test, and if the result is positive for bTB, the badger is euthanised. If the result is negative, the badger is microchipped, vaccinated, and when revived, it is released.

companies operating under licence conditions and involves trained marksmen shooting badgers while they roam fields during late evening / night. While it was predominantly a controlled shoot approach, some badgers were removed by cage trap and shoot, particularly in areas where the terrain was not suited for controlled shooting.

4.2.7 In theory, all options could be undertaken by either the public sector or the private sector. Note, however, that public sector deployment costs are only available for cage-based deployment options where DAERA knows in detail the effort and resources required to deploy cages from its experience with the TVR feasibility study. No other country has a dedicated cage trap approach for badger intervention, so there are no private sector deployment cost figures available from elsewhere to inform private sector cage trapping cost estimates. Rather, DAERA calculated what it would cost for public sector staff to deploy cage trapping and then made some adjustments to the costs to derive an estimate for private sector deployment of cage trap options.

4.2.8 DAERA does **not** have **public** sector delivery costs for restraint trap or predominant controlled shoot options as these approaches are deployed in the ROI and England with **private** sector delivery. DAERA has high level **private** sector delivery costs for these options, and it is possible to extrapolate this high-level information to derive an estimate of what it might cost for **private** sector deployment of a restraint trap or controlled shooting cull, and for restraint-trap TVR or vaccination approach in NI. But, as we do not have detailed effort requirements and related detailed costs, we do not know how much of the high-level private sector cost relates to labour, or to equipment, etc. As such**, it is not possible to estimate how much it might cost the public sector to carry out badger deployment options using restraints or controlled shooting.**

4.2.9 However, **it seems reasonable to assume that public sector deployment would cost more than private sector deployment**. Public sector delivery is likely to be both more expensive and suboptimal compared to private sector delivery due to these factors:

- Statistics[66] show that, in general, public-sector wages tend to be higher than private sector wages;
- A large organisation like the NI Civil Service has a high level of overheads. This adds a large overhead "uplift" to public sector wage rates when deriving staff "full" costs. This public sector overhead uplift is likely to be higher than that charged by private sector companies interested in undertaking badger deployment;
- The contracts for public sector staff tend to suit "normal" 9-5 working patterns. Wage uplifts are applied for overtime/out of hours work. Private sector employment contracts tend to be more flexible and better able to factor in "out of hours" working requirements that align with badger intervention deployment tasks; and
- Most badger deployment tasks are required to be conducted within the "open season" for badger intervention. The "open season" in Northern Ireland is currently set at 1st July to 30 November. Therefore, in this context, the labour requirement increases significantly during the open season but is not required for the remainder of the year. Public sector employment contracts tend to be less flexible than those available in the private sector and are not ideal for short-term seasonal work.

4.2.10 Table 3 explains if each option is carried forward to the costing stage, and if not, the reason why generating a robust estimate of the cost of the option is not currently possible.

[66] NISRA: Annual Survey of Hours and Earnings, Annual Survey of Hours and Earnings | Northern Ireland Statistics and Research Agency (ASHE)

Table 3: Long list of Potential Initial Badger Intervention Options

Bager Removal Intervention	Public sector deployment	Private sector deployment
Reactive Cull Options		
Reactive Cull - This is where non-selective culling (or selective culling via TVR) is undertaken locally around farms with bTB breakdown issues (i.e. small distinct areas; not across a large area which is the nature of a proactive cull below).	This option (no matter how deployed) is not carried forward for further consideration because, as outlined in the DAERA (2025) Scientific Opinion Paper[67], trials into reactive culling showed **significant negative effects for neighbouring farms**. In contrast, this paper says that for a proactive culling approach, "the majority of previous studies have reported beneficial effects of culling strategies in terms of bTB prevalence in both badger populations and cattle herds." As such, the reactive culling option will be discarded, and only proactive (i.e. large scale) interventions will be considered.	
Proactive Cull Options		
Proactive Non-Selective Cull using Cage Traps – i.e. involves culling over large areas. Bait is inserted into cages for a period, and then the cages are primed to close if triggered for a number of nights. Trapped badgers are dispatched by shooting.	This can be costed using DAERA's experience of cage trapping in the TVR Pilot, adjusted from a TVR to a Cull approach => C/F to costing stage.	No information is available on the cost of private sector delivery of a full cage trap option (as the ROI uses restraint trapping for their cull, and England's cull approach is predominantly controlled shoot). However, as DAERA has experience of the labour required for cage trapping, which is the bulk of the cost, it can make an estimate of private sector costs by holding the effort required constant and adjusting the labour cost per hour[68]. => C/F to costing stage.

[67] DAERA 2025) scientific opinion on the peer reviewed evidence on badger intervention in relation the control of bovine tuberculosis. Internal analysis. Appended to the 2026 "Bovine Tuberculosis (bTB) Consultation on Potential Wildlife Intervention Options as part of the Bovine Tuberculosis in Northern Ireland: Blueprint for Eradication".
[68] Using data from the Annual Survey of Hours and Earnings (ASHE statistics) which helps provide an estimate of how much cheaper private sector labour might be compared to public sector labour.

Bager Removal Intervention	Public sector deployment	Private sector deployment
Proactive Non-Selective Cull using Restraint Traps – as above, but restraint traps are used instead of cages. Restraints do not need to be baited and have potential to trap badgers from the first night of deployment.	DAERA has no experience of trapping badgers using restraints. While some high level cost information of **private** sector delivery is available from the ROI, it does not provide details of the labour effort and other resources required. Therefore it is not possible to generate a public sector equivalent deployment cost (as we don't have labour effort levels to multiply by public sector wage costs). However, this is not a major issue because, as explained in para. 4.2.9, public sector deployment is likely to cost more than private sector deployment. => Not C/F to costing stage.	Secured high level private sector cost estimates from the ROI for this option. => C/F to the costing stage. NB: For any intervention, the aim is to catch as many badgers as possible. Restraints are used in the ROI, but it has a different open season from NI[69]. Restraints may or may not be effective in NI's "open" season for trapping. For instance, stopped restraints have a fixed diameter when triggered and smaller badgers can slip through. Therefore, they work best with a long open season such as that in place in the ROI. Therefore, for this analysis, it is assumed that the "open" period for badger intervention in NI could, if required, be changed to mirror the open period used by the country where the option was deployed (in this case, ROI's open period). **This may or may not be the case in reality, and therefore, this issue will need to be kept under review**.
Proactive Non-Selective Cull using Controlled Shooting (C.S.), complemented by cage trap and shoot where the terrain does not suit C.S. - This involves trained marksmen shooting badgers as they roam fields during late evening/night.	DAERA has no experience of controlled shooting. While some cost information of **private** delivery by farmer-controlled companies is available from the DEFRA website, detailed labour effort and other resource information is not available. Therefore it is not possible to generate a public sector equivalent deployment cost (as we don't have labour effort levels to multiply by public sector wage costs). However, this is not a major issue because, as explained in para. 4.2.9, public sector deployment is likely to cost more than private sector deployment. => Not C/F to costing stage.	High level cost estimates for this option are available from the DEFRA website. This analysis used the 2019 Value for Money Analysis paper as it contained information on estimated deployment costs by farmer controlled companies. Figures from that 2019 report were inflated to 2026/27 prices => C/F to the costing stage. NB: England has a different "open" period for badger intervention than that currently operated in NI. For this analysis, it is assumed that the "open" period for badger intervention in NI could, if required, be changed to mirror the open period used by the country where the option was deployed (in this case, England's open period). **This may or may not be the case in reality, and therefore, this issue will need to be kept under review**.
Selective Cull Options		

[69] See Table 1 of the Badger Intervention Analyses – Calculation Assumptions **(appendix 1)** which outlines the Open Seasons in NI, ROI and England. The "open" season for badger intervention in NI is currently 1 Jul. until 30 Nov. In the ROI, it is all year round for existing interventions and from 1 Apr. to 30 Jan. for new interventions.

Bager Removal Intervention	Public sector deployment	Private sector deployment
Proactive Selective Cull via Test and Vaccinate or Remove using **Cage Traps** – i.e. involves selective culling over large areas. Trapped badgers are anesthetised by a veterinarian, blood drawn from the jugular vein, this blood is tested for bTB using a sett-side test, and if the result is positive for bTB, the badger is euthanised. If the result is negative, the badger is microchipped, vaccinated, and when revived, it is released.	This can be costed using DAERA's experience of cage trapping in its TVR Pilot => C/F to costing stage.	No information is available on the cost of private sector delivery of this option. However, as DAERA has experience of the labour effort required for cage trapping and TVR, it can make an estimate of private sector costs by holding the effort required constant and adjusting the labour cost per hour. => C/F to costing stage.
Proactive Selective Cull via Test and Vaccinate or Remove using **Restraint Traps** – As above but using restraint traps.	DAERA has no experience of trapping badgers using restraints. While some high level cost information of **private** sector delivery is available from the ROI, it does not provide details of the labour effort and other resources required. Therefore it is not possible to generate a public sector equivalent deployment cost (as we don't have labour effort levels to multiply by public sector wage costs). However, this is not a major issue because, as explained in para. 4.2.9, public sector deployment is likely to cost more than private sector deployment. => Not C/F to costing stage.	Secured high level private sector cost estimates from the ROI for a restraint-based Cull. These costs can be adjusted to allow for TVR to be administered to trapped badgers using DAERA's experience from the TVR Pilot. => C/F to the costing stage. NB: For any intervention, the aim is to catch as many badgers as possible. Restraints are used in the ROI, but it has a different open season from NI. Restraints may or may not be effective in NI's "open" season for trapping. For instance, stopped restraints have a fixed diameter when triggered and smaller badgers can slip through. Therefore, they work best with a long open season such as that in place in the ROI. Therefore, for this analysis, it is assumed that the "open" period for badger intervention in NI could, if required, be changed to mirror the open period used by the country where the option was deployed (in this case, ROI's open period). **This may or may not be the case in reality, and therefore, this issue will need to be kept under review.**
Vaccination options		

Bager Removal Intervention	Public sector deployment	Private sector deployment
Proactive Vaccination using **Cage Traps** – Badgers are trapped, given a temporary identification mark (via shaving / spray paint) and vaccinated. If badgers are re-trapped in a later year, they are revaccinated once per year. Badgers that are re-caught in the same year (which are identified by their temporary shaving / spray paint), are not revaccinated in-year.	This can be costed using DAERA's experience of cage trapping in the TVR Pilot, adjusted using costs and processes required for a Vaccination only approach => C/F to costing stage.	No information is available on the cost of private sector delivery of this option. However, as DAERA has experience of the labour effort required for cage trapping and TVR, it can make an estimate of private sector costs by amending the effort required to reflect the Vaccination only approach and adjusting the labour cost accordingly. => C/F to costing stage.
Proactive Vaccination using **Restraint Traps**	DAERA has no experience of trapping badgers using restraints. While some high level cost information of **private** sector delivery is available from the ROI, it does not provide the detail of the labour and other effort required. Therefore, as already explained, it is not possible to reliably generate a public sector deployment cost. That said, public sector deployment is likely to cost more than private sector deployment. => Not C/F to costing stage.	Secured high level private sector cost estimates from the ROI for a restraint-based Cull. These costs can be adjusted to allow for vaccination to be administered to trapped badgers (where vaccination costs are derived from DAERA's experience from the TVR Pilot). => C/F to the costing stage. NB: For any intervention, the aim is to catch as many badgers as possible. Restraints are used in the ROI, but it has a different open season from NI. Restraints may or may not be effective in NI's "open" season for trapping. For instance, stopped restraints have a fixed diameter when triggered and smaller badgers can slip through. Therefore, they work best with a long open season such as that in place in the ROI. Therefore, for this analysis, it is assumed that the "open" period for badger intervention in NI could, if required, be changed to mirror the open period used by the country where the option was deployed (in this case, ROI's open period). **This may or may not be the case in reality, and therefore, this issue will need to be kept under review.**

NB: Where information is available, options are costed from data available in DAERA, provided by the ROI or from the DEFRA website. However, **note that it is not known if farmer-controlled companies in NI would be prepared to do approaches other than controlled shooting. Should this be the case, the cost of a farmer led approach may be lower than the estimates provided in this document.**

4.2.11 The CVO Review raised the hypothetical possibility of having an adaptive hybrid approach, i.e. mix of interventions chosen for an area[70]. However, this would be a novel approach. Its design would be complex and would require significant further exploratory work. Therefore, it is not possible to include an adaptive hybrid option in the current analyses. However, if further work results in such an option becoming feasible at a later date, the information in this document provides the cost 'building blocks' that could be used to inform its analysis.

4.2.12 The NI parameterised model created by APHA also considered a type of hybrid option (core and ring hybrid) where a non-selective cull is carried out in a central core area with vaccination carried out in a ring around this (i.e. a vaccination 'buffer' area). This was in relation to mitigating any perturbation effect risks. However, this option is not being considered further in this paper as there may not be a perturbation effect for a non-selective cull if it is designed similar to the ROI's Four Area Trial which did not find this effect. Rather, the impact of a perturbation effect for non-selective cull options is considered in the sensitivity analysis.

[70] Chief Veterinary Officer Review of Bovine Tuberculosis in Northern Ireland November 2024 | Department of Agriculture, Environment and Rural Affairs

4.3 Shortlist of options

4.3.1 Following on from the information provided in Table 3 above, the badger intervention options shortlisted for costing are:

- Option 1: Do Nothing (i.e. no badger intervention);
- Option 2: Proactive **non-selective cull**, trapping badgers using **cages**, deployed by the **public** sector (costed using DAERA's experience of its cage trap TVR pilot, adjusted for a cull);
- Option 3: Proactive **non-selective cull**, trapping badgers using **cages**, deployed by the **private** sector (costed using DAERA's knowledge of cage trapping TVR, adjusted for a cull, and using ASHE[71] statistics to estimate a potentially lower private sector wage rate);
- Option 4: Proactive **non-selective cull**, trapping badgers using **restraints**, deployed by the **private** sector (using high level cost information from the ROI on a private sector delivered restraint-based cull);
- Option 5: Proactive **non-selective cull**, with **predominant controlled shooting** of free-roaming badgers (complemented by cage trap and shoot where the terrain is not suitable for controlled shooting), deployed by the **private** sector (using high level information from the DEFRA website[72] on a predominant C.S. cull by private sector farmer-controlled companies)
- Option 6: Proactive **selective cull** using **Test and Vaccinate or Remove (TVR)**, trapping badgers using **cages**, deployed by the **public** sector (costed using DAERA's experience of its cage trap TVR pilot);
- Option 7: Proactive **selective cull** using **TVR**, trapping badgers using **cages**, deployed by the **private** sector (costed using DAERA's experience of its cage trap TVR pilot, and using ASHE statistics to estimate a potentially lower private sector wage rate);
- Option 8: Proactive **selective cull** using **TVR**, trapping badgers using **restraints**, deployed by the **private** sector (costed using high level information from the ROI on a private sector deployed restraint-based cull and adjusting it for a TVR approach);

[71] NISRA: Annual Survey of Hours and Earnings, Annual Survey of Hours and Earnings | Northern Ireland Statistics and Research Agency
[72] DEFRA's 2019 Value for Money Analysis

- Option 9: Proactive non-selective **vaccination**, trapping badgers using **cages,** deployed by the **public** sector (costed using DAERA's experience of its cage trap TVR pilot, adjusted for a vaccination only approach);
- Option 10: Proactive non-selective **vaccination**, trapping badgers using **cages,** deployed by the **private** sector (costed using DAERA's knowledge of cage trapping TVR, adjusted for a vaccination only approach, and using ASHE[73] statistics to estimate a potentially lower private sector wage rate);
- Option 11: Proactive non-selective **vaccination**, trapping badgers using **restraints**, deployed by the **private** sector (costed using high level information from the ROI on a private sector deployed restraint-based cull, adjusting it for a vaccination approach).

[73] NISRA: Annual Survey of Hours and Earnings, Annual Survey of Hours and Earnings | Northern Ireland Statistics and Research Agency

5. Economic Case: Monetary Costs/Benefits

5.1 Methodology

5.1.1 The economic analyses were conducted following these main steps:

5.1.1.1 **Step 1**: The cost of each shortlisted badger intervention option was estimated.

5.1.1.2 **Step 2**: In theory, the benefit arising from badger intervention is the value of herd breakdowns avoided over a period as a result of badger intervention. This would require an estimate of:

a) The value of a herd breakdown avoided (breakdown costs borne by both government / taxpayers and farmers), *multiplied by*;
b) The number of years over which one would expect to see a reduction in herd breakdowns as a result of badger intervention, *multiplied by*;
c) The average number of herd breakdowns avoided for each year in this period.

5.1.1.3 While it is possible to consider estimates for a) and b), the number of herd breakdowns that would be avoided in an intervention area specifically as a result of badger intervention (i.e. c)) is much less certain. In such circumstances, it is appropriate to use **breakeven analysis** to determine how many herd breakdowns would ***need*** to be avoided for the benefits of badger intervention to at least offset its cost[74].

5.1.1.4 **Step 3**: The next step was to consider the question "**Does the breakeven number of herd breakdowns avoided for each shortlisted option appear achievable**?". To consider this, the following steps were undertaken:

a) Firstly, the breakeven number of herd breakdowns avoided for each option was compared against the outputs from a NI parameterised model. It is useful to some degree in sense-checking the achievability of

[74] The use of Breakeven Analysis is aligned to DEFRA's approach. DEFRA (2005) "Cost benefit analysis of badger management as a component of bovine TB control in England". See para. 9

the number of herd breakdowns avoided that would need to be achieved to offset the cost of badger intervention;

b) Secondly, to bring real-world experience to bear, the breakeven number of herd breakdowns avoided for cull options were compared with the results from one of the large scale replicated badger cull research trials, i.e. the Four Area Trial that was conducted in the ROI.

5.1.2 A separate paper, entitled "Badger Intervention Analyses – Calculation Assumptions" (**see appendix 1**) outlines the assumptions used to estimate badger intervention costs, and the value of a herd breakdown avoided.

5.1.3 As outlined in that paper, note that:

- All badger intervention costs (and the value of a breakdown avoided in the breakeven analysis) are presented in 2026/27 prices;
- The discount rate used is 3.5%;
- Estimated costs exclude VAT;
- The estimated cost of each option relates to deployment carried out over a standard 100km^2 area, which is simply a convenient unit of analysis that allows the cost of options to be considered on a 'like for like' basis;
- It is assumed that each intervention operates for five years;

Focus on variable costs

5.1.4 As outlined in the Badger Intervention Analyses – Calculation Assumptions (**appendix 1**), the cost of the vast majority of labour and items required for badger intervention deployment vary in proportion to the number and size of areas chosen for deployment. In other words, most badger intervention costs are 'variable' with scale of deployment. As the fixed costs are the same across options, and relatively small (~£5-£6k per year, no matter the scale of badger intervention deployment), the focus of the remainder of this chapter is on the **variable costs of each badger intervention option**.

Effort involved in badger trapping

5.1.5 The most expensive aspect of a badger intervention is trapping. An option that involves less trapping, such as England's predominant controlled shooting approach, has lower deployment effort, and therefore, lower cost. All other options require all badgers to be trapped prior to "treatment", whether that treatment is cull, TVR or vaccination. The shortlisted options include trapping badgers in cages (as used in DAERA's TVR pilot study) and stopped restraints (as used in the ROI's culling and vaccination deployment). Stopped restraints have a fixed diameter when triggered and smaller badgers can slip through. Therefore, they work best with a long open season such as that in place in the ROI.

5.1.6 As outlined in the Badger Intervention Analyses – Calculation Assumptions (**appendix 1**), the open seasons differ between countries. The short open season currently operational in NI would likely limit the effectiveness of the stopped restraint trapping approach as smaller badgers would be missed. A pragmatic approach needs to be taken to extrapolate high level intervention costs from England and the ROI to a 100km^2 indicative area, and therefore it is assumed that the open season in NI could, in theory, be changed to mirror that of the country where the option approach is currently operational. Therefore, when considering options involving stopped restraints or predominant controlled shooting, it is assumed that the open season could be changed to mirror the open seasons operational in the ROI or in England respectively. The issue of open season will be revisited in the future, as necessary, depending on what option ends up being "preferred" for deployment.

5.2 Variable full economic costs over five years for each shortlisted option

5.2.1 Table 4 presents the estimated variable costs for each option (full economic costs) totalled over a five-year period. The last row of the table shows the discounted 5-year total cost for each option. Note that these figures do not include a policing cost estimate. No policing effort was required for the NI TVR feasibility study; however, it is not known if it may be required for badger

intervention options. As such, policing cost estimates are discussed in the sensitivity analysis section later.

Table 4: Estimated variable cost of initial badger intervention options deployed over a five-year period (no policing cost included)D

Monetary values in:	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m
Option No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Type of interv.	**N/A**	**Proactive**	**Proactive**	**Proactive**	**Proactive**	**Proactive**	**Proactive**	**Proactive**	**Proactive**	**Proactive**	**Proactive**
Type of interv.	**N/A**	**Non-selective**	**Non-selective**	**Non-selective**	**Non-selective**	**Selective**	**Selective**	**Selective**	**Non-selective**	**Non-selective**	**Non-selective**
Option (Approach)	**Do Nothing**	**Cull**	**Cull**	**Cull**	**Cull**	**TVR**	**TVR**	**TVR**	**VACC**	**VACC**	**VACC**
Trapping Method:	**N/A**	**Cage Trap**	**Cage Trap**	**Restraint Trap**	**Contr Shoot & CT**	**Cage Trap**	**Cage Trap**	**Restraint Trap**	**Cage Trap**	**Cage Trap**	**Restraint Trap**
Deployed By:	**N/A**	**Public Sector**	**Private Sector**	**Private Sector**	**Private Sector**	**Public Sector**	**Private Sector**	**Private Sector**	**Public Sector**	**Private Sector**	**Private Sector**
No. of Areas:	1	1	1	1	1	1	1	1	1	1	1
Size of Area:	100km2	100km2	100km2	100km2	100km2	100km2	100km2	100km2	100km2	100km2	100km2
Policing Cost Included?	N/A	No	No	No	No	No	No	No	No	No	No
Full Econ. Variable Cost - 5 Yr Total	**£0.000**	**£2.396**	**£1.609**	**£0.726**	**£0.444**	**£2.648**	**£1.811**	**£0.949**	**£2.425**	**£1.647**	**£0.782**
Av. Full Econ. Var. Cost per Yr	£0.000	£0.479	£0.322	£0.145	£0.089	£0.530	£0.362	£0.190	£0.485	£0.329	£0.156
Present Cost (var costs) 5 Yr Total	**£0.000**	**£2.201**	**£1.462**	**£0.664**	**£0.408**	**£2.429**	**£1.645**	**£0.865**	**£2.227**	**£1.496**	**£0.714**
	1	9	6	**3**	**2**	11	8	**5**	10	7	**4**
% of most expensive opt	0%	91%	60%	27%	17%	100%	68%	36%	92%	62%	29%

NB: “Present Cost 5 Yr. Total” is the sum of the option’s variable costs over five years after the cost for each year has been multiplied by the respective year’s discount factor, based on a discount rate of 3.5%.

5.2.2 Obviously, Option 1, 'do nothing', has the lowest implementation cost, but it does not meet the objectives set.

5.2.3 When the initial badger intervention options are considered (i.e. Options 2-11), based on the above discounted cost estimates totalled over 5 years (present cost), it appears that:

- A non-selective cull is the least expensive option, i.e. the predominant controlled shooting option has the lowest cost, and the remainder of the non-selective cull options cost less than their equivalently deployed TVR or Vaccination alternatives.

- TVR is the most expensive approach.
    - **In terms of the discounted variable costs of options totalled over 5 years, a TVR approach costs approximately £183k to £228k more than an equivalently deployed cull per 100km^2 area**. This is because it has higher staff requirements as a vet is required to apply the TVR method. It also has additional drug, vaccine and equipment costs.

    - **A TVR approach costs between £149k to £151k more than an equivalently deployed vaccination approach per 100km^2 area.** This is mainly because it is assumed that vaccination can be administered by trapping staff as 'lay' vaccinators, whereas a TVR approach requires a vet. TVR also requires additional drugs and equipment.

- A Vaccination approach costs slightly more than an equivalently deployed non-selective cull. This is because vaccination is slightly more expensive than the resources required to remove a badger. Also, as no badgers are removed in the vaccination options, the number of badgers trapped and vaccinated remains high over the five-year period (whereas the number trapped decreases under non-selective cull options).

5.2.4 In terms of deployment approach, based on the above five-year totalled discounted cost estimates (i.e. present cost), it appears that:

- The **public sector cage trap options have the highest cost**.
    - Option 6, the **Cage-Trap** TVR approach deployed by the **public** sector is the most expensive option, ranked 11th on Present Cost, at £2.429m per 100km^2 area (where options are ranked 1 for least expensive and 11 for most expensive).
    - Option 9, the **Cage-Trap** Vaccination approach deployed by the **public** sector is the second most expensive option, ranked 10th on Present Cost, at £2.227m per 100km^2 area.
    - Option 2, the **Cage-Trap** non-selective Cull option deployed by the **public** sector is projected to be the third most expensive, and is ranked 9th on Present Cost, at £2.201m.

- The **private sector cage trap options are the next most expensive:**
    - Based on current cost estimates (which have not been market tested), private sector cage-trap options may be around £0.7-£0.8m less expensive than their equivalent public sector deployment options.
    - Option 7, the **Cage-Trap** TVR approach deployed by the **private** sector is ranked 8th, at £1.645m per 100km^2 area.
    - Option 10, the **Cage-Trap** Vaccination approach deployed by the **private** sector is ranked 7th, at £1.496m.
    - Option 3, the **Cage-Trap** non-selective Cull approach deployed by the **private** sector is ranked 6th, at £1.462m.

- The **private sector restraint trap options are estimated to cost significantly less than their public and private sector cage trap equivalents**.
    - Option 8, the **Restraint-Trap TVR** approach deployed by the **private** sector is ranked 5th, at £0.865m per 100km^2. This is £1.563m less than the present cost of the public sector cage trap TVR option, and £0.780m less than the present cost of the private sector cage trap TVR option.

- Option 11, the **Restraint-Trap Vaccination** approach deployed by the **private** sector is ranked 4th, at £0.714m per 100km^2. This is £1.512m less than the present cost of the public sector cage trap vaccination option, and £0.782m less than the present cost of the private sector cage trap vaccination option.
- Option 4, the **Restraint-Trap non-selective Cull** deployed by the **private** sector is ranked 3rd, at £0.664m. This is £1.537m less than the present cost of the public sector cage trap cull option, and £0.798m less than the present cost of the private sector cage trap cull option.

- **The predominant controlled shooting non-selective cull approach deployed by the private sector (farmer controlled companies in England) has the lowest cost -** The English approach which used farmer-controlled companies to carry out a predominant **"Controlled Shoot"** of free roaming badgers, complemented with some cage trapping where the terrain is not suitable for controlled shooting, **is the 'do something' option with the lowest cost, at £0.408m**. It is ranked 2nd on present cost (i.e. after the "do-nothing" option). Its cost is 17% of the most expensive option (public sector deployment of TVR, using cages).

- As discussed previously, if deployment by farmer-controlled companies was considered for other options (e.g. restraint or cage trap Cull, TVR, or Vaccination), their costs may be lower than the estimates presented in the table.

5.3 Methodology: Consideration of potential for benefit generation

5.3.1 As discussed earlier, the benefit arising from badger intervention is the value of herd breakdowns avoided over a period as a result of badger intervention. To calculate this benefit, it would require an estimate of:

a) The value of a herd breakdown avoided (breakdown costs borne by both government / taxpayers and farmers), *multiplied by;*
b) The number of years over which one would expect to see a reduction in herd breakdowns as a result of badger intervention, multiplied by:
c) The average number of herd breakdowns avoided for each year in this period.

5.3.2 While it is possible to estimate a), and to consider different estimates for b), the number of herd breakdowns that would be avoided in an intervention area specifically as a result of badger intervention in NI (i.e. c)) is not known. In such circumstances, it is appropriate to use **breakeven analysis** to determine how many herd breakdowns would ***need*** to be avoided for the benefits of badger intervention to at least offset its cost[75].

5.3.3 As regards a), with current cattle numbers, disease levels, etc., it is estimated that avoiding one unique herd breakdown would save the NI economy around **£27,500** in 2026/27 prices (see Badger Intervention Analyses – Calculation Assumptions **(appendix 1)** for further information).

[75] The use of Breakeven Analysis is aligned to DEFRA's approach. DEFRA (2005) "Cost benefit analysis of badger management as a component of bovine TB control in England". See para. 9

5.3.4 As regards b), a **conservative estimate** is **9 years** from the commencement of a badger intervention.

Table 5: Rationale for considering benefits over 9 years from the commencement of a badger intervention

Study	Relevant information on duration of benefits
Four Area Trial, ROI	Not particularly helpful. It says that the reduced breakdown risk was sustained and continued to fall over a total of 16 years though this *"encompassed periods of both intensive and less-intensive badger removal"*[76].
RBCT, England	It originally appeared that the benefits disappeared four years post the initial 5-year cull, i.e. **~9 years**[77]. However, Donnelly (2011) provided an update by to the RBCT results provided by Jenkins et al (2010)[78] in September 2011 and appears to suggest that **the post intervention period benefits of lower herd breakdowns were sustained for 60 months, i.e. 5 years**, which appear to be measured from one year from the last cull finishing, i.e. an eleven-year period since the start of the intervention. England's VFM analyses used eleven years of benefit[79].
NI parameterised model	In line with the RBCT, the modellers wished to model the impact on herd breakdowns **five years post intervention**. In this case, the interventions under consideration were seven years (i.e. an initial intervention of cull, TVR or vaccination for four years, followed by a follow-up three-year period of vaccination). The modellers considered, therefore, a benefit period of twelve years (seven-year period of intervention plus a five-year follow-on period).
Rationale for 9 years for the main economic analysis, with 7 and 11 years considered in the sensitivity analysis.	The ROI study is not definitive on the time-period to be assumed for benefits. The NI Model focused on benefits lasting for five years post intervention. This analysis is considering the benefits following an initial intervention of five years. However, the initial intervention in the NI parameterised model was for four years. Four years of initial intervention PLUS five years of follow-up consideration of herd breakdowns equals nine years. So, the main economic analysis will consider a benefit period of nine years. However, later in the sensitivity analysis, the impact of assuming a seven-year and eleven-year benefit period will also be considered.

5.3.5 As regards c), it is **not possible to be definitive** on the **number** of breakdowns avoided as a direct result of each badger intervention option.

[76]Kelly, G.E., Condon, J., More, S. J., Dolan, L., Higgins, I. and Eves, J. (2007). A long-term observational study of the impact of badger removal on herd restrictions due to bovine TB in the Irish midlands during 1989–2004 - PMC
[77]Quote from Prof. C. Donnelly 2010. Benefits Of Badger Cull Not Long Lasting | The Cattle Site
[78] Jenkins, H.E., Woodroffe, R., and Donnelly, C.A. (2010) "The duration of the effects of repeated widespread badger culling on cattle tuberculosis following the cessation of culling". Plos One. The Duration of the Effects of Repeated Widespread Badger Culling on Cattle Tuberculosis Following the Cessation of Culling | PLOS One See also Comments by C Donnelly 23/9/11 "Analysis of further data (to 28 August 2011) on the impacts on cattle TB incidence of repeated badger culling.
[79]DEFRA (2019) Badger control policy: value for money analysis 2019. Badger control policy: value for money analysis 2019 - GOV.UK

5.3.6 Therefore, the following approaches are used:

(i) firstly, a **breakeven analysis** is carried out, with the question asked, "how many cattle herd breakdowns would NEED to be avoided for badger intervention to be worthwhile?"

(ii) secondly, the following question is considered: "does this breakeven number of breakdowns avoided **appear achievable**?". To attempt an answer to this question:

a. Firstly, the breakeven number of herd breakdowns avoided is compared against the outputs from a NI parameterised model[80]. The modelling was carried out in 2019, reflects the cattle disease levels at that time[81], and considers a slightly different intervention (a four-year initial intervention plus three years of follow-up vaccination as opposed to a five-year initial intervention currently under review). However, it is useful to some degree in sense-checking the achievability of the breakeven outlining the **relativity** of the potential breakdowns saved from the Cull, TVR and Vaccination approaches.

b. Finally, to bring real-world experience to bear, the breakeven number of herd breakdowns avoided from non-selective cull options are compared with the results from one of the large scale replicated badger cull research trial projects – the Four Area Trial that was conducted in the ROI.

Breakeven analysis

5.3.7 The Present Cost of each badger intervention can be converted into its Equivalent Annual Cost (EAC) over nine years. (See Badger Intervention Analyses – Calculation Assumptions (**appendix 1**) for an example of using EAC factors for breakeven analysis). Table 6 shows the number of Unique Herd Breakdowns **per year** that would need to be avoided in order to offset the cost of the initial badger intervention over a nine-year benefit period.

[80] Budgey, R. and Smith, G.C. (2019) "A simulation model to assess the relative performance of wildlife intervention options on bTB in wildlife and cattle in Northern Ireland." National Wildlife Management Centre, Animal and Plant Health Agency (APHA).

[81] For modelling, Area 1 input herd incidence was 15.3%. When it is assumed that the badgers have a 10% badger bTB prevalence rate, the model output is 15.5% herd incidence.

Table 6: Breakeven analysis for the initial badger intervention options considered

NO PERTURBATION EFFECT												
NO POLICING												
Values in £m												
Option		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Trapping		N/A	Cage	Cage	Restraint	Predom. Contr. Shoot	Cage	Cage	Restraint	Cage	Cage	Restraint
Deployment by:		N/A	Public	Private	Private	Private	Public	Private	Private	Public	Private	Private
Approach		Do Nothing	Non-selective Cull	Non-selective Cull	Non-selective Cull	Non-selective Cull	Selective Cull - TVR	Selective Cull - TVR	Selective Cull - TVR	Vaccinat'n	Vaccinat'n	Vaccinat'n
Variable Costs, Full Econ. 5 Yrs (without policing)		£0.000	£2.396	£1.609	£0.726	£0.444	£2.648	£1.811	£0.949	£2.425	£1.647	£0.782
Pres. Cost - Var. Costs (5 yrs)		£0.000	£2.201	£1.462	£0.664	£0.408	£2.429	£1.645	£0.865	£2.227	£1.496	£0.714
Rank by NPC (1st=lowest cost)		1	9	6	**3**	**2**	11	8	**5**	10	7	**4**
Pres. Cost as a % of the most expensive option		0%	91%	60%	27%	17%	100%	68%	36%	92%	62%	29%
Breakeven no. of herd BDs Avoided if benefits last 9 years		0.0	10.5	**7.0**	**3.2**	**1.9**	11.6	7.9	**4.1**	10.6	7.2	**3.4**

5.3.8 For the lowest cost option (non-selective cull via 'predominant controlled shooting'), assuming that each unique breakdown avoided saves the NI economy an average of £27,500, and if the benefits of badger intervention last 9 years, then an average of 1.9 herd breakdowns would need to be avoided for each year of a nine-year period for the costs to be offset by benefits. The options with private sector deployment of the cull, vaccination and TVR approaches via restraint-trapping all had a relatively small number of herd breakdowns avoided that would be required per year for benefits to exactly offset badger intervention costs (i.e. breakeven number), at 3.2, 3.4 and 4.1.

5.3.9 The breakeven numbers of herd breakdowns avoided that are required per year for private sector deployed cage trap cull, vaccination and TVR were higher than the restraint-based figures, at 7.0, 7.2 and 7.9 respectively.

5.3.10 All public sector cage trap options had high breakeven numbers (10.5 -11.6 herd breakdowns avoided/year). The highest cost option is 'Selective cull via TVR using cages, deployed by the public sector', and if it is assumed that benefits last 9 years, then the average number of breakdowns avoided would need to be ~12 per year for breakeven (benefits to equal the variable costs of badger intervention in one 100km^2 area).

Likelihood of achieving the breakeven number of herd breakdowns avoided

5.3.11 The next step is to consider if the breakeven number of unique herd breakdowns avoided is *likely* to be achieved. This requires benchmarking the breakeven figures as far as possible.

NI Parameterised Model

5.3.12 In 2018, DAERA commissioned modelling work from APHA[82] in England to compare badger intervention options. It used NI input data to maximise the ability of the model to reflect the local situation as far as practically possible. The options that are relevant to those assessed in this paper are: Option (i)

[82] Budgey, R. and Smith, G.C. (2019) "A simulation model to assess the relative performance of wildlife intervention options on bTB in wildlife and cattle in Northern Ireland." National Wildlife Management Centre, Animal and Plant Health Agency (APHA).

BAU[83], Option (iii) Cull in core area for 4 years, followed by vaccination in core area for 3 years; Option (iv) TVR in core area for 4 years, followed by vaccination in core area for 3 years; and Option (v) Vaccination in core area for 4 years, followed by vaccination in core area for 3 years.

5.3.13 This modelling paper was critically assessed by internal experts[84]. These reviewers stress that the model outputs should **not** be taken as **predictions**[85], rather the simulated outputs from the model should be interpreted as giving a **broad indication of the relative performance of options.** They also said that the outputs estimated for the model's "core" area is the observation of interest as this reflects where badger intervention occurs. Therefore, the "core" results will be considered in the main economic analysis section.

5.3.14 Due to area connectivity, the modellers also estimated the number of herd breakdowns avoided in 'buffer' area (a 2km ring around the core intervention area) and in a further 'outside' area beyond the buffer. Together, the core intervention area, the 'buffer' area around that, and the 'outside' area make up a 400km^2 "arena". The impact in areas beyond the core are arguably more sensitive to modelling assumptions because they depend on boundary geometry, badger movement, cross-boundary transmission pathways, etc. So, the "core" results for herd breakdowns are considered most worthy of note and are presented in the main economic analysis, but the modelled impact across the 400km^2 arena (adjusted pro rata[86]) will also be provided in the sensitivity analysis. As can be seen in the sensitivity analysis, adding in herd breakdowns avoided across a larger area results in some options with an illustrative Net Present Cost (NPC) from the "core" analyses changing to a Net Present Value (NPV) when "arena" modelled results are used.

[83] Note: Option (ii) was a hybrid option that is not considered in these analyses (see paras. 4.2.11-4.2.12)
[84] Hatch, M. and Anderson, H. (2019) "Follow up report on the National Wildlife Management Centre TB model outputs: DAERA veterinary and NIEA interpretation of the results.
[85] "…the results presented in the report show no indication of the uncertainty surrounding the point estimates provided… but it is understood that any confidence intervals would be wide and would probably encompass any of the other options presented. Therefore, there is unlikely to be any statistically significant different between any of the interventions and do nothing because of the large uncertainty surrounding the model outputs. The model outputs do give a broad indication of the relative performance of each intervention." Hatch & Anderson (2019), p4.
[86] 400km^2 arena in modelling paper was related to a 123km^2 intervention "core". As it is the effects of intervention in a 100km^2 core area that are now of interest, all modelled results (both core and arena) are divided by 123 and multiplied by 100.

5.3.15 One of the options in the modelling paper is a type of “hybrid”, with culling in an inner core, and TVR in a buffer. This option has not been shortlisted for further consideration in this paper as discussed in the long list of options section. However, as this hybrid option has a different size of intervention area than the other options modelled, the modellers needed to adjust areas so they could be compared “like for like”, and ran an analysis called “alternative configuration of Area 1”[87].

5.3.16 In this (alternative configuration of Area 1) analysis, the modellers assume a starting badger prevalence rate of 10%. The modellers did not run a 40% badger prevalence scenario for the alternative area 1 configuration. They explain, “because the differences between areas and between different background bTB prevalences are small, observations regarding the relative efficacies of the four active intervention options have been henceforward restricted to the alternative zone configuration simulations for area 1 with lower background prevalence (10%)”.

5.3.17 The reviewers[88] explain that this Alternative Area 1 analysis is the most useful for comparing options on a like for like basis. Also, the Alternative Area 1 analysis has each core intervention area set at 123km^2, and as NI is likely to choose badger interventions with an intervention area of around 100km^2 (see Badger Intervention Analyses – Calculation Assumptions para. 2.7.1(**appendix 1**)), this is the appropriate modelling scenario to consider from the APHA work for this benchmarking exercise. (Note, however, that in the analyses discussed here, as the cost of badger intervention is provided for a 100km^2 area, the data on number of herd breakdowns avoided from the modelled alternative configuration of Area 1 are adjusted pro rata from 123km^2 to 100km^2.)

5.3.18 The reviewers also explain that the model considers the impact of a perturbation effect, which is based on the effect seen in the RBCT in England,

[87] Budgey, R. and Smith, G.C. (2019) “A simulation model to assess the relative performance of wildlife intervention options on bTB in wildlife and cattle in Northern Ireland.” National Wildlife Management Centre, Animal and Plant Health Agency (APHA).
[88] Hatch, M. and Anderson, H. (2019) “Follow up report on the National Wildlife Management Centre TB model outputs: DAERA veterinary and NIEA interpretation of the results. See page 4: “In summary, options 2-5 can only be directly compared using the alternative zone configuration”.

and it is either fully "on" or fully "off" (no perturbation effect or complete perturbation effect) for all options with any badger removal. The reviewers explain that an increase in cattle herd breakdowns in buffer areas outside of cull zones due to a perturbation-related effect was not found in the ROI's Four Area Trial. It is possible that its larger intervention area and use of hard boundaries wherever possible helped reduce the risk of a perturbation effect. If an option with badger removal was considered for NI, then this approach could provide a blueprint for a NI intervention which should mitigate the risk of perturbation effects here. The reviewers do not see a straight read across from England's RBCT to NI and say that "one might speculate that the (RBCT) observed perturbation effects may well be ameliorated or even negated[89]". Therefore, perturbation will be left out of the main analysis in this chapter but will be considered and discussed further in the sensitivity analysis chapter.

5.3.19 The results from the NI Parameterised Model for the broad options shortlisted (non-selective cull, TVR, vaccination) for the Area 1 alternative zone configuration, extrapolated to a standard unit of 100km^2, are outlined in Table 7. However, note that the model does not exactly replicate the options under consideration. While it does consider non-selective cull, selective cull via TVR, and vaccination options, it does not make any distinction for cage trapping versus restraint trapping versus predominant control shooting. To apply the model outputs to these approaches, it is assumed that each would secure similar access to badgers. This is a pragmatic assumption, and it is discussed further in the Badger Intervention Analyses – Calculation Assumptions[90] (**appendix 1**).

5.3.20 Also, as discussed earlier, the model assumed four years of initial intervention, but DAERA is now considering an initial intervention of 5-years. Also, the model

[89] Hatch and Anderson, (2019) pg. 3

[90] E.g. Model based on cage trapping in DAERA TVR project (trapping rate 55%). For restraints, Byrne AW, O'Keeffe J, Green S, Sleeman DP, Corner LAL, et al. (2012) Population Estimation and Trappability of the European Badger (Meles meles): Implications for Tuberculosis Management. PLoS ONE 7(12): e50807. doi:10.1371/journal.pone.0050807 – not dissimilar. In England, cage trapping and controlled shooting are deployed together to maximise access to badgers, with the aim of removing 70% of the badger population in target areas by end of the cull. However, in practice, When England commenced their proactive non-selective cull in 2013, the percentage split of badgers removed was 66% by controlled shooting and 34% by cage trapping in Gloucestershire, and 46% by controlled shooting and 54% by cage trapping in Somerset. In 2013, it is estimated that this approach removed somewhere between 43.0% and 55.7% of the badger population in Gloucestershire and between 37.0% and 50.9% in Somerset (based on 95% confidence intervals).

assumed three years of follow-on vaccination, but this is not assumed at this time. Before deciding the follow-on approach for NI, further modelling and consideration is required. There is also a need for DAERA to take account of the follow-on approaches deployed in the ROI and in England.

5.3.21 That said, comparing breakeven herd breakdowns avoided with those estimated by the model remains useful to get a feel for what options have breakeven herd avoided numbers that look small and achievable, and what options have overly high, unachievable breakeven numbers. Arguably, given that the model shows a stronger impact on cattle herd breakdowns for options involving non-selective or selective badger removal vis a vis vaccination, and the fact that the non-selective and selective cull options now considered include a further year of badger removal, the model may be providing reasonably conservative estimates of the potential illustrative impact of a cull and TVR approach on cattle herd breakdowns.

Table 7: APHA Model[91] - Area 1 Alternative Zone Configuration, data adjusted pro-rata for a **Core Area of 100km^2 (i.e. from 123km^2)**, badger prevalence 10%, and assuming benefits last for 9 years

Modelled Option	Sum of Unique Officially bTB Free status Withdrawn (OTW) herd breakdowns over a 9-year period in the core intervention area	No. of Unique herd breakdowns saved – totalled over 9 years in core (option sum minus Bus. As Usual sum)	Av. No. of Unique Herd BDs saved per yr over this period in core intervention area	% of Unique Herd BDs saved over 9 yrs in core intervention area
(i) Bus. As Usual	166	0	0.0	0%
(iii) Cull, no pert.	99	-68	-7.5	-41%
(iv) TVR, no pert.	100	-66	-7.3	-40%
(v) Vaccination	145	-21	-2.3	-13%

5.3.22 When the perturbation effect is assumed not to occur (i.e., the perturbation effect is "turned off"), the model suggests that an average of 7.5 herd

[91]Budgey, R. & Smith, G.C. (2019), "A simulation model to assess the relative performance of wildlife intervention options on bTB in wildlife and cattle in Northern Ireland". National Wildlife Management Centre, Animal and Plant Health Agency (APHA).

breakdowns per year may be saved over a nine-year period for a non-selective cull, 7.3 for TVR, and 2.3 for vaccination.

5.3.23 The options that are most likely to deliver benefits greater than their costs are those where the breakeven number of herd breakdowns avoided (i.e. that would need to be avoided for benefits to offset the intervention's cost) is lower than the number avoided calculated by the mode. In simple terms, these options are expected to have higher benefits than costs. These include:

Option 5: Non-selective cull via predominant controlled shooting deployed by the **private sector** (Breakeven = 1.9 herd BDs avoided/yr, which is well below the modelled benefit of 7.5 herd BDs avoided/yr);

Option 4: Non-selective cull using restraint traps deployed by the **private sector** (3.2 herd BDs avoided/yr, which is well below the modelled benefit of 7.5 herd BDs avoided/yr);

Option 8: Selective cull via TVR using restraint traps deployed by the **private sector** (its breakeven of 4.1 is well below the modelled TVR benefit of 7.3 herd breakdowns avoided per year); and

Option 3: Non-selective cull using cage traps deployed by the **private sector** (7.0 herd BDs avoided/yr, which is just below the modelled benefit of 7.5 BDs avoided per year).

5.3.24 Having considered the modelling results, though noting the caveats highlighted, it seems reasonable to conclude that the breakeven number of unique herd breakdowns avoided appear achievable for these options.

5.3.25 Table 8 goes a step further and multiplies the modelled average number of herd breakdowns avoided each year in the core intervention area by the estimated value of a herd breakdown avoided of £27,500. The annual benefits are discounted using the 3.5% discount factor. The illustrative net present value can then be calculated by deducting each option's present cost (added over five years) from model-based illustrative present benefits (added over nine years).

Table 8: Using modelling estimates of unique herd breakdowns avoided x £27,500 benefit/BD avoided to compare potential discounted benefits over nine years with estimated discounted intervention costs (over five years)

NO PERTURBATION EFFECT												
NO POLICING												
Values in £m												
Option No.		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Type of interv.		N/A	Proactive	Proactive	Proactive	Proactive	Proactive	Proactive	Proactive	Proactive	Proactive	Proactive
Type of interv.		N/A	Non-selective	Non-selective	Non-selective	Non-selective	Selective	Selective	Selective	Non-selective	Non-selective	Non-selective
Trapping		N/A	Cage	Cage	Restraint	Predom. Contr. Shoot	Cage	Cage	Restraint	Cage	Cage	Restraint
Deployment by:		N/A	Public	Private	Private	Private	Public	Private	Private	Public	Private	Private
Approach		**Do Nothing**	**Cull**	**Cull**	**Cull**	**Cull - Predom. Contr. Sho't**	**TVR**	**TVR**	**TVR**	**Vaccinat'n**	**Vaccinat'n**	**Vaccinat'n**
Variable Costs, Full Econ. 5 Yrs (without policing)		£0.000	£2.396	£1.609	£0.726	£0.444	£2.648	£1.811	£0.949	£2.425	£1.647	£0.782
Pres. Cost - Var. Costs (5 yrs)		£0.000	£2.201	£1.462	£0.664	£0.408	£2.429	£1.645	£0.865	£2.227	£1.496	£0.714
Rank by NPC (1st=lowest cost)		1	9	6	**3**	**2**	11	8	**5**	10	7	**4**
Pres. Cost as a % of the most expensive option		0%	91%	60%	27%	17%	100%	68%	36%	92%	62%	29%
Breakeven no. of herd BDs Avoided if benefits last 9 years		0.0	10.5	**7.0**	**3.2**	**1.9**	11.6	7.9	**4.1**	10.6	7.2	**3.4**
Model H BD Avoided if benefits last 9 yrs -No.		**0.0**	**-7.5**	**-7.5**	**-7.5**	**-7.5**	**-7.3**	**-7.3**	**-7.3**	**-2.3**	**-2.3**	**-2.3**
Pres. Benefit: Model - if benefits last 9 yrs		**£0.000**	**£1.573**	**£1.573**	**£1.573**	**£1.573**	**£1.533**	**£1.533**	**£1.533**	**£0.488**	**£0.488**	**£0.488**
NPV: Model - if benefits last 9 yrs		**£0.000**	**-£0.628**	**£0.111**	**£0.909**	**£1.165**	**-£0.895**	**-£0.112**	**£0.668**	**-£1.739**	**-£1.008**	**-£0.226**
Rank by NPV-if benefits last 9 yrs		5	8	**4**	**2**	**1**	9	6	**3**	11	10	7

5.3.26 Extrapolating from the modelling outputs, the options with an illustrative net present benefit are:

Option 5, **Non-selective cull via predominant controlled shooting** deployed by the **private** sector - illustrative NPV of £1.165m and ranked first.

Option 4, Non-selective cull using restraint traps deployed by the **private** sector - illustrative NPV of £0.909m, ranked second.

Option 8, **Selective cull via TVR using restraint traps** deployed by the **private** sector – illustrative NPV of £0.668m, ranked third; and

Option 3, Non-selective cull using cage trapping deployed by the **private** sector – illustrative NPV of £0.111m, ranked fourth.

5.3.27 For all other options, based on the cost and model assumptions, the estimated discounted costs are greater than discounted illustrative benefits, resulting in an estimated net present cost (i.e. a net economic loss to the NI economy).

5.3.28 Finally, it is useful to benchmark the breakeven number of herd breakdowns avoided for the proactive **non-selective cull** approach against the results from large, replicated trials. NB: This comparison can only be carried out for the cull option as no large scale replicated research trial of vaccination or TVR approaches have been conducted on the island of Ireland, or in GB.

5.3.29 The two large scale, replicated, proactive non-selective cull research projects are: England's RBCT[92] and the ROI's Four Area Trial[93]. Although areas for badger intervention in NI haven't been chosen at this stage, it is likely that the areas eventually selected for badger intervention would have cattle and badger parameters that will not be exactly the same as the parameters of these studies, both of which were undertaken >20 years ago. That said, the terrain in NI is not dissimilar to that in the rest of Ireland, and this is the most appropriate comparator.

[92] 1998-2005: See Griffin, J.M, More, S. J., Clegg, T.A, Collins, J. D., O'Boyle, I., Williams, D.H., Kelly, G.E., Costello, E., Sleeman, D.P., O'Shea, F., Duggan, M., Murphy, J., Lavin, D.P.T. (2005), Tuberculosis in cattle: the results of the four-area project. Irish Veterinary Journal, 58(11), 629-636. Tuberculosis in cattle: the results of the four-area project - PMC. And Griffin, J.M., Williams, D.H., Kelly, G.E., Clegg, T.A., O'Boyle, I., Collins, J.D., More, S.J. (2005) "The impact of badger removal on the control of tuberculosis in cattle herds in Ireland". Preventive Veterinary Medicine, 67(4), 237-266. The impact of badger removal on the control of tuberculosis in cattle herds in Ireland - ScienceDirect

[93] 1997-2002. See: Jenkins, H.E., Woodroffe, R., and Donnelly, C.A. (2010) The duration of the effects of repeated widespread badger culling on cattle tuberculosis following cessation of culling (2010). PLOS ONE. The Duration of the Effects of Repeated Widespread Badger Culling on Cattle Tuberculosis Following the Cessation of Culling | PLOS One

5.3.30 In regard to the Four Area Trial, during the study period, when the results for the four areas are averaged, the percentage of herds restricted in the badger removal areas was 40% of the percentage of herds restricted in the reference areas (i.e. a 60% reduction in the breakdown rate). The NI parameterised model (area 1, alternative zone configuration, 10% badger prevalence) assumed a baseline of an average of 18 unique herd breakdowns per year (which aligned to a model input of 15% herd incidence). Forty per cent of 18 baseline herd breakdowns is 7, i.e. a potential saving of 11 herd breakdowns per year if NI secured a similar result as to that published for the Four Area Trial. All of the non-selective cull options have a breakeven number of herd breakdowns avoided lower than this, with the lower cost options having breakeven figures significantly lower than 11.

Option 5, **Non-selective cull via predominant controlled shooting** deployed by the **private** sector (1.9 herd BDs avoided for breakeven vis a vis 11 extrapolated from F.A.T. results[94]);

Option 4, Non-selective cull using restraint traps deployed by the **private** sector (3.2 herd BDs avoided for breakeven vis a vis 11 extrapolated from F.A.T. results);

Option 3, **Non-selective cull using cage traps** deployed by the **private** sector, (7.0 herd BDs avoided for breakeven vis a vis 11 extrapolated from F.A.T. results);

Option 2, **Non-selective cull using cage traps** deployed by the **public** sector, (10.5 herd BDs avoided for breakeven vis a vis 11 extrapolated from F.A.T. results).

5.4 Conclusion of the economic analysis (prior to sensitivity analysis)

5.4.1 On the basis of the above analysis, it appears that the four options outlined in Table 9 have a reasonable likelihood of delivering sufficient benefit in terms of herd breakdowns avoided to offset their implementation cost.

[94] Four Area Trial

Table 9: Top ranked options (before sensitivity analysis).

Option with a reasonable likelihood of delivery benefits greater than their cost in terms of herd breakdowns avoided	**Rank on potential Cost:Benefit**
Option 5, **Non-selective cull via predominant controlled shooting** deployed by the **private** sector (Breakeven = 1.9 herd BDs avoided/yr, which is **well below** the modelled benefit of 7.5 herd BDs avoided/yr on average over 9 years, and is also **well below** the herd breakdowns avoided (11) suggested potentially possible from extrapolation of the Four Area Trial data to NI);	1st
Option 4, Non-selective cull using restraint traps deployed by the **private** sector (3.2 is well below 7.5; and also below 11);	2nd
Option 8, **Selective cull via TVR using restraint traps** deployed by the **private** sector (4.1 is well below the modelled TVR benefit of 7.3 herd breakdowns avoided per year).	3rd
Option 3, Non-selective cull using cage traps deployed by the **private** sector (**7.0** is slightly below 7.5; and also below 11);	4th

5.4.2 The next chapter considers if these options still appear likely to have benefits that offset their cost once some assumptions are changed.

5.4.3 The other options (i.e. not in Table 9) **would require solutions to reduce their intervention costs before it would become likely that quantitative economic benefits would more than offset their cost**.

6. Economic Case: Monetary Costs/Benefits Sensitivity Analysis

6.1 Increased ranging behaviour (perturbation effect)

6.1.1 As previously discussed, the RBCT in England found that there was a perturbation effect from proactive non-selective culling. It is believed that the disruption to the social structure of badger communities caused increased badger ranging behaviour which in turn brought about a short-term increase in herd breakdown levels in farms located in the buffer/ring area surrounding the cull zone. This was not recorded as an effect of the Four Area Trial project, which had larger badger intervention zones with hard boundaries utilised as far as possible.

6.1.2 The ROI approach could potentially provide a blueprint for any NI intervention, which should mitigate the risk of any perturbation effect. As such, the reviewers of the NI Parameterised Model concluded that "one might speculate that the (RBCT) observed perturbation effects may well be ameliorated or even negated[95]".

6.1.3 However, it is useful to check the potential impact of a perturbation effect in this sensitivity analysis chapter. The calculations from the previous main analysis chapter have been repeated, with the lower number of herd breakdowns avoided from the NI Parameterised Model used for all non-selective cull options (i.e. using the data for the alternative configuration of Area 1, assuming 9 years of benefit, with results for non-selective cull options drawn from the perturbation effect turned "on" scenario).

6.1.4 There is assumed to be no perturbation effect for the vaccination and TVR approaches, thereby maintaining their original results. This is because a perturbation effect is not relevant to the vaccination approach (as no badgers

[95] Hatch and Anderson, (2019) pg. 3

are removed) and was not evidenced for a TVR approach when it was piloted in NI[96].

6.1.5 When the perturbation effect is assumed to occur for the non-selective cull options (i.e., the perturbation effect is “turned on”), and a nine-year benefit period is applied, the modelling indicates that the average number of herd breakdowns prevented per year in the core intervention area would fall from the original estimate of 7.5 to 3.6. This reduces the illustrative net present value of non-selective cull options from the original estimates. Options 5 and 4 retain an illustrative Net Present Value, but Option 3 (non-selective cull using cages, deployed by the private sector) no longer has an illustrative net present value.

6.1.6 As outlined in Table 10, Options 5, 4 and 8 which were previously identified as potentially capable of delivering a Net Present Value if modelled benefits were achieved over a nine-year period **continue to do so** under this sensitivity scenario. However, **their rank order changes**, **with Option 8 (Selective cull via TVR using restraint traps deployed by the private sector) now ranked first**, i.e. ahead of Options 5 and 4 which are private sector deployed non-selective cull options via predominant controlled shooting and restraint trapping respectively.

[96] O’Hagan, M.J.H., Gordon, A.W., McCormick, C.M., et al. Effect of selective removal of badgers (Meles meles) on ranging behaviour during a ‘Test and Vaccinate or Remove’ intervention in Northern Ireland. *Epidemiology and Infection*. 2021;149:e125. doi:10.1017/S0950268821001096

Table 10: Using modelling estimates of unique herd breakdowns avoided x £27,500 benefit/BD avoided to compare potential discounted benefits over nine years with estimated discounted intervention costs (over five years), assuming perturbation effect "on" for Options 2-5. Core impacts.

	Benefits assumed to last:	9 Yrs		9 Yrs	
	Perturbation effect on proactive cull opts.	Off		On	
	Policing cost estimated included?	No		No	
	Impacts measured?	Core		Core	
		Orig. Analysis		Sens. Pert. On	
Opt		NPV (indicative)	Rank	NPV (indicative)	Rank
5	**Non-select. cull via predominant controlled shooting** deployed by the private sector	**£1.165**	**1**	£0.336	**2**
4	**Non-select. cull via restraint trap** deployed by the private sector	**£0.909**	**2**	£0.079	**3**
8	**Selective cull via TVR using restraint traps** deployed by the private sector	**£0.668**	**3**	£0.668	**1**
3	**Non-select. cull**, trapping badgers using **cages**, deployed by the **private** sector	**£0.111**	4	-£0.719	7
1	**Do Nothing**	£0.000	5	£0.000	4
7	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **private** sector	**-£0.112**	6	-£0.112	5
11	**Vaccination**, trapping badgers using **restraints**, deployed by the **private** sector	**-£0.226**	7	-£0.226	6
2	**Non-select. cull**, trapping badgers using **cages**, deployed by the **public** sector	**-£0.628**	8	-£1.458	10
6	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **public** sector	**-£0.895**	9	-£0.895	8
10	**Vaccination**, trapping badgers using **cages,** deployed by the **private** sector	**-£1.008**	10	-£1.008	9
9	**Vaccination**, trapping badgers using **cages,** deployed by the **public** sector	**-£1.739**	11	-£1.739	11

6.2 Policing Costs

6.2.1 Policing costs are considered unlikely but cannot be ruled out completely. The ROI had no policing of badger culls; there was no policing requirement for the badger TVR pilot conducted in NI, but policing was a feature of the proactive badger culls conducted in England.

6.2.2 It appears that England allocated significant resource to policing predominant controlled shooting culls at the early stages of their badger culling policy[97], but policing costs have since reduced substantially. For example, in the DEFRA 2019 VFM analysis[98], it was estimated that policing would cost £217,000 for one 632km^2 cull area over a four-year period. Pro-rata to 100km^2, and to a five-year initial intervention, this equates to £43,000, and when uplifted to 2026/27 prices, it is estimated to be £56,000 per 100km^2 area. The profile of spend is likely to be 52% in year 1, with the remainder split over the following four years (i.e. 12% per year). This adds £52,000 to the discounted present costs per 100km^2 area.

6.2.3 Adding a policing cost estimate increases the breakeven number of breakdowns required a year by an insignificant 0.2.

6.2.4 As outlined in Table 11, when a perturbation effect is turned 'off' for non-selective cull options, and using the APHA modelling to help derive a benefit estimate, and subtracting costs for an illustrative NPV, the inclusion of a policing cost estimate does not change the options with illustrative NPVs (options 5, 4, 8 and 3) or their rank order from the original analysis.

6.2.5 When a perturbation effect is turned "on" for non-selective cull options, as before, Option 8 (TVR via restraint traps, deployed by the private sector) becomes ranked first, followed by Option 5 (Non-selective cull via Predominant

[97] DEFRA 2015 VFM analysis says "Based on experience in the existing cull areas" policing costs of £700k per area per year are estimated. Over four years, that is £2,800,000 per 230km^2 area. Pro-rata, that equates to £1.2m per 100km^2 area. It says "However, it is a shared goal of Defra and the Home Office that policing should become business as usual for local police forces and attract no additional costs. Over time, following further successful culls without security incident, we expect any policing costs to disappear." badger-control-policy-value-analysis.pdf

[98] For the central case, DEFRA estimates that policing will cost £217,000 per area over four years. Explanation below see Table 5. Badger control policy: value for money analysis 2019 - GOV.UK

Controlled Shooting, by the private sector), then Option 4 (Non-selective cull via restraint traps, deployed by the private sector).

Table 11: Sensitivity analysis - policing: Using modelling estimates of unique herd breakdowns avoided x £27,500 benefit/BD avoided to compare potential discounted benefits over nine years with estimated discounted intervention costs (over five years), assuming perturbation effect "OFF" and "ON" for Options 2-5. Core impacts.

	Benefits assumed to last:	9 Yrs		9 Yrs		9 Yrs		9 Yrs	
	Perturbation effect on proactive cull opts.	Off		On		Off		On	
	Policing cost estimated included?	No		No		Yes		Yes	
	Impacts measured?	Core		Core		Core		Core	
		Orig. Analysis		Sens. Pert. On		Sens. Policing Incl, Pert. Off		Sens. Policing Incl, Pert. On	
Opt		NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank
5	**Non-select. cull via predominant controlled shooting** deployed by the private sector	**£1.165**	**1**	£0.336	**2**	£1.113	**1**	£0.284	**2**
4	**Non-select. cull via restraint trap** deployed by the private sector	**£0.909**	**2**	£0.079	**3**	£0.857	**2**	£0.027	**3**
8	**Selective cull via TVR using restraint traps** deployed by the private sector	**£0.668**	**3**	£0.668	**1**	£0.616	**3**	£0.616	**1**
3	**Non-select. cull**, trapping badgers using **cages**, deployed by the **private** sector	**£0.111**	4	-£0.719	7	**£0.059**	4	-£0.770	7
1	**Do Nothing**	£0.000	5	£0.000	4	£0.000	5	£0.000	4
7	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **private** sector	**-£0.112**	6	-£0.112	5	-£0.163	6	-£0.163	5
11	**Vaccination**, trapping badgers using **restraints**, deployed by the **private** sector	**-£0.226**	7	-£0.226	6	-£0.278	7	-£0.278	6
2	**Non-select. cull**, trapping badgers using **cages**, deployed by the **public** sector	**-£0.628**	8	-£1.458	10	-£0.680	8	-£1.510	10
6	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **public** sector	**-£0.895**	9	-£0.895	8	-£0.947	9	-£0.947	8
10	**Vaccination**, trapping badgers using **cages,** deployed by the **private** sector	**-£1.008**	10	-£1.008	9	-£1.060	10	-£1.060	9
9	**Vaccination**, trapping badgers using **cages,** deployed by the **public** sector	**-£1.739**	11	-£1.739	11	-£1.790	11	-£1.790	11

6.3 What if badger intervention costs were 15% or 30% higher than estimated

6.3.1 As previously explained, the estimated costs of badger intervention are based either on DAERA's first-hand experience with the cage trapping TVR project, or on high level information from the ROI's private sector delivered restraint-trap cull, or England's private sector delivery of predominant controlled shooting approach (by farmer-controlled companies). The original cost estimates are considered reasonably robust, but it is useful to redo the cost:benefit calculations to consider the impact on illustrative net present value and the rank order of options if costs were higher than anticipated.

6.3.2 As DAERA has detailed knowledge of the cost of delivering public sector cage-trap options, cost sensitivity is not applied to those options. DAERA is much less sure about the cost of private sector delivery, having not procured private sector delivery of any badger interventions to date. Therefore, Table 12 shows the impact of a 15% or 30% increase to the variable costs of private sector delivered options. The inclusion of the policing cost has little impact on the rank order of options, and it is not included.

6.3.3 Under both cost increase scenarios, when a perturbation effect is turned off for non-selective cull options, the rank order of the first three options (i.e. with illustrative NPVs) remains the same as the original analysis: Option 5 is ranked first (Non-selective cull via predominant controlled shooting by private sector), Option 4 second (Non-selective cull via restraint trap deployed by the private sector), and Option 8 third (TVR via restraints by the private sector), all with positive illustrative NPVs. However, Option 3 (Non-selective cull using cages deployed by the private sector) changes from having an illustrative NPV to a NPC.

6.3.4 However, if a perturbation effect is turned on for non-selective cull options, Option 8 (TVR with restraints deployed by the private sector) becomes ranked first, ahead of the predominant controlled shooting option (Option 5). In addition, Option 4 (Non-selective cull via restraints via private sector) switches

from an illustrative NPV to a NPC, and is ranked fourth after the “Do Nothing” option.

Table 12: Sens. Analy. considering the impact of a cost overrun (+15% or +30%) to private sector delivered options: Using model estimates of unique herd BDs avoided x £27,500 benefit/BD avoided to compare potential discounted benefits over nine years with estimated discounted intervention costs (over five years), assuming perturbation effect "Off" and "ON" for Options 2-5. Core impacts.

	Benefits assumed to last:	9 Yrs		9 Yrs		9 Yrs		9 Yrs		9 Yrs		9 Yrs	
	Perturbation effect on proactive cull opts.	**Off**		**On**		**Off**		**On**		**Off**		**On**	
	Policing cost estimated included?	**No**		**No**		**No**		**No**		**No**		**No**	
	Impacts measured?	**Core**		**Core**		**Core**		**Core**		**Core**		**Core**	
		Orig. Analysis		Sens. Pert. On		Sens. Policing Excl, Pert. Off, Costs incr. 15% for private		Sens. Policing Excl, Pert. On, Costs incr. 15% for private opt.		Sens. Policing Excl, Pert. Off, Costs incr. 30% for private opt.		Sens. Policing Excl, Pert. On, Costs incr. 30% for private opt.	
Opt		NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank
5	**Non-select. cull via predominant controlled shooting** deployed by the private sector	**£1.165**	**1**	£0.336	**2**	**£1.104**	**1**	£0.274	**2**	**£1.043**	**1**	£0.213	**2**
4	**Non-select. cull via restraint trap** deployed by the private sector	**£0.909**	**2**	£0.079	**3**	**£0.809**	**2**	-£0.020	**4**	**£0.710**	**2**	-£0.120	**4**
8	**Selective cull via TVR using restraint traps** deployed by the private sector	**£0.668**	**3**	£0.668	**1**	**£0.538**	**3**	£0.538	**1**	**£0.408**	**3**	£0.408	**1**
3	**Non-select. cull**, trapping badgers using **cages**, deployed by the **private** sector	**£0.111**	4	-£0.719	7	**-£0.108**	5	-£0.938	8	**-£0.327**	5	-£1.157	8
1	**Do Nothing**	£0.000	5	£0.000	4	£0.000	4	£0.000	3	**£0.000**	4	£0.000	3
7	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **private** sector	**-£0.112**	6	-£0.112	5	**-£0.358**	7	-£0.358	6	**-£0.605**	7	-£0.605	6
11	**Vaccination**, trapping badgers using **restraints**, deployed by the **private** sector	**-£0.226**	7	-£0.226	6	**-£0.334**	6	-£0.334	5	**-£0.441**	6	-£0.441	5
2	**Non-select. cull**, trapping badgers using **cages**, deployed by the **public** sector	**-£0.628**	8	-£1.458	10	**-£0.628**	8	-£1.458	10	**-£0.628**	8	-£1.458	10
6	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **public** sector	**-£0.895**	9	-£0.895	8	**-£0.895**	9	-£0.895	7	**-£0.895**	9	-£0.895	7
10	**Vaccination**, trapping badgers using **cages,** deployed by the **private** sector	**-£1.008**	10	-£1.008	9	**-£1.233**	10	-£1.233	9	**-£1.457**	10	-£1.457	9
9	**Vaccination**, trapping badgers using **cages,** deployed by the **public** sector	**-£1.739**	11	-£1.739	11	**-£1.739**	11	-£1.739	11	**-£1.739**	11	-£1.739	11

6.4 What if benefits lasted for a shorter period of 7 years, instead of 9 years?

6.4.1 Table 13 considers the illustrative NPV of options (where the NPV excludes the policing cost estimate) if benefits last for 7 years vis a vis the central assumption used in the main analysis that benefits are likely to last for 9 years.

6.4.2 When the perturbation effect is turned off for non-selective cull options, the rank order remains the same as the original analysis: Option 5 is ranked first (Non-selective cull via predominant controlled shooting by private sector), Option 4 second (Non-selective cull via restraint trap deployed by the private sector), and Option 8 third (TVR via restraints deployed by the private sector), all with positive illustrative NPVs. However, Option 3 (Non-selective cull via cages deployed by the private sector) changes from having an illustrative NPV to a NPC.

6.4.3 When the perturbation effect is turned on for non-selective cull options, only two options have illustrative NPVs: Option 8 (TVR via restraints by private sector) which is ranked first, and Option 5 (Non-selective cull via controlled shooting) which is ranked second.

Table 13: Sensitivity analysis considering the impact a shorter period of benefits i.e. 7 years rather than 9 years. Core impacts.

	Benefits assumed to last:	9 Yrs		9 Yrs		**7 Yrs**		**7 Yrs**	
	Perturbation effect on proactive cull opts.	**Off**		**On**		**Off**		**On**	
	Policing cost estimated included?	**No**		**No**		**No**		**No**	
	Impacts measured?	**Core**		**Core**		**Core**		**Core**	
		Orig. Analysis		Sens. Pert. On		Sens. Policing Excl, Pert. Off, Benefits last 7 yrs		Sens. Policing Excl, Pert. On, Benefits last 7 yrs	
Opt		NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank
5	**Non-select. cull via predominant controlled shooting** deployed by the private sector	**£1.165**	**1**	£0.336	**2**	**£0.754**	**1**	£0.016	**2**
4	**Non-select. cull via restraint trap** deployed by the private sector	**£0.909**	**2**	£0.079	**3**	**£0.497**	**2**	-£0.240	**4**
8	**Selective cull via TVR using restraint traps** deployed by the private sector	**£0.668**	**3**	£0.668	**1**	**£0.234**	**3**	£0.234	**1**
3	**Non-select. cull**, trapping badgers using **cages**, deployed by the **private** sector	**£0.111**	4	-£0.719	7	**-£0.301**	5	-£1.038	7
1	**Do Nothing**	£0.000	5	£0.000	4	**£0.000**	4	£0.000	3
7	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **private** sector	**-£0.112**	6	-£0.112	5	**-£0.545**	7	-£0.545	6
11	**Vaccination**, trapping badgers using **restraints**, deployed by the **private** sector	**-£0.226**	7	-£0.226	6	**-£0.454**	6	-£0.454	5
2	**Non-select. cull**, trapping badgers using **cages**, deployed by the **public** sector	**-£0.628**	8	-£1.458	10	**-£1.040**	8	-£1.778	10
6	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **public** sector	**-£0.895**	9	-£0.895	8	**-£1.329**	10	-£1.329	9
10	**Vaccination**, trapping badgers using **cages,** deployed by the **private** sector	**-£1.008**	10	-£1.008	9	**-£1.236**	9	-£1.236	8
9	**Vaccination**, trapping badgers using **cages,** deployed by the **public** sector	**-£1.739**	11	-£1.739	11	**-£1.967**	11	-£1.967	11

6.5 What if benefits lasted for a longer period of 11 years, instead of 9 years?

6.5.1 Table 14 considers the illustrative NPV of options (where the NPV excludes the policing cost estimate) if benefits last for 11 years vis a vis the central assumption used in the main analysis that benefits are likely to last for 9 years.

6.5.2 When the perturbation effect is turned off for non-selective cull options, and benefits are assumed to last for 11 years, then six options have illustrative NPVs: Option 5 is ranked first (Non-selective cull via predominant controlled shooting by private sector), Option 4 second (Non-selective cull via restraint trap deployed by the private sector), Option 8 third (TVR via restraints by private sector), Option 3 fourth (Non-selective cull using cages, deployed by private sector), Option 7 fifth (TVR using cages deployed by the private sector) and Option 11 sixth (Vaccination using restraints deployed by the private sector). The inclusion of two more years of benefit (from 9 to 11 years) result in the latter two options changing from having illustrative NPCs to NPVs.

6.5.3 When the perturbation effect is turned on for non-selective cull options, and benefits are assumed to last for 11 years, then five options have illustrative NPVs: Option 8 (TVR via restraints by private sector) is ranked first, followed by Option 5 (Non-selective cull via predominant controlled shooting by private sector), followed by Option 4 (Non-selective cull via restraints, by the private sector), followed by Option 7 (TVR using cage traps, by the private sector) and Option 11 (Vaccination using restraint traps, by the private sector). Again, the inclusion of two extra years of benefit result in the latter two options changing from having illustrative NPCs to NPVs. In addition, the assumption of a perturbation effect for non-selective cull options results in Option 3 (Non-selective cull via cages, by the private sector) changing from having an illustrative NPV to an NPC.

Table 14: Sensitivity analysis considering the impact a longer period of benefits i.e. 11 years rather than 9 years. Core impacts.

	Benefits assumed to last:	9 Yrs		9 Yrs		**11 Yrs**		**11 Yrs**	
	Perturbation effect on proactive cull opts.	**Off**		**On**		**Off**		**On**	
	Policing cost estimated included?	**No**		**No**		**No**		**No**	
	Impacts measured?	**Core**		**Core**		**Core**		**Core**	
		Orig. Analysis		Sens. Pert. On		Sens. Policing Excl, Pert. Off, Benefits last 11 yrs		Sens. Policing Excl, Pert. On, Benefits last 11 yrs	
Opt		NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank
5	**Proactive cull via predominant controlled shooting** deployed by the private sector	**£1.165**	**1**	£0.336	**2**	**£1.596**	**1**	£0.633	**2**
4	**Proactive cull via restraint trap** deployed by the private sector	**£0.909**	**2**	£0.079	**3**	**£1.340**	**2**	£0.377	**3**
8	**Selective cull via TVR using restraint traps** deployed by the private sector	**£0.668**	**3**	£0.668	**1**	**£1.096**	**3**	£1.096	**1**
3	**Proactive cull**, trapping badgers using **cages**, deployed by the **private** sector	**£0.111**	4	-£0.719	7	**£0.542**	4	-£0.421	7
1	**Do Nothing**	£0.000	5	£0.000	4	**£0.000**	7	£0.000	6
7	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **private** sector	**-£0.112**	6	-£0.112	5	**£0.316**	5	£0.316	4
11	**Vaccination**, trapping badgers using **restraints**, deployed by the **private** sector	**-£0.226**	7	-£0.226	6	**£0.068**	6	£0.068	5
2	**Proactive cull**, trapping badgers using **cages**, deployed by the **public** sector	**-£0.628**	8	-£1.458	10	**-£0.198**	8	-£1.160	10
6	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **public** sector	**-£0.895**	9	-£0.895	8	**-£0.468**	9	-£0.468	8
10	**Vaccination**, trapping badgers using **cages,** deployed by the **private** sector	**-£1.008**	10	-£1.008	9	**-£0.714**	10	-£0.714	9
9	**Vaccination**, trapping badgers using **cages,** deployed by the **public** sector	**-£1.739**	11	-£1.739	11	**-£1.444**	11	-£1.444	11

6.6 Summary of sensitivity analyses impact on options when benefits are assessed over the "core" intervention area

6.6.1 Tables 15 and 16 provide a summary of the various sensitivity scenarios with and without a policing cost assumed. (This allows a reader to compare the cost of some options with policing costs included, and others without policing costs included by considering the relevant values from each table.) They show that with no perturbation effect assumed, Options 5, 4 and 8 are consistently ranked first, second and third. When a perturbation effect is assumed, Options 8 and 5 are consistently ranked first and second, except when policing costs are added and benefits are only assumed to last 7 years, when option 5 changes from having an illustrative NPV to an NPC.

Table 15: Outlining all "core impact" sensitivity scenarios vis a vis the original assumptions (highlighted in yellow)- no policing cost

	Benefits assumed to last:	9 Yrs		9 Yrs		9 Yrs		9 Yrs		9 Yrs		9 Yrs		**7 Yrs**		**7 Yrs**		**11 Yrs**		**11 Yrs**	
	Perturbation effect on proactive cull opts.	Off		On		Off		On		Off		On		Off		On		Off		On	
	Policing cost estimated included?	No		No		No		No		No		No		No		No		No		No	
	Impacts measured?	Core		Core		Core		Core		Core		Core		Core		Core		Core		Core	
		Orig. Analysis		Sens. Pert. On		Sens. Policing Excl, Pert. Off, Costs incr. 15% for private		Sens. Policing Excl, Pert. On, Costs incr. 15% for private opt.		Sens. Policing Excl, Pert. Off, Costs incr. 30% for private opt.		Sens. Policing Excl, Pert. On, Costs incr. 30% for private opt.		Sens. Policing Excl, Pert. Off, Benefits last 7 yrs		Sens. Policing Excl, Pert. On, Benefits last 7 yrs		Sens. Policing Excl, Pert. Off, Benefits last 11 yrs		Sens. Policing Excl, Pert. On, Benefits last 11 yrs	
Opt		NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank
5	**Non-select. cull via predominant controlled shooting** deployed by the private sector	**£1.165**	**1**	£0.336	**2**	**£1.104**	**1**	£0.274	**2**	**£1.043**	**1**	£0.213	**2**	**£0.754**	**1**	£0.016	**2**	**£1.596**	**1**	£0.633	**2**
4	**Non-select. cull via restraint trap** deployed by the private sector	**£0.909**	**2**	£0.079	**3**	**£0.809**	**2**	-£0.020	**4**	**£0.710**	**2**	-£0.120	**4**	**£0.497**	**2**	-£0.240	**4**	**£1.340**	**2**	£0.377	**3**
8	**Selective cull via TVR using restraint traps** deployed by the private sector	**£0.668**	**3**	£0.668	**1**	**£0.538**	**3**	£0.538	**1**	**£0.408**	**3**	£0.408	**1**	**£0.234**	**3**	£0.234	**1**	**£1.096**	**3**	£1.096	**1**
3	**Non-select. cull**, trapping badgers using **cages**, deployed by the **private** sector	**£0.111**	4	-£0.719	7	**-£0.108**	5	-£0.938	8	**-£0.327**	5	-£1.157	8	**-£0.301**	5	-£1.038	7	**£0.542**	4	-£0.421	7
1	**Do Nothing**	£0.000	5	£0.000	4	£0.000	4	£0.000	3	**£0.000**	4	£0.000	3	**£0.000**	4	£0.000	3	**£0.000**	7	£0.000	6
7	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **private** sector	**-£0.112**	6	-£0.112	5	**-£0.358**	7	-£0.358	6	**-£0.605**	7	-£0.605	6	**-£0.545**	7	-£0.545	6	**£0.316**	5	£0.316	4
11	**Vaccination**, trapping badgers using **restraints**, deployed by the **private** sector	**-£0.226**	7	-£0.226	6	**-£0.334**	6	-£0.334	5	**-£0.441**	6	-£0.441	5	**-£0.454**	6	-£0.454	5	**£0.068**	6	£0.068	5
2	**Non-select. cull**, trapping badgers using **cages**, deployed by the **public** sector	**-£0.628**	8	-£1.458	10	**-£0.628**	8	-£1.458	10	**-£0.628**	8	-£1.458	10	**-£1.040**	8	-£1.778	10	**-£0.198**	8	-£1.160	10
6	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **public** sector	**-£0.895**	9	-£0.895	8	**-£0.895**	9	-£0.895	7	**-£0.895**	9	-£0.895	7	**-£1.329**	10	-£1.329	9	**-£0.468**	9	-£0.468	8
10	**Vaccination**, trapping badgers using **cages,** deployed by the **private** sector	**-£1.008**	10	-£1.008	9	**-£1.233**	10	-£1.233	9	**-£1.457**	10	-£1.457	9	**-£1.236**	9	-£1.236	8	**-£0.714**	10	-£0.714	9
9	**Vaccination**, trapping badgers using **cages,** deployed by the **public** sector	**-£1.739**	11	-£1.739	11	**-£1.739**	11	-£1.739	11	**-£1.739**	11	-£1.739	11	**-£1.967**	11	-£1.967	11	**-£1.444**	11	-£1.444	11

Table 16: Outlining all "core impact" sensitivity scenarios vis a vis the original assumptions (highlighted in yellow)- WITH policing cost

	Benefits assumed to last:	9 Yrs		9 Yrs		9 Yrs		9 Yrs		9 Yrs		9 Yrs		9 Yrs		9 Yrs		**7 Yrs**		**7 Yrs**		**11 Yrs**		**11 Yrs**	
	Perturbation effect on proactive cull opts.	Off		On		Off		On		Off		On		Off		On		Off		On		Off		On	
	Policing cost estimated included?	No		No		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
	Impacts measured?	Core		Core		Core		Core		Core		Core		Core		Core		Core		Core		Core		Core	
		Orig. Analysis		Sens. Pert. On		Sens. Policing Incl, Pert. Off		Sens. Policing Incl, Pert. On		Sens. Policing Incl, Pert. Off, Costs incr. 15% for priv. opt.		Sens. Policing Incl, Pert. On, Costs incr. 15% for priv.		Sens. Policing Incl, Pert. Off, Costs incr. 30% for priv. opt.		Sens. Policing Incl, Pert. On, Costs incr. 30% for priv. opt.		Sens. Policing Incl, Pert. Off, Benefits last 7 yrs		Sens. Policing Incl, Pert. On, Benefits last 7 yrs		Sens. Policing Incl, Pert. Off, Benefits last 11 yrs		Sens. Policing Incl, Pert. On, Benefits last 11 yrs	
Opt		NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank
5	**Non-select. cull via predominant controlled shooting** deployed by the private sector	**£1.165**	**1**	£0.336	**2**	£1.113	**1**	£0.284	**2**	£1.044	1	£0.215	2	£0.976	1	£0.146	2	£0.702	**1**	-£0.036	**3**	£1.544	**1**	£0.582	**2**
4	**Non-select. cull via restraint trap** deployed by the private sector	**£0.909**	**2**	£0.079	**3**	£0.857	**2**	£0.027	**3**	£0.750	2	-£0.080	4	£0.642	2	-£0.187	4	£0.446	**2**	-£0.292	**4**	£1.288	**2**	£0.325	**3**
8	**Selective cull via TVR using restraint traps** deployed by the private sector	**£0.668**	**3**	£0.668	**1**	£0.616	**3**	£0.616	**1**	£0.479	3	£0.479	1	£0.341	3	£0.341	1	£0.182	**3**	£0.182	**1**	£1.044	**3**	£1.044	**1**
3	**Non-select. cull**, trapping badgers using **cages**, deployed by the **private** sector	**£0.111**	4	-£0.719	7	**£0.059**	4	-£0.770	7	-£0.168	5	-£0.998	8	-£0.395	5	-£1.225	8	-£0.352	5	-£1.090	7	£0.490	4	-£0.473	7
1	**Do Nothing**	£0.000	5	£0.000	4	£0.000	5	£0.000	4	£0.000	4	£0.000	3	£0.000	4	£0.000	3	£0.000	4	£0.000	2	£0.000	7	£0.000	6
7	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **private** sector	**-£0.112**	6	-£0.112	5	-£0.163	6	-£0.163	5	-£0.418	7	-£0.418	6	-£0.673	7	-£0.673	6	-£0.597	7	-£0.597	6	£0.264	5	£0.264	4
11	**Vaccination**, trapping badgers using **restraints**, deployed by the **private** sector	**-£0.226**	7	-£0.226	6	-£0.278	7	-£0.278	6	-£0.393	6	-£0.393	5	-£0.508	6	-£0.508	5	-£0.506	6	-£0.506	5	£0.016	6	£0.016	5
2	**Non-select. cull**, trapping badgers using **cages**, deployed by the **public** sector	**-£0.628**	8	-£1.458	10	-£0.680	8	-£1.510	10	-£0.680	8	-£1.510	10	-£0.680	8	-£1.510	9	-£1.092	8	-£1.829	10	-£0.250	8	-£1.212	10
6	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **public** sector	**-£0.895**	9	-£0.895	8	-£0.947	9	-£0.947	8	-£0.947	9	-£0.947	7	-£0.947	9	-£0.947	7	-£1.381	10	-£1.381	9	-£0.520	9	-£0.520	8
10	**Vaccination**, trapping badgers using **cages,** deployed by the **private** sector	**-£1.008**	10	-£1.008	9	-£1.060	10	-£1.060	9	-£1.293	10	-£1.293	9	-£1.525	10	-£1.525	10	-£1.288	9	-£1.288	8	-£0.766	10	-£0.766	9
9	**Vaccination**, trapping badgers using **cages,** deployed by the **public** sector	**-£1.739**	11	-£1.739	11	-£1.790	11	-£1.790	11	-£1.790	11	-£1.790	11	-£1.790	11	-£1.790	11	-£2.018	11	-£2.018	11	-£1.496	11	-£1.496	11

6.7 What if we consider the modelled estimates for a wider arena (rather than only considering impacts within the 100km^2 badger intervention "core" area).

6.7.1 The original economic analysis used the modelled illustrative herd breakdowns avoided from the area of badger intervention, called the "core" area. As previously discussed, the impact in areas beyond the core are arguably more sensitive to modelling assumptions because they depend on boundary geometry, badger movement, cross-boundary transmission pathways, etc. So, the "core" results for herd breakdowns are considered most worthy of note and are presented in the main economic analysis.

6.7.2 The sensitivity now undertaken explores the rank order of options if the modelled illustrative herd breakdowns avoided from a wider arena are included. These modelled benefits take the original "core" area benefits but also add in "buffer" and "outside" area benefits, with the result that the modelled impact on herd breakdowns avoided are counted across a larger "arena" area.

Nine-year benefit period, arena impact, no perturbation effect

6.7.3 Excluding a policing cost estimate, with benefits assumed over a nine-year period, but with no perturbation effect assumed for non-selective cull options, the following options have illustrative NPVs if the modelled arena benefit is considered:

- (as before) Opt. 5– N.Sel. Cull via predom. C.S., deployed by private sector;
- (as before) Opt. 4– N.Sel. Cull via restraint traps, deployed by private sector;
- (as before) Opt. 8– S. Cull using TVR via restraint traps, deployed by private sector;
- (as before) Opt. 3– N.Sel. Cull, using cages, deployed by private sector;
- (new) Opt. 7– S. Cull using TVR via cages, deployed by private sector; and
- (new) Opt. 2– N.Sel. Cull, using cages, deployed by the public sector.

Seven-year benefit period, arena impact, no perturbation effect

6.7.4 Should the benefits only last for seven years, then the original options with illustrative NPVs remain the only ones with NPVs (i.e. Opt. 5, 4, 8 and 3).

Eleven-year benefit period, arena impact, no perturbation effect

6.7.5 Should the benefits last for eleven years, then the options with illustrative NPVs are:

- (as before) Opt. 5– N.Sel. Cull via predom. C.S., deployed by private sector;
- (as before) Opt. 4– N.Sel. Cull via restraint traps, deployed by private sector;
- (as before though moved up a rank) Opt. 3– N.Sel. Cull, using cages, deployed by the private sector; and
- (as before though moved down a rank) Opt. 8– S. Cull using TVR via restraint traps, deployed by private sector;
- (new) Opt. 2– N.Sel. Cull using cage traps, deployed by the public sector;
- (new) Opt. 7– S. Cull using TVR via cage traps, deployed by the private sector;
- (new) Opt. 6– S. Cull using TVR via cage traps, deployed by the public sector; and
- Opt. 11– Vaccination using restraint traps, deployed by the private sector.

Nine-year benefit period, arena impact, WITH perturbation effect

6.7.6 If perturbation is turned on for non-selective Cull options, then the following options have illustrative NPVs:

- (as before) Opt. 8 – S. Cull using TVR via restraint traps, deployed by private sector;
- (new) Opt. 7 – S. Cull using TVR via cage traps, deployed by private sector; and
- (as before, though moved down a rank) Opt. 5 – Non-Sel. Cull via predominate C.S., deployed by private sector.

Seven-year benefit period, arena impact, WITH perturbation effect

6.7.7 If perturbation is turned on for Non-selective Cull options, and benefits are assumed for seven years, then only Option 8 (S. Cull using restraint traps, deployed by the private sector) has an illustrative NPV.

Eleven-year benefit period, arena impact, WITH perturbation effect

6.7.8 However, if benefits are considered over an eleven-year period, with perturbation effect turned on for Non-selective Cull options, the following options have illustrative NPVs:

- (as before) Opt. 8 – S. Cull via TVR using restraint traps, deployed by private sector;
- (new) Opt. 7: S. Cull via TVR using cage traps, deployed by the private sector;
- (as before, though moved down a rank) Opt. 5 – N.Sel. Cull via predominant C.S., deployed by private sector;
- (as before, though moved down a rank) Opt. 4 – N.Sel. Cull using restraint traps, deployed by private sector;
- (new) Opt. 6 – S. Cull via TVR using cage traps, deployed by public sector; and
- (new) Opt. 11 – Vaccination using restraint traps, deployed by private sector.

ARENA Sensitivity analysis IF a policing cost is assumed

6.7.9 When a policing cost is assumed, the rank order of options under the various sensitivity scenarios remain as described above.

Table 17: Sensitivity considering what happens when a policing cost is excluded but instead of counting 'core' area impacts on herd Breakdowns avoided, 'arena' impacts from modelling are included

	Benefits assumed to last:	9 Yrs		9 Yrs		9 Yrs		9 Yrs		7 Yrs		7 Yrs		11 Yrs		11 Yrs	
	Perturbation effect on proactive cull opts.	Off		On		Off		On		Off		On		Off		On	
	Policing cost estimated included?	No		No		No		No		No		No		No		No	
	Impacts measured?	Core		Core		ARENA		ARENA		ARENA		ARENA		ARENA		ARENA	
		Orig. Analysis		Sens. Pert. On		Sens. Policing Excl, Pert. Off, Benefits last 9 yrs - ARENA		Sens. Policing Excl, Pert. On, Benefits last 9 yrs - ARENA		Sens. Policing Excl, Pert. Off, Benefits last 7 yrs - ARENA		Sens. Policing Excl, Pert. On, Benefits last 7 yrs - ARENA		Sens. Policing Excl, Pert. Off, Benefits last 11 yrs - ARENA		Sens. Policing Excl, Pert. On, Benefits last 11 yrs - ARENA	
Opt		NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank
5	**Non-select. cull via predominant controlled shooting** deployed by the private sector	**£1.165**	**1**	£0.336	**2**	**£2.060**	**1**	£0.252	**3**	**£1.321**	**1**	-£0.219	**4**	**£2.840**	**1**	£0.756	**3**
4	**Non-select. cull via restraint trap** deployed by the private sector	**£0.909**	**2**	£0.079	**3**	**£1.804**	**2**	-£0.004	**5**	**£1.065**	**2**	-£0.475	**5**	**£2.583**	**2**	£0.500	**4**
8	**Selective cull via TVR using restraint traps** deployed by the private sector	**£0.668**	**3**	£0.668	**1**	**£1.173**	**3**	£1.173	**1**	**£0.569**	**3**	£0.569	**1**	**£1.785**	**4**	£1.785	**1**
3	**Non-select. cull**, trapping badgers using **cages**, deployed by the **private** sector	**£0.111**	4	-£0.719	7	**£1.006**	4	-£0.802	8	**£0.267**	4	-£1.273	8	**£1.785**	3	-£0.298	8
1	**Do Nothing**	£0.000	5	£0.000	4	**£0.000**	7	£0.000	4	**£0.000**	5	£0.000	2	**£0.000**	9	£0.000	7
7	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **private** sector	**-£0.112**	6	-£0.112	5	**£0.394**	5	£0.394	2	**-£0.211**	6	-£0.211	3	**£1.006**	6	£1.006	2
11	**Vaccination**, trapping badgers using **restraints**, deployed by the **private** sector	**-£0.226**	7	-£0.226	6	**-£0.191**	8	-£0.191	6	**-£0.503**	8	-£0.503	6	**£0.176**	8	£0.176	6
2	**Non-select. cull**, trapping badgers using **cages**, deployed by the **public** sector	**-£0.628**	8	-£1.458	10	**£0.267**	6	-£1.541	10	**-£0.473**	7	-£2.012	10	**£1.046**	5	-£1.037	10
6	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **public** sector	**-£0.895**	9	-£0.895	8	**-£0.390**	9	-£0.390	7	**-£0.995**	9	-£0.995	7	**£0.222**	7	£0.222	5
10	**Vaccination**, trapping badgers using **cages,** deployed by the **private** sector	**-£1.008**	10	-£1.008	9	**-£0.973**	10	-£0.973	9	**-£1.285**	10	-£1.285	9	**-£0.606**	10	-£0.606	9
9	**Vaccination**, trapping badgers using **cages,** deployed by the **public** sector	**-£1.739**	11	-£1.739	11	**-£1.703**	11	-£1.703	11	**-£2.015**	11	-£2.015	11	**-£1.336**	11	-£1.336	11

Table 18: Sensitivity considering what happens when a policing cost is included but instead of counting 'core' impacts on herd BDs avoided, 'arena' impacts from modelling are included

	Benefits assumed to last:	9 Yrs		9 Yrs		9 Yrs		9 Yrs		**7 Yrs**		**7 Yrs**		**11 Yrs**		**11 Yrs**	
	Perturbation effect on proactive cull opts.	**Off**		**On**		**Off**		**On**		**Off**		**On**		**Off**		**On**	
	Policing cost estimated included?	**No**		**No**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
	Impacts measured?	**Core**		**Core**		**ARENA**		**ARENA**		**ARENA**		**ARENA**		**ARENA**		**ARENA**	
		Orig. Analysis		Sens. Pert. On		Sens. Policing Incl, Pert. Off, Benefits last 9 yrs - ARENA		Sens. Policing Incl, Pert. On, Benefits last 9 yrs - ARENA		Sens. Policing Incl, Pert. Off, Benefits last 7 yrs - ARENA		Sens. Policing Incl, Pert. On, Benefits last 7 yrs - ARENA		Sens. Policing Incl, Pert. Off, Benefits last 11 yrs - ARENA		Sens. Policing Incl, Pert. On, Benefits last 11 yrs - ARENA	
Opt		NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank	NPV (indicative)	Rank
5	**Non-select. cull via predominant controlled shooting** deployed by the private sector	**£1.165**	**1**	£0.336	**2**	£2.009	**1**	£0.200	**3**	£1.269	**1**	-£0.270	**4**	£2.788	**1**	£0.705	**3**
4	**Non-select. cull via restraint trap** deployed by the private sector	**£0.909**	**2**	£0.079	**3**	£1.752	**2**	-£0.056	**5**	£1.013	**2**	-£0.527	**5**	£2.532	**2**	£0.448	**4**
8	**Selective cull via TVR using restraint traps** deployed by the private sector	**£0.668**	**3**	£0.668	**1**	£1.122	**3**	£1.122	**1**	£0.517	**3**	£0.517	**1**	£1.733	**4**	£1.733	**1**
3	**Non-select. cull**, trapping badgers using **cages**, deployed by the **private** sector	**£0.111**	4	-£0.719	7	£0.954	4	-£0.854	8	£0.215	4	-£1.325	8	£1.734	3	-£0.350	8
1	**Do Nothing**	£0.000	5	£0.000	4	£0.000	7	£0.000	4	£0.000	5	£0.000	2	£0.000	9	£0.000	7
7	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **private** sector	**-£0.112**	6	-£0.112	5	£0.342	5	£0.342	2	-£0.263	6	-£0.263	3	£0.954	6	£0.954	2
11	**Vaccination**, trapping badgers using **restraints**, deployed by the **private** sector	**-£0.226**	7	-£0.226	6	-£0.243	8	-£0.243	6	-£0.555	8	-£0.555	6	£0.124	8	£0.124	6
2	**Non-select. cull**, trapping badgers using **cages**, deployed by the **public** sector	**-£0.628**	8	-£1.458	10	£0.215	6	-£1.593	10	-£0.525	7	-£2.064	10	£0.994	5	-£1.089	10
6	**Selective cull** using Test Vaccinate Remove, trapping badgers using **cages**, deployed by the **public** sector	**-£0.895**	9	-£0.895	8	-£0.442	9	-£0.442	7	-£1.047	9	-£1.047	7	£0.170	7	£0.170	5
10	**Vaccination**, trapping badgers using **cages,** deployed by the **private** sector	**-£1.008**	10	-£1.008	9	-£1.025	10	-£1.025	9	-£1.337	10	-£1.337	9	-£0.658	10	-£0.658	9
9	**Vaccination**, trapping badgers using **cages,** deployed by the **public** sector	**-£1.739**	11	-£1.739	11	-£1.755	11	-£1.755	11	-£2.067	11	-£2.067	11	-£1.388	11	-£1.388	11

6.8 Conclusion of sensitivity analysis

6.8.1 As explained earlier, the results of most interest are those relating to impacts in the "core" badger intervention area. Considering "core" results in the sensitivity analyses, the general conclusions still stand:

- In all scenarios, vaccination options rank less well than either TVR or Cull options, using the same trapping and deployment approach.

- Public sector deployment is the most expensive. In the vast majority of sensitivity scenarios, public sector deployment options consistently have illustrative NPCs, and always rank worse than the private sector equivalent options. Therefore, from an economic NPV perspective, private sector deployment is preferred to public sector deployment no matter what badger intervention approach is chosen.

- Undertaking each approach with restraints rather than cages significantly reduces the cost of options and tends to improve their rank.

- Without a perturbation effect assumed for non-selective cull options, the three options that were top ranked in the main analysis continue to be ranked top in all sensitivity scenarios, i.e.

    - **Option 5**, **Non-selective cull via predominant controlled shooting** deployed by the private sector
    - **Option 4, Non-selective cull via restraint trap** deployed by the private sector
    - **Option 8**, **Selective cull via TVR using restraint traps** deployed by the private sector

- These options are resilient to changes in key assumptions and continue to have a reasonable likelihood of delivering sufficient benefit in terms of herd breakdowns avoided to offset their implementation cost under the various sensitivity scenarios.

- While Option 3 (Non-selective cull using cage trapping deployed by the private sector) has an illustrative NPV in a few scenarios, it is very sensitive to an increase in cost, or a lower benefit period, and in most "core" sensitivity scenarios, it has an illustrative NPC.

- If a perturbation effect is assumed for non-selective cull options, then Option 8 (Selective cull using TVR via restraint trapping deployed by the private sector) becomes consistently ranked first in all sensitivity scenarios. It is generally followed by Option 5 (Predominant Controlled Shoot). (The exception to this is where it is assumed that benefits only last for 7 years instead of 9 years, and a policing cost estimate is included. In this scenario Option 5 ranked third after the "Do Nothing" option as its NPV switches to an NPC.)

- Option 7, Selective cull via TVR using cages, deployed by the private sector, costs almost twice that of Option 8 and generally has an illustrative NPC for "core" area results, except when it is assumed that benefits last for an eleven-year period. Under eleven-year benefit assumptions, it remains ranked less well than Option 8 (TVR using restraints, deployed by the private sector) and the two non-selective cull options using controlled shooting and restraints (Option 5 and Option 4).

6.8.2 If the design of a non-selective cull intervention in NI broadly copies the ROI's Four Area Trial (i.e. relatively large areas surrounded by hard boundaries as far as possible), perturbation may not be an issue. If that should be the case, then **Option 5** (Non-selective cull via Predominant Control Shooting deployed by the private sector) would rank the highest on illustrative NPV in all scenarios, followed by **Option 4** (Non-selective cull via restraint trapping deployed by the private sector), followed by **Option 8** (TVR via restraint trapping deployed by the private sector).

6.8.3 However, if smaller sized areas are selected, and if there are limited opportunities to use hard boundaries, then the risk of a perturbation effect may increase. Should the perturbation effect be similar to that modelled, then

Option 8 (Selective Cull via Restraints deployed by the private sector) would rank highest on illustrative NPV in all scenarios.

7. Non-monetary factor analysis

7.1 Principles of non-monetary analysis

7.1.1 This chapter considers costs/benefits that differ between options that cannot be easily monetised. As per the Better Business Case guidance[99], factors are avoided that cannot be measured, assessed or evaluated in any realistic way because there is no established evidence. Rather, the focus is on factors where there is an evidence base.

7.2 Distilling out non-monetary factors with an evidence base that differ between some of the short-listed options

7.2.1 From the consultation conducted on proposals presented by the TB Strategic Partnership Group (TBSPG), DAERA is aware that there is a very wide range of views and opinions on different approaches to badger intervention.

7.2.2 Table 19 provides a summary of the most common issues raised by stakeholders and considers if (i) there is an evidence base to demonstrate how shortlisted options might vary on this factor, and (ii) if so, where in the analysis of options that this aspect is considered.

7.2.3 A consultation will be conducted in July – September 2026 that will allow stakeholders to feed new / additional evidence into this draft non-monetary analysis. Written evidence submitted to DAERA during the consultation period will be considered and this analysis updated as required. This is considered the most appropriate approach to comprehensive stakeholder engagement given the diverse, and often polarised, range of views held.

[99] Guide to developing the Project Business Case. Page 51. Second para. under Action 11.

Table 19: Most commonly cited views on badger intervention proposals

Issue	Is there an evidence base?	Where addressed? To be included in Non-monetary Factor (NMF) Analysis?
Badger welfare		
Badgers removed, and broad proportion of these that are healthy: Some stakeholders are concerned about cull options being indiscriminate (i.e. removing both healthy badgers alongside bTB diseased badgers).	Yes. APHA modelling data illustrates the relativity of the number of badgers removed under each approach, including the broad proportion potentially healthy.	**Included in Non-Monetary Factor Analysis**
Badger welfare: Some stakeholders are concerned about the welfare of the controlled shooting approach to a cull in particular. Some also have concerns about the injury impact of badger trapping using restraints or cages.	Yes. There is some evidence available on 'time to die' under a controlled shoot approach, and on injuries from the two trapping approaches.	**Included in Non-Monetary Factor Analysis**
Cattle welfare		
Cattle welfare: Some stakeholders are concerned about the number of cattle removed prematurely.	Yes. By way of background / context, the NI cattle identification system tells us that > 20,000 cattle are removed per annum under the "status quo" bTB programme. As these cattle are compulsorily removed (i.e. prior to being sent to slaughter voluntarily by their owners), it is assumed that they are removed prematurely to some degree. This is an emotive issue, and it is exacerbated when the animals are relatively young. bTB is a multifaceted disease, which makes it impossible to predict exactly what the change in	**Included in Non-Monetary Factor Analysis**

	this figure will be purely as a result of introducing wildlife intervention as an aspect of the bTB programme. However, the APHA modelling is a useful evidence source as it provides relative illustrative impacts on the number of herd breakdowns avoided per year as a result of introducing a cull, TVR and vaccination badger intervention. When adapted to a 100km^2 pro-rata and multiplied by the average number of cattle removed per breakdown, this provides an illustrative estimate of how many less cattle would be compulsorily removed prematurely compared to the status quo situation (no badger intervention).	
Environmental Impact – Ecology: Perturbation effect concerns		
Perturbation concerns – Non-selective cull	Yes. Can use NI Parameterised Model to consider perturbation "on" and "off" scenarios for non-selective cull options.	This is dealt with elsewhere. In the main economic analysis, there is no perturbation effect assumed for any option, i.e. the modelling results with no perturbation effect are firstly considered (perturbation turned "off" in the model). Then the Economic Sensitivity Analysis tests an alternative scenario in which a perturbation effect is assumed for the non-selective cull approach only, i.e. the results for the non-selective cull options are taken from the modelled scenario where a perturbation effect is turned "on". **As a perturbation effect risk is considered in the Economic Sensitivity Analysis, it is not included in the Non-Monetary Factor Analysis.**
Perturbation concerns - TVR	Yes.	As discussed above, a perturbation effect risk is considered for the Non-selective Cull approach in the Economic Sensitivity Analysis. As the TVR Pilot in Co. Down did not show increased badger ranging

	The DAERA TVR Pilot conducted in Co. Down confirmed that a TVR approach does not increase badger ranging behaviour[100].	behaviour, the Sensitivity Analysis does not consider a perturbation effect for the TVR approach. **=>As discussed above, as a perturbation effect risk is considered in the Economic Sensitivity Analysis, it is not included in NMF Analysis.**
Perturbation concerns - Vaccination	Yes. I.e. No evidence of a perturbation effect with a vaccination approach found[101].	As discussed above, a perturbation effect risk is considered for the Non-selective Cull approach in the Economic Sensitivity Analysis. It is not relevant to vaccination options as no badgers are removed. **=>As discussed above, as a perturbation effect risk is considered in the Economic Sensitivity Analysis, it is not included in the NMF Analysis.**
Environmental Impact – Ecology: Effect of removal of badgers on wider ecosystem		
Impact on other species: Options involving badger removal (Cull and TVR) may influence other species	This is not clear cut. For example, there are some suggestions that badger removal will have both positive and negative effects on other species, e.g. - Removing badgers from an eco-system brings potential for an increase in pest species, such as rabbits, rats and mice[102]; - It has also been evidenced that following badger culls, the number of foxes and hedgehogs increased[103]; - A rise in fox numbers can reduce populations of other animals, such as hedgehogs, hares and ground-nesting birds, due to increased predation[104].	Included in Risk Analysis (Risk of a negative net change to local biodiversity / ecosystems). **=>As this is dealt with in the Risk Analysis, it is not included in NMF Analysis.**

[100] Menzies, F.D., McCormick, C.M., O'Hagan, M.J.H., Collins, S.F., McEwan, J., McGeown, C.F., McHugh, G.E., Hart, C.D., Stringer, L.A., Molloy, C., Burns, G., McBride, S.J., Doyle, L.P., Courcier, E.A., McBride, K.R., McNair, J., Thompson, S., Corbett, D.M., Harwood, R.G., Trimble, N.A. (2021). Test and vaccinate or remove: Methodology and preliminary results from a badger intervention research project. Veterinary Record 189(5): no. DOI: 10.1002/vetr.248.

[101] Woodroffe, R., Donnelly, C.A., Ham, C., Jackson, S.Y.B., Moyes, K., Chapman, K., Stratton, N.G., Cartwright, S.J. (2017). Ranging behaviour of badgers Meles meles vaccinated with Bacillus Calmette Guerin. Journal of Applied Ecology 54(3): 718-725.
DOI: 10.1111/1365-2664.12837.

[102] Trewby et al. Experimental evidence of competitive release in sympatric carnivores (2008) Biology letters

[103] Trewby et al. Impacts of removing badgers on localised counts of hedgehogs (2014) PloS one

[104] https://tbhub.co.uk/wp-content/uploads/2020/02/AR-factsheet-the-effect-of-badger-culling-on-other-species-151118b.pdf

	This aspect is best dealt with in the risk analysis section.	
Environmental Impact – Risk of badger extinction		
Badger extinction risk: Some stakeholders are concerned about the risk of badger extinction if a non-selective cull is deployed.	This is discussed further in the risk analysis section. Badger intervention has been deployed elsewhere in GB and in the ROI and this risk is mitigated by various means.	Included in Risk Analysis **=>As this is dealt with in the Risk Analysis, it is not included in Non-Monetary Factor Analysis.**
Environmental Impact – Climate Change: GHG inefficiency due to animals compulsorily removed		
GHG inefficiency	In absence of bTB, farms would carry fewer replacement animals. The premature removal of cattle due to bTB is an inefficiency in bovine production systems, which results in an inefficiency in the GHG intensity per kg of meat or litre of milk produced.	While the data is not available to permit a quantification of the difference in GHG emissions due to the introduction of each badger intervention option into an indicative 100km^2 area, it is clear that this is related to the number of cattle removed prematurely. Therefore, this indicator can be used as a proxy to allow the relative scoring of options on this factor. The APHA model provides illustrative estimates of the relative difference each main badger intervention approach would have on the number of herd breakdowns in the 100km^2 area (pro rata). This can be multiplied by the average number of cattle removed per breakdown to arrive at an estimate of how many less cattle might be removed under each option compared to the status quo (no badger intervention). **Included in Non-Monetary Factor Analysis**
GHG emissions associated with the deployment mechanics of each intervention option	No, but the relative difference between options is likely to be insignificant.	The short-listed badger intervention options are predominantly labour based (i.e. very little use of machinery except for a small amount of jeep/trailer use for cage trapping, labour travel to farms, etc.). As such, there is likely to be very little difference

		between the deployment GHG emissions of each option. Therefore, this is **not** included in the **Non-Monetary Factor Analysis**.
Social Impact: Human Welfare		
Human Welfare – By way of context, there are approximately 21,500[105] herd keepers in NI. A Social Survey found 3.89[106] household members are associated with each active family farm. Pro-rata to the current number of herd keepers, that means 83,635 household members supported by bovine enterprises. There is evidence to show that bTB places a severe psychological burden on farmers and families (depression, stress, sleepless nights, relationship break-ups, family tensions and suicidal thoughts were repeated themes[107]).	The economic cost to farmers of complying with the bTB programme requirements and the fall-out of a herd breakdown is estimated (quantified) and included in the economic analysis. This factor encompasses the human welfare impact beyond economic loss. It seems that all herd owner households can be impacted by the threat of a bTB breakdown (i.e. not just those households experiencing a breakdown). For instance, a recent study found that often the primary cause of stress among farmers is regulation, compliance and inspection, and that for many farmers these outweigh the impact of a disease outbreak itself[108]. This means that all herd owners and household members carry a certain amount of stress about the threat of a breakdown. For households experiencing a breakdown, the direct financial impact of bTB is undoubtedly often severe and acute, if inherently variable, and shaped by the nature of an individual business concerned and ease of access to household cash	**Included in Non-Monetary Factor Analysis.**

[105] Tuberculosis - monthly statistics - December 2025.pdf
[106] Farmers and farm families in Northern Ireland
[107] Smith, W., McCann, J., Phillimore, A. and Jones, L. (2025) "Finding the Box-Top: Addressing the human cost of bTB." A report from The Farming Community Network (FCN). bTB-report-2025-final-Addressing-the-human-cost-of-bTB.pdf
[108] Smith, et al. (2025): bTB-report-2025-final-Addressing-the-human-cost-of-bTB.pdf

	reserves. However, a survey found that the recurrent message from respondents was that the greatest impact of bTB on the farm household, whether from a new outbreak or in anticipation of testing, came from the uncertainty involved and the cumulative impact on their mental health and wellbeing[109]. At programme level, the human impact is correlated to the success or otherwise of the bTB programme reducing disease levels in cattle. However, the issue of relevance here is badger intervention and each approach's ability to save herd breakdowns. APHA modelling illustrates the relativity of intervention approaches in terms of the number of herd breakdowns saved, which can inform option scoring on this factor.	
Social impact - Farmer confidence in the badger intervention element of the bTB programme		
Farmer Confidence in a badger intervention element of the bTB programme - Linked to evidence that the approach would lead to a reduction in herd bTB incidence	Farmers' confidence in the badger element of the bTB programme is related to the introduction of an intervention that is evidence based and capable of reducing herd bTB incidence (alongside other programme measures). Discussed below.	Links to criterion below.
Ultimate objective of disease control - Evidence that the badger intervention approach would contribute to the bTB Programme objective		
How a badger intervention approach supports progress toward the bTB programme objective of bTB eradication	The DAERA Science Opinion Paper found that all shortlisted approaches (Cull, TVR and Vaccination) are technically viable. However, each has a different risk profile in terms of reducing herd	**This is considered in the Risk Analysis. Therefore, not included in the Non-Monetary Factor Analysis.**

[109] [109] Smith, et al. (2025): bTB-report-2025-final-Addressing-the-human-cost-of-bTB.pdf

	bTB incidence given the current evidence available. This is considered in the risk analysis section.	

7.3 Non-monetary factors

7.3.1 In line with the principles outlined above, and following on from the discussion of many issues, the non-monetary factors carried forward for further analysis are:

Badger Welfare

- Number of badgers removed and the proportion that may be healthy under each intervention approach compared to the status quo situation (no badger intervention);
- Other badger welfare issues (time to die for predominant controlled shoot option, and injury information for trap options, compared to the status quo situation);

Cattle Welfare

- Number of cattle killed prematurely, and how this might differ under each intervention approach compared to the status quo situation (no badger intervention);

Environmental impact – climate change

- GHG emissions impacts, which is related to the number of cattle killed prematurely, exploring how this might differ under each intervention approach compared to the status quo situation (no badger intervention); and

Human welfare

- Number of farm household members affected by bTB breakdowns, and how this might differ under each intervention approach compared to the status quo situation (no badger intervention).

7.4 Non-monetary factors scores

7.4.1 Each “do something” short-listed option is scored from 1-4 (where 1 means scored lowest on a criterion, and 4 means ranked highest on a criterion). The ‘Do Nothing’ option does not meet the project objectives and is not given a score in this analysis. The score allocated to each option under each criterion is discussed below.

7.4.2 **Total number of badgers removed, and broad proportion of these that may be healthy.**

7.4.2.1 As discussed in the Badger Intervention Analyses – Calculation Assumptions (**appendix 1**), a pragmatic assumption is that each trapping method (cage-trapping and restraint trapping) and predominant controlled shooting would secure roughly the same 'access' to badgers. Under this assumption, the number of badgers removed will vary mainly due to the intervention approach used (Non-selective Cull, TVR or Vaccination).

7.4.2.2 The APHA modelling data for area 1 alternative zone configuration, when changed pro-rata to a 100km^2 intervention area, is quoted in Table 20. (The reasons for considering these results are explained in paras. 5.3.15-5.3.17). It illustrates the potential relative differences between the number of badgers removed under each badger intervention approach, with the assumption that the starting badger prevalence is 10%[110]. As regards the broad proportion of the badgers removed that are likely to be healthy (i.e. do not have bTB):

- the vaccination approach will not remove any badgers, and therefore none that are healthy. Vaccination options score 4 out of 4;
- for a TVR approach, it will depend on badger bTB prevalence, and on the ability of the sett side test to find truly infected badgers. The APHA modelling suggests that, under its assumptions, 76 badgers would be removed under a TVR approach. Most of these are likely to be truly infected[111]. TVR options are scored 3 out of 4.
- a non-selective cull will remove all badgers captured/accessed irrespective of their disease status, so a high broad proportion of these are likely to be healthy. For instance, under the APHA modelled scenario, for the non-selective cull options, 351 out of 427

[110] The road traffic accident survey of dead badgers suggests prevalence is higher, at around 21% in 2024 (Irish Farmers Journal, Peter McCann, 28/5/25). However, the modelling is simply used to show the potential relativity of each option on the removal of badgers.

[111] For example, in the Banbridge TVR Pilot, the sett side (DPP) test had a specificity of 98%, which means a high ability to avoid false positives. Arnold et al (2021): A Bayesian analysis of a Test and Vaccinate or Remove study to control bovine tuberculosis in badgers (Meles meles) - PubMed

badgers removed would not have bTB. That suggests a low score on this criterion and the non-selective cull options are scored 1 out of 4.

Table 20: Badger welfare – number of badgers removed and the broad proportion of badgers removed that may be healthy under each option

Opt.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Trap by:	**N/A**	**Cage**	**Cage**	**Restraint**	**N/A**	**Cage**	**Cage**	**Restraint**	**Cage**	**Cage**	**Restraint**
Deploy by:	**N/A**	**Public**	**Private**	**Private**	**Private**	**Public**	**Private**	**Private**	**Public**	**Private**	**Private**
Interv. Type	**N/A**	**Non-select.**	**Non-select.**	**Non-select.**	**Non-select.**	**Selective**	**Selective**	**Selective**	**Non-select.**	**Non-select.**	**Non-select.**
Approach:	**Do Nothing**	**Cull**	**Cull**	**Cull**	**Cull -Predom't Control Shoot**	**TVR**	**TVR**	**TVR**	**Vaccination**	**Vaccination**	**Vaccination**
Veterinary Epidemiology Pragmatic assumptions on number of badgers removed to allow the derivation of intervention cost estimates, provided for each option carried out over 100km2 area for 5 yrs. of initial intervention – see Appendix 1. [Starting badger	0	598	598	598	598	126	126	126	0	0	0
Difference from P. Cull						-472	-472	-472	-598	-598	-598
Data source 2: APHA Model Estimate of the number of badgers removed from core intervention area over 4 yrs. of initial intervention, (which is followed by 3 years of vaccination where no badgers are removed). Used Area 1 Alternative Configuration, where data is converted pro-rata to 100km2; No perturbation effect assumed. [Starting badger bTB prevalence of 10%.]	0	427	427	427	427	76	76	76	0	0	0
Difference from P. Cull						-351	-351	-351	-427	-427	-427

Opt.	1	2	3	4	5	6	7	8	9	10	11
Trap by:	**N/A**	**Cage**	**Cage**	**Restraint**	**N/A**	**Cage**	**Cage**	**Restraint**	**Cage**	**Cage**	**Restraint**
Deploy by:	**N/A**	**Public**	**Private**	**Private**	**Private**	**Public**	**Private**	**Private**	**Public**	**Private**	**Private**
Interv. Type	**N/A**	**Non-select.**	**Non-select.**	**Non-select.**	**Non-select.**	**Selective**	**Selective**	**Selective**	**Non-select.**	**Non-select.**	**Non-select.**
Approach:	**Do Nothing**	**Cull**	**Cull**	**Cull**	**Cull -Predom't Control Shoot**	**TVR**	**TVR**	**TVR**	**Vaccination**	**Vaccination**	**Vaccination**
Broad proportion of badgers removed that might be healthy		High broad proportion as cull indiscriminate (E.g. using data source 2 (APHA model), if, as est. under TVR, 76 badgers are found to be diseased, then 351 healthy badgers are removed under the modelling scenario for this cull opt.)	As Opt. 2	As Opt. 2	As Opt. 2	Dep. on badger prevalence & sett-side test functionality – but it will be a low proportion relative to a Cull option, as illustrated in the APHA modelling (data source 2).	As Opt. 6	As Opt. 6	None	None	None
Score of each option on NMF		1	1	1	1	3	3	3	**4**	**4**	**4**

7.4.3 **Badger welfare – time to die; and trap injury information.**

7.4.3.1 For a non-selective cull approach, trapped badgers can be given a head shot and die very rapidly. In regard to the controlled shooting approach, the independent analysis of shooting of free roaming badgers in Gloucestershire and Somerset (pilot cull areas) found that between 7.4% and 22.8% of badgers that were shot at were still alive after 5 minutes and therefore were at risk of experiencing marked pain[112]. Due to this evidence, the controlled shooting option is awarded the lowest score, at 1 out of 4.

7.4.3.2 As regards stopped restraint trapping, which is deployed in the ROI, a study[113] assessed the skin and the tissues underlying the restraint of 343 badgers by visual examination and found that there was an absence of skin damage or only minor skin abrasions in 302 (88%) badgers. More serious classes of skin injury were observed in 41 (12%) badgers. The authors conclude that the majority of badgers examined sustained minimal injuries attributable to capture in stopped restraints.

7.4.3.3 Byrne et al (2015)[114] assessed injuries in badgers captured by stopped restraints as part of the badger culling in the ROI. Over 18,500 badgers were assessed post-mortem, and no stopped restraint-related deaths were reported. Eighty four percent of captured badgers exhibited no impact or only superficial hair/skin compression. This paper highlights the need for continual welfare vigilance and adaptive management to reduce injury risk.

[112] Independent Expert Panel (2014). Pilot Badger Culls in Somerset and Gloucestershire. Chair Prof. Ranald Munro. Presented to the Sec. of State for Environment, Food and Rural Affairs March 2014. Pilot Badger Culls in Somerset and Gloucestershire: Report by the Independent Expert Panel

[113] Murphy, D., O'Keefe, J., Martin, S., Gormley, E. and Corner, L. (2009). "An assessment of injury to European badgers (meles meles) due to capture in stopped restraints." Journal of wildlife diseases, 45(2), p 481-90. (PDF) An assessment of injury to European badgers (meles meles) due to capture in stopped restraints

[114] Monitoring trap-related injury status during large-scale wildlife management programmes: an adaptive management approach. AW Byrne. Springer-Verlag. Published online: 8 April 2015.

7.4.3.4 As regards cage traps, which have been used in England to complement controlled shooting, and in the preceding large research trial (RBCT), a study[115] found in the latter that:

- 88% of badgers received no detectable injuries as a result of being confined in the trap;
- Of the 12% with detectable injuries, most had only minor skin abrasions (72% of 12%=8.6%) and a minority (1.8% of the total) acquired damage to the teeth or jaws that may have caused serious pain. Future modification of the door design reduced tooth damage.

7.4.3.5 No approach is perfect in terms of badger welfare and none of the options score 4. Cage and stopped restraint traps appear to have similar impacts as regards badger welfare. However, in Table 21, stopped restraint traps are awarded a score of one less than cages because of the slightly higher percentage of badgers for which non-minor injuries were recorded (i.e. stopped restraint trapping options score 2, and cage trapping options score 3 out of 4).

7.4.3.6 The relative scores allocated are outlined in Table 21.

[115] Woodroffe, R., Bourne, F.J., Cox, D.R., Donnelly, C.A., Gettinby, G., McInerney, J.P., and Morrison, W.I. (2005). "Welfare of badgers (meles meles) subjected to culling: patterns of trap-related injury." Animal Welfare, 14(1), 11-17. doi:10.1017/S0962728600028876 Welfare of badgers (Meles meles) subjected to culling: patterns of trap-related injury | Animal Welfare | Cambridge Core

Table 21: Badger welfare (humaneness of approach)

Opt.	1	2	3	4	5	6	7	8	9	10	11
Trap by:	N/A	Cage	Cage	Restraint	N/A	Cage	Cage	Restraint	Cage	Cage	Restraint
Deploy by:	N/A	Public	Private	Private	Private	Public	Private	Private	Public	Private	Private
Interv. Type	N/A	Non-select.	Non-select.	Non-select.	Non-select.	Selective	Selective	Selective	Non-select.	Non-select.	Non-select.
Approach:	Do Nothing	Cull	Cull	Cull	Cull -Predom't Control Shoot	TVR	TVR	TVR	Vaccination	Vaccination	Vaccination
Data on injuries / Time to die	None	88% no detectable injuries / Death by shooting instant	88% no detectable injuries / Death by shooting instant	84% no detectable injuries / Death by shooting instant	Between 77.2% and 92.6% were shot and dead within 5 mins. (Between 7.4% and 22.8% of badgers that were shot at were still alive after 5 minutes)	88% no detectable injuries / For TVR test positive animals, death by euthanising drug	88% no detectable injuries / For TVR test positive animals, death by euthanising drug	84% no detectable injuries / For TVR test positive animals, death by euthanising drug	88% no detectable injuries / Badger alive	88% no detectable injuries / Badger alive	84% no detectable injuries / Badger alive
Score of each option on NMF		3	3	2	1	3	3	2	**3**	**3**	**2**

7.4.4 **Cattle welfare - Number of cattle killed prematurely.**

7.4.4.1 The APHA model (alternative area 1) which compares Business As Usual, Cull, TVR, and Vaccination options on a like for like basis is consulted to understand the relativity of options regarding the number of herd breakdowns under each of these approaches. The modelled figures can be adjusted pro rata to a 100km^2 intervention area. The number of unique herd breakdowns can be multiplied by the average number of cattle removed per unique herd breakdown (~7 animals)[116] for an estimate of the number of cattle killed prematurely.

7.4.4.2 Table 22 below shows the estimated number of cattle killed prematurely under each option over the modelled initial intervention period of four years (pro rata 100km^2 area), and also over a seven and nine year period.

7.4.4.3 The model considers a four-year initial intervention period followed by three years of vaccination. The initial intervention now under consideration is for five years, not four, but this difference is unlikely to change the relativity of options on this factor. When the four-year intervention period is considered, the relativity of options is established by the model.

7.4.4.4 Assuming 7 cattle are removed per unique herd breakdown on average, when this is multiplied by the estimated number of herd breakdowns avoided, and considering benefits over a four-year period (i.e. during the initial intervention), compared to the business as usual situation, non-selective cull approaches would save 133 premature cattle deaths due to bTB; TVR approaches would save 119, and vaccination approaches would save 14. The number of cattle premature deaths due to bTB that

[116] A total of 22,318 cattle were compulsorily removed in the 2024/25 financial year (i.e. the sum of skin test reactors, negative in contacts, and IFNG +ve, skin test negative animals). A TB unique herd breakdown is defined as a herd which has had at least one TB reactor during the specified calendar year irrespective of any TB reactors during the previous calendar year. It is estimated that there were 3,216 unique herd BDs in the 2024/25 financial year. Therefore, the av. no. of cattle removed per unique herd BD is ~7.

are saved under the Cull and TVR approaches are almost ten times the number under vaccination approaches over this period.

7.4.4.5 Assuming a seven-year benefit period, then compared to the status quo situation, cull, TVR and vaccination approaches would reduce the number of premature cattle deaths due to bTB by 336, 322 and 76 respectively. Assuming a nine-year benefit period, the figures would be 469 premature cattle deaths saved with a Non-selective Cull approach, 462 saved with a TVR approach, and 147 saved with a Vaccination approach.

7.4.4.6 Therefore, Non-selective Cull and TVR options are scored the highest at 4 out of 4, and the vaccination options score the lowest (1 out of 4).

Table 22: Number of cattle removed prematurely (no perturbation effect assumed)

Opt.	1	2	3	4	5	6	7	8	9	10	11
Trap by:	N/A	Cage	Cage	Restraint	N/A	Cage	Cage	Restraint	Cage	Cage	Restraint
Deploy by:	N/A	Public	Private	Private	Private	Public	Private	Private	Public	Private	Private
Interv. Type	N/A	Non-select.	Non-select.	Non-select.	Non-select.	Selective	Selective	Selective	Non-select.	Non-select.	Non-select.
Approach:	Do Nothing	Cull	Cull	Cull	Cull -Predom't Control Shoot	TVR	TVR	TVR	Vaccination	Vaccination	Vaccination
No. of Uniq. BDs over FOUR yrs/100km2	75	56	56	56	56	58	58	58	73	73	73
No. of an. removed/Unique H'rd BD	7	7	7	7	7	7	7	7	7	7	7
No. of an. removed per 100km2 area over 4 years	525	392	392	392	392	406	406	406	511	511	511
Saving in animals removed from Do Nothing		-133	-133	-133	-133	-119	-119	-119	-14	-14	-14
No. of Uniq. BDs over SEVEN yrs/100km2	130	82	82	82	82	84	84	84	119	119	119
No. of an. removed/Unique H'rd BD	7	7	7	7	7	7	7	7	7	7	7
No. of an. removed per 100km2 area over 7 yrs	910	574	574	574	574	588	588	588	833	833	833
Saving in animals removed from Do Nothing		-336	-336	-336	-336	-322	-322	-322	-77	-77	-77
No. of Uniq. BDs over NINE yrs/100km2	166	99	99	99	99	100	100	100	145	145	145
No. of an. removed/Unique H'rd BD	7	7	7	7	7	7	7	7	7	7	7
No. of an. removed per 100km2 area over 9 yrs	1162	693	693	693	693	700	700	700	1015	1015	1015
Saving in animals removed from Do Nothing		-469	-469	-469	-469	-462	-462	-462	-147	-147	-147
Score of each option on NMF		4	4	4	4	4	4	4	**1**	**1**	**1**

7.4.5 **GHG emissions due to inefficiency in the cattle production sectors**

7.4.5.1 The bTB disease currently causes the premature removal of more than 20,000 cattle per year in NI. The premature removal of cattle due to bTB is an inefficiency in bovine production systems, which results in an inefficiency in the GHG intensity per kg of meat or litre of milk produced. Ultimately, if there was no bTB disease in NI, farms would produce and carry fewer replacement animals.

7.4.5.2 While the data is not available to permit a quantification of the difference in GHG emissions due to the introduction of each badger intervention option into an indicative 100km^2 area, it is clear that this is related to the number of cattle removed prematurely. Therefore, this indicator can be used as a proxy to allow the relative scoring of options on this factor.

7.4.5.3 The APHA model provides illustrative estimates of the relative difference each main badger intervention approach would have on the number of herd breakdowns in the 100km^2 area (pro rata). This can be multiplied by the average number of cattle removed per breakdown to arrive at an estimate of how many less cattle might be removed under each option compared to the status quo (no badger intervention). As the number of cattle removed prematurely is related to the extent of GHG inefficiency, this allows the relative scoring of options on this factor.

Table 23: GHG emissions due to wastage in the cattle production sector – linked to no. of cattle prematurely killed

Opt.	1	2	3	4	5	6	7	8	9	10	11
Trap by:	N/A	Cage	Cage	Restraint	N/A	Cage	Cage	Restraint	Cage	Cage	Restraint
Deploy by:	N/A	Public	Private	Private	Private	Public	Private	Private	Public	Private	Private
Interv. Type	N/A	Non-select.	Non-select.	Non-select.	Non-select.	Selective	Selective	Selective	Non-select.	Non-select.	Non-select.
Approach:	Do Nothing	Cull	Cull	Cull	Cull -Predom't Control Shoot	TVR	TVR	TVR	Vaccination	Vaccination	Vaccination
No. of Uniq. BDs over FOUR yrs/100km2	75	56	56	56	56	58	58	58	73	73	73
No. of an. removed/Unique H'rd BD	7	7	7	7	7	7	7	7	7	7	7
No. of an. removed per 100km2 area over 4 years	525	392	392	392	392	406	406	406	511	511	511
Saving in animals removed from Do Nothing		-133	-133	-133	-133	-119	-119	-119	-14	-14	-14
No. of Uniq. BDs over SEVEN yrs/100km2	130	82	82	82	82	84	84	84	119	119	119
No. of an. removed/Unique H'rd BD	7	7	7	7	7	7	7	7	7	7	7
No. of an. removed per 100km2 area over 7 yrs	910	574	574	574	574	588	588	588	833	833	833
Saving in animals removed from Do Nothing		-336	-336	-336	-336	-322	-322	-322	-77	-77	-77
No. of Uniq. BDs over NINE yrs/100km2	166	99	99	99	99	100	100	100	145	145	145
No. of an. removed/Unique H'rd BD	7	7	7	7	7	7	7	7	7	7	7
No. of an. removed per 100km2 area over 9 yrs	1162	693	693	693	693	700	700	700	1015	1015	1015
Saving in animals removed from Do Nothing		-469	-469	-469	-469	-462	-462	-462	-147	-147	-147
Score of each option on NMF		4	4	4	4	4	4	4	**1**	**1**	**1**

7.4.6 **Human welfare**

7.4.6.1 A recent study found that “many farmers believe that health impacts are generated more by anticipation of statutory testing and the fear engendered in anticipation of an outbreak, than by the disease itself”[117]. This suggests that the human welfare impact (i.e. stress) is related to the threat of a bTB breakdown, and it is relevant to all herd keepers and their households (i.e. not just to those experiencing a herd breakdown). There is approximately 21,500[118] herd keepers in NI. A Social Survey found 3.89[119] household members are associated with each active family farm, and therefore that equates to 83,635 people in herd keeper households impacted in this way.

7.4.6.2 That study also said, “The recurrent message from respondents, however, was that the greatest impact of bTB on the farm household, whether from a new outbreak or in anticipation of testing, came from the uncertainty involved and the cumulative impact on their mental health and wellbeing[120]”.

7.4.6.3 Beyond the threat of a breakdown, many households are actively dealing with an actual herd breakdown. There were around 3,216 unique herd breakdowns in the most recent year for which data is available, and with an average of 3.89 household members, actual herd breakdowns will affect around 12,510 household members.

7.4.6.4 bTB places a severe psychological burden on farmers and their families. A study found that “depression, stress, sleepless nights, relationship break-ups, family tensions and suicidal thoughts were repeated themes. The stresses were often exacerbated by uncertainty, fear of further disease outbreaks, or by the fear of continued financial losses. These conditions turned many farmers inwards, so that the stresses and strains

[117] bTB-report-2025-final-Addressing-the-human-cost-of-bTB.pdf – pg. 4
[118] Tuberculosis - monthly statistics - December 2025.pdf
[119] Farmers and farm families in Northern Ireland
[120] bTB-report-2025-final-Addressing-the-human-cost-of-bTB.pdf – pg.14

extended among all family members"[121]. In another survey completed by 507 Welsh farmers, 85% said bTB had negatively impacted their own mental health or someone in their family[122].

7.4.6.5 The study into the human cost of bTB also said that, for most farmers, "an outbreak quickly translates into a cash flow crisis and unplanned debts" and "the financial, mental health and physical health symptoms generated by bTB are closely interrelated…. Characteristic physical injuries were identified by farmers as a result of increased workloads, by necessarily taking on tasks previously delegated to younger staff. Pre-existing injuries were often exacerbated by such circumstances. The increase in the volume of work associated with bTB was in some instances also evident in blood pressure problems among many farmers which made them more vulnerable and their lives harder"[123].

7.4.6.6 At programme level, the human welfare impact is correlated to the success or otherwise of the bTB programme reducing disease levels in cattle.

7.4.6.7 However, the issue of relevance here is badger intervention and each approach's ability to save herd breakdowns. APHA modelling, when extrapolated to a 100km^2 area, illustrates the relativity of intervention approaches in saving herd breakdowns (see table 24 below). This can be further extrapolated to the number of people in households experiencing breakdowns in the 100km^2 area (i.e. by multiplying the number of unique herd breakdowns under each option by 3.89 people on average per household).

7.4.6.8 As outlined in Table 24, the options with a lethal component have a lower number of people affected by a bTB herd breakdown than the figures estimated for vaccination options. The extrapolated model information

[121] bTB-report-2025-final-Addressing-the-human-cost-of-bTB.pdf – pg. 14/15
[122] Survey reveals worrying emotional and financial impact of bovine TB on Welsh farming – NFU Cymru
[123] bTB-report-2025-final-Addressing-the-human-cost-of-bTB.pdf – pg. 13; 15

suggests that the introduction of non-selective cull options in a 100km^2 area would save 74 household members from having to deal with bTB breakdown impacts over a four-year intervention period compared to the status quo situation (i.e. no badger intervention).

7.4.6.9 This benefit (i.e. saving in the number of household members from having to deal with bTB breakdown impacts) increases from 74 to 187 and 261 if the benefit period is extended to seven or nine years respectively. The TVR figures are not dissimilar to those for non-selective cull options (66, 179 and 257), so both Cull and TVR options are scored 4 out of 4. The Vaccination options perform less well, i.e. 8, 43 and 82 household members avoiding having to deal with the impacts of a bTB breakdown over a four, seven or nine year benefit period, and they are scored 1 out of four.

Table 24: Human welfare – linked to number of herd breakdowns saved

Opt.	1	2	3	4	5	6	7	8	9	10	11
Trap by:	N/A	Cage	Cage	Restraint	N/A	Cage	Cage	Restraint	Cage	Cage	Restraint
Deploy by:	N/A	Public	Private	Private	Private	Public	Private	Private	Public	Private	Private
Interv. Type	N/A	Non-select.	Non-select.	Non-select.	Non-select.	Selective	Selective	Selective	Non-select.	Non-select.	Non-select.
Approach:	Do Nothing	Cull	Cull	Cull	Cull -Predom't Control Shoot	TVR	TVR	TVR	Vaccination	Vaccination	Vaccination
Herds affected by the threat of a bTB breakdown	21,500	21,500	21,500	21,500	21,500	21,500	21,500	21,500	21,500	21,500	21,500
Household members affected by threat of a bTB breakdown	83,635	83,635	83,635	83,635	83,635	83,635	83,635	83,635	83,635	83,635	83,635
Current number of unique herd BDs in NI	3,216	3,216	3,216	3,216	3,216	3,216	3,216	3,216	3,216	3,216	3,216
No. of household members affected by a bTB breakdown	12,510	12,510	12,510	12,510	12,510	12,510	12,510	12,510	12,510	12,510	12,510
APHA Modelling - No. of UH BDs per 100km2 under each option over a certain period											
No. of Uniq. BDs over FOUR yrs/100km2	75	56	56	56	56	58	58	58	73	73	73
No. of household members affected by a BD	292	218	218	218	218	226	226	226	284	284	284
Diff from Business as usual		-74	-74	-74	-74	-66	-66	-66	-8	-8	-8
No. of Uniq. BDs over SEVEN yrs/100km2	130	82	82	82	82	84	84	84	119	119	119
No. of household members affected by a BD	506	319	319	319	319	327	327	327	463	463	463
Diff from Business as usual		-187	-187	-187	-187	-179	-179	-179	-43	-43	-43
No. of Uniq. BDs over NINE yrs/100km2	166	99	99	99	99	100	100	100	145	145	145
No. of household members affected by a BD	646	385	385	385	385	389	389	389	564	564	564
Diff from Business as usual		-261	-261	-261	-261	-257	-257	-257	-82	-82	-82
Score of each option on NMF		4	4	4	4	4	4	4	1	1	1

NB: For each row with data on the number of household members affected, note that this is derived by multiplying the herds/unique herd breakdowns in view by 3.89 people per household/herd.

7.1 Summary of non-monetary factor scores

7.1.1 Table 25 provides a summary of Non-Monetary Factor scores, and overall score. It assumes all criteria are equal. This seems appropriate given the very polarised views of stakeholders on badger intervention which would make the allocation of different weights to different Non-Monetary Factors contentious.

7.1.2 The TVR options score the highest, with public and private sector cage trapping TVR options scoring 18 each. This is followed by private sector TVR using restraints which scores one less (17). The non-selective cull options are scored next highest, with cage trapping achieving a higher score than restraint trapping, which in turn achieves a higher score than controlled shooting. Vaccination options have the lowest scores.

Table 25: Summary of Non-Monetary Factor scores

Opt.	1	2	3	4	5	6	7	8	9	10	11
Trap by:	**N/A**	**Cage**	**Cage**	**Restraint**	**N/A**	**Cage**	**Cage**	**Restraint**	**Cage**	**Cage**	**Restraint**
Interv. Type	**N/A**	**Non-select.**	**Non-select.**	**Non-select.**	**Non-select.**	**Selective**	**Selective**	**Selective**	**Non-select.**	**Non-select.**	**Non-select.**
Deploy by:	**N/A**	**Public**	**Private**	**Private**	**Private**	**Public**	**Private**	**Private**	**Public**	**Private**	**Private**
Approach:	**Do Nothing**	**Cull**	**Cull**	**Cull**	**Cull -Predom't Control Shoot**	**TVR**	**TVR**	**TVR**	**Vaccination**	**Vaccination**	**Vaccination**
BADGER WELFARE											
Number of badgers removed and the proportion that may be healthy under each intervention approach compared to the status quo situation (no badger intervention)		1	1	1	1	3	3	3	4	4	4
Oher badger welfare issues (time to die for predominant controlled shoot option, and injury information for trap options, compared to the status quo situation)		3	3	2	1	3	3	2	3	3	2
CATTLE WELFARE											
Number of cattle killed prematurely, and how this might differ under each intervention approach compared to the status quo situation (no badger intervention)		4	4	4	4	4	4	4	1	1	1
ENVIRONMENTAL IMPACT - GHG EMISSIONS											
GHG emissions impacts, which is related to the number of cattle killed prematurely, exploring how this might differ under each intervention approach compared to the status quo situation (no badger intervention)		4	4	4	4	4	4	4	1	1	1
HUMAN WELFARE											
Number of farm household members affected by bTB breakdowns, and how this might differ under each intervention approach compared to the status quo situation (no badger intervention)		4	4	4	4	4	4	4	1	1	1
Overall score		**16**	**16**	**15**	**14**	**18**	**18**	**17**	**10**	**10**	**9**

8. Risk analysis

8.1 Identification of risks

8.1.1 This chapter specifies the main risks associated with the achievement of the project's objectives, and outlines the relative riskiness of the short-listed options. Later, once a preferred option is selected, a comprehensive risk management plan will be developed, and it will include strategies to mitigate the risks associated with the preferred option.

8.1.2 To consider the relative riskiness of short-listed options, the following steps were undertaken:

a) The key risks associated with badger intervention were identified. These are listed in Table 26 and Table 27. Table 26 summarises all risks highlighted by the Strategic Environmental Assessment and whether the risk is considered further in the Risk Analysis (and if not, why not). Table 27 summarises all risks (whether identified by the Strategic Environmental Assessment or by DAERA) that are carried forward for further analysis.

b) It was considered whether, and how, the short-listed options vary in relation to each risk identified.

- However, where a risk was considered elsewhere (e.g. in the sensitivity analysis, or in the non-monetary factor analysis), it was not assessed again here to avoid duplication. Such risks are shown in light grey in Table 27.

- In addition, one risk (the potential risk of badger extinction) has been assessed as not applicable to any of the short-listed options as the conditions set by the Bern Convention for badger intervention provide mitigation. This risk is therefore excluded from further consideration and is shaded dark grey in Table 27.

- Risks that are broadly the same for short-listed options are not given risk scores (because if options were given the same score, this would not contribute to varying the final risk score). These are

coloured blue in Table 27 and are denoted “same” which means all options broadly carry the same level of risk on this factor.

- The key risks of interest in this section are those where the short-listed options would likely vary in relation to the risk. These are coloured green in Table 27 and are of interest in this chapter.

c) Each risk carried forward for further analysis was allocated a weighting depending on its relative importance for meeting the bTB programme objective to reduce bTB in cattle, paving the way for eradication. The weights are explained in Table 28.

d) Note, however, all risks (whether scored in this analysis or not) will be carried forward into the Risk Management Plan for whatever option is eventually selected as preferred, and mitigations put in place, as required.

8.1.3 The following table lists potential risks identified in the Strategic Environmental Assessment.

Table 26: Potential risks mentioned in Strategic Environmental Assessment, including whether each is considered further in the risk analysis

Potential Risk	Mitigation	Considered further in Risk Analysis?
Impact on Biodiversity, Flora and Fauna: Potential for **regionalised direct negative impacts on badger populations** within intervention areas from culling activities as a protected species. **Relevance for options:** Particular implications for non-selective cull options which remove all badgers caught/accessed.	This relates to the relative number of badgers removed under each option which is dealt with in the Non-monetary analysis. As such, it is not repeated here. Note: The knock-on implications for other species is dealt with under the criterion: Biodiversity, Flora and Fauna - the "potential for disturbance or displacement effects on species".	No.
Impact on Biodiversity, Flora and Fauna: Potential for **disturbance or displacement effects on species**. **Relevance for options:** Higher risk for options that remove more badgers.	This is dealt with later in the Risk Analysis under "Risk of a negative net change to local biodiversity / ecosystems"	Yes.
Risk of an adverse impact on Biodiversity, Flora and Fauna: Potential for effects on **protected areas**, **protected and priority habitats and species**. Note: potential for regionalised direct negative impacts on badger populations from culling activities is dealt with separately (above). Also potential for indirect effects on water is dealt with separately. **Relevance for options:** Implications for cull options which involve shooting (noise disruption); Implications for all options which involve trapping, i.e. in regard to the potential capture of non-target species; Implications for all options which involve traversing protected land, e.g. when weather conditions might mean damage is caused to priority habitat.	**SEA:** the bTB proposals are unlikely to have a significant negative effect upon the integrity of any European site (in view of the site's conservation objectives). **DAERA:** All shortlisted intervention options (and their method of accessing badgers) have been conducted previously in at least one country, i.e. -Non-selective culls in England and ROI; -Selective cull via TVR in NI; -Vaccination in Wales, England and the ROI; -Use of cage trapping in NI, England, Wales; -Use of restraint trapping in the ROI. All have had to develop protocols to mitigate this risk, e.g. for shooting, mandatory use of noise suppression equipment and "no go" zones where there is a risk of damage to, or disturbance of, protected areas or habitat for priority species at critical times (e.g. breeding), etc. A protocol for intervention will be drawn up if and when a final intervention option is chosen for deployment in NI. Mitigations for this risk will be considered. Further mitigations may also be added when the specifics of the target intervention areas are known. **Residual risk: insignificant.** This is on the basis of the SEA conclusion, and the fact that DAERA can learn from other countries and ensure that any protocol for an eventual preferred option is designed to mitigate this risk.	No.

Potential Risk	Mitigation	Considered further in Risk Analysis?
Risk of an adverse impact on Biodiversity, Flora and Fauna: Potential for **indirect effects on water-dependent habitats and species**, including effects on freshwater pearl mussel, salmonids and other protected fish and shellfish species. **Potential for direct and indirect effects on water quality (drinking and recreational activities)** Note: in the SEA, the is listed under "population and human health" but as it relates to water, it is dealt with here. Note: this water impacts are also mentioned under "Geogology, Soils & Land Use" and under "Water" in the SEA, but water impacts are dealt with here. **Relevance for options:** Implications for cull options which involve shooting if lead shot is used (i.e. due to potential for lead leakage into water); Implications for cull and TVR options which involve carcase removal (i.e. due to potential for contamination of water from carcasses if they are not appropriately handled and removed)	**SEA**: Implementation of Plan measures, including wildlife intervention options, are unlikely to affect water at a national or regional level. There may be potential for localised effects, e.g. contamination of water from badger carcasses and lead-shot, however, the likelihood of such occurrences is low. In addition, these risks were discussed under the "Water" heading, and due to the very low risk, all options were given a neutral rating. **DAERA:** A protocol for intervention will be drawn up which will be designed to mitigate these risks (e.g. if an option with controlled shooting of free roaming badgers is selected, then there may be consideration of restrictions on the use of lead shot and/or restrictions on where controlled shooting with lead shot can and cannot be carried out; double bagging of carcases and their prompt removal for options involving badger removal; etc.). **Residual risk: insignificant.** This is on the basis that the SEA considered this risk to be very low, and that DAERA can learn from other countries and ensure that any protocol for an eventual preferred option is designed to mitigate these risks.	No.
Risk of an adverse impact on Population & Human Health: **Potential for noise disturbance** Note: noise disturbance implications for priority species was also mentioned under Biodiversity, Flora and Fauna "Potential for effects on protected areas, protected and priority habitats and species" in the SEA and is dealt with under this criterion above. Also, noise disturbance implications for rural residents in or near intervention areas was also mentioned under "Air" impacts in the SEA. This is dealt with here. **Relevance for options:** Implications for cull options which involve shooting, whether capture and shoot options or controlled shooting of free roaming badgers.	**SEA:** The implementation of the Wildlife Intervention Options has potential for noise disturbance via culling, of which this is likely to be occurring predominantly in rural areas of lower background noise sources, potentially amplifying the noise of any shooting. [As regards controlled shooting].....Given the nocturnal nature of badgers, such activities will likely occur at night, further increasing the potential for disturbances on local populations and potential negative impacts on human health. [For capture and cull options, the shooting would take place early in the morning, after daybreak]. **DAERA:** A protocol for intervention will be drawn up which will be designed to mitigate this risk (i.e. if an option is selected that includes gun use, lessons will be learned from countries previously deploying such, e.g. consideration given to perhaps including a mandatory requirement to use noise suppression equipment, etc.). **Residual risk: insignificant.** This is on the basis that DAERA can learn from other countries and ensure that any protocol for an eventual preferred option is designed to mitigate this risk.	No.

Potential Risk	Mitigation	Considered further in Risk Analysis?
Risk of an adverse impact on Population & Human Health: Potential for **health and safety risks from use of firearms** **Relevance for options:** Implications for cull options which involve shooting, whether capture and shoot options or controlled shooting of free roaming badgers.	**SEA:** Identified that options involving shooting brings health and safety risks for the gun operator or members of the public entering areas of active shooting (where the latter would be particularly relevant to an option involving controlled shooting). **DAERA:** A protocol for intervention will be drawn up which will be designed to mitigate this risk. If an option is selected that includes gun use, lessons will be learned from countries previously deploying such, e.g. consideration given to the qualifications that any gun user must hold; additional training that should be provided to gun users; contract or licensing conditions, etc. **Residual risk: insignificant.** This is on the basis that DAERA can learn from other countries using shooting and ensure that any protocol for an eventual preferred option is designed to mitigate this risk.	No.
Risk of an adverse impact on Population & Human Health: **Potential risks from biohazards** **Relevance for options:** Implications for all options where workers are close to badgers. Main risk is close working with live badgers due to potential for aerosol spread of bTB (as would be the case for TVR and vaccination options); lower risk when dealing with carcases.	**SEA:** It identified that deployment operatives potentially risk contracting bTB from close working with live badgers or carcasses. **DAERA:** A protocol for intervention will be drawn up which will be designed to mitigate this risk. E.g. if an option is selected that includes close working with live badgers, as would be the case under TVR and vaccination options, operators will be required to use appropriate personal protective equipment (PPE). If an option is selected that includes working with dead badgers, in addition to PPE, carcases will need to be double bagged and disposed of via an approved carcase disposal protocol, etc. **Residual risk: insignificant.** This is on the basis that DAERA can learn from other countries and ensure that any protocol for an eventual preferred option is designed to mitigate this risk.	No.
Risk of an adverse impact on Population & Human Health: Potential risks of **hearing loss** due to shooting **Relevance for options:** Implications for all options where shooting is a feature.	**SEA:** Gunfire can result in damage to ears and hearing loss from prolonged use known as shooter's ear with muffled speech, tinnitus or difficulty understanding speech. This is due to gunshots reaching sounds of 140 decibels or more, where the exposure to sounds above 85 decibels can cause hearing damage. The Control of Noise at Work Regulations (Northern Ireland) 2006 requires employers to safeguard employees against the harmful effects of excessive noise in their work environment. **DAERA:** A protocol for intervention will be drawn up which will be designed to mitigate this risk. E.g. The protocol drawn up for shooting will require the use of Personal Protective Equipment, which would include the use of ear protection, as appropriate to the option under consideration. **Residual risk: insignificant.** This is on the basis that DAERA can learn from other countries and ensure that any protocol for an eventual preferred option is designed to mitigate this risk	No.

Potential Risk	Mitigation	Considered further in Risk Analysis?
Risk of an adverse impact on Population & Human Health: **Reduced risk of infection amongst farm workers and the general population through reduced prevalence of bTB within cattle**. **Relevance for options:** Related to the ability of options to contribute to reduced badger, and cattle, bTB prevalence.	**DAERA:** This is a potentially positive side effect (rather than a risk) of wildlife options. But it is likely to be a relatively minor issue as there are very few reports of farmers/workers currently being infected with bTB from working with cattle. It is not considered separately as it is related to intervention success in reducing bTB prevalence in cattle. The latter is encompassed in a risk factor scored in this chapter entitled "the risk of an option not supporting progress toward the bTB programme objective of bTB eradication in a timely manner".	Not directly, but indirectly under the criterion "Risk of an approach not supporting progress towards the bTB programme objective of bTB eradication in a timely manner".
Risk of an adverse impact on Geology, Soils and Land Use: Potential for **temporary localised effects on soil** through soil loss or disturbances should trapping be introduced Note: the SEA also discussed lead / (carcase) bTB contamination and water contamination under this criterion, which are dealt with under Biodiversity, Flora and Fauna. **Relevance for options:** Implications for all options as all involve trapping (even controlled shooting which has some complementary trapping). More of an issue for digging in cage traps to ensure they are steady than for the use of restraints which have bars that anchor into the ground.	**SEA:** It highlighted the potential risk that badger trapping may disturb soil or lead to soil loss. Though it considered the risk to be very low and gave a neutral score to all options on Geology, Soils and Land Use. **DAERA:** A protocol for intervention will be drawn up. It will include risk mitigations. E.g. The protocol drawn up for trapping may clarify when "digging" in of cages is required, and emphasise keeping soil disruption to a minimum, etc. **Residual risk: insignificant.** This is on the basis that DAERA can learn from other countries and ensure that any protocol for an eventual preferred option is designed to mitigate this risk.	No.
Risk of an adverse impact on Water: i.e. contamination from badger carcases and/or lead; localised effects on status of water bodies; or on ground or drinking water quality. (Dealt with under Biodiversity, Flora and Fauna - water issues above)	Dealt with above	No.

Potential Risk	Mitigation	Considered further in Risk Analysis?
Risk of an adverse impact on Air: Potential for **localised effects on air pollutant emissions arising from vehicle emissions**. Note: the SEA considers potential for localised effects on air pollutant emissions arising from gun emissions from the implementation of wildlife intervention options. But this is dealt with under Climatic Factors below. It also considers potential for effects of noise on local populations and human health from culling under this criterion. But this was dealt with under Population and Human Health above. **Relevance for options:** All options are predominantly labour based. However, as regards vehicle emissions, there is implications for all options as all use vehicles to some degree.	**SEA:** It says that the use of vehicles to access intervention areas may result in localised temporary increases of emissions associated with vehicles. **DAERA:** The deployment options are predominantly labour based, as opposed to relying on vehicles, machinery, equipment. However, all options use vehicle transport to and around intervention areas to some degree. Mitigations for this risk will be considered when a preferred option is identified. E.g. any procurement market testing exercise may explore potential contractors' use of hybrid or electric vehicles, and consider if this should be a procurement scoring criterion, etc. **Residual risk: With mitigations in place, the residual risk is deemed insignificant, and it is not considered further in the Risk Analysis.** [NB: This was discussed in the analysis of non-monetary factors, and it was not scored as options are predominantly labour based, emissions will not be significant and are unlikely to vary much between options.]	No.
Risk of an adverse impact on Climatic Factors: Potential for localised effects on **air pollutant emissions arising from gun emissions** from the implementation of wildlife intervention options. Note: vehicle emissions are discussed under Air impacts above **Relevance for options:** As regards gun emissions, there is implications for cull options which use guns for dispatch of badgers.	**SEA:** It says that the use of shooting activities to implement culling under the Wildlife Intervention Options has the potential to lead to very localised emissions of greenhouse cases from gun firing releasing carbon monoxide, particulate matter, carbon dioxide, ammonia, polycyclic aromatic hydrocarbons and methane, however the emissions are expected to be insignificant in quantity. As such, it rated this risk for all option as neutral. **Residual risk: insignificant.** This is on the basis that the SEA considered the potential impact to be insignificant.	No.
Risk of an adverse impact on Material Assets: The following potential positive effects are relevant to badger intervention: - **Potential for effects on the productivity of agricultural farm holdings with fewer bTB herd breakdowns** (i.e. if less cattle are removed); - **Potential for increased agricultural output and farm incomes per hectare with fewer bTB herd breakdowns** (i.e. less removal of animals due to breakdowns);	**SEA:** It says that there is potential for medium to long-term secondary indirect **positive effects** on material assets through reduced potential for transmission of M. bovis between badgers and cattle arising from the implementation of wildlife intervention options to address the reservoir of infection present within wildlife. This could reduce bTB infections and herd breakdowns, as well as reduce cattle losses through slaughter or movement restrictions, supporting cattle as an agricultural asset. **DAERA:** This is not considered separately as it is related to intervention success in reducing bTB prevalence in cattle. This is encompassed in a risk factor scored later entitled "the risk of an option not supporting progress toward the bTB programme objective of bTB eradication in a timely manner".	Yes, under the criterion "the risk of an option not supporting progress toward the bTB programme objective of bTB eradication in a timely manner".

Potential Risk	Mitigation	Considered further in Risk Analysis?
Risk of an adverse impact on Cultural, Architectural and Archaeological Heritage: The following are relevant to badger intervention: - Potential **for localised disturbance or disruption to assets or areas of importance for cultural, architectural and archaeological heritage**.	**SEA:** It says that implementation of the Plan measures, including the potential Wildlife Intervention Options, may have the potential to affect Cultural, Architectural and Archaeological Heritage assets at a localised level e.g., through highly localised disturbance or disruption to assets or areas of importance for cultural, architectural and archaeological heritage. However, as the risk is very low, it rates all options as neutral in regard to this risk. **DAERA:** A protocol for intervention will be drawn up which will be designed to mitigate this risk. E.g. The protocol may identify "no go" areas for intervention to protect cultural, architectural and archaeological heritage; etc. **Residual risk:** insignificant.	No.
Risk of an adverse impact on Landscape and Visual Amenity: - Potential for **localised disturbance or disruption with areas of significance for landscape or visual amenity**	**SEA:** It says that there is not anticipated to be potential for any significant positive or negative, direct or indirect effects in the short, medium, or long-term to arise on Landscape and Visual Amenity from the implementation of the Plan measures, including the potential Wildlife Intervention Options. Interaction with areas of significance for landscape or visual amenity via disturbance or disruption from implementation of actions within the Wildlife Intervention Option should be limited to a short-term, temporary and localised basis. There is also unlikely to be potential for transboundary impacts on Landscape and Visual Amenity in the Republic of Ireland. Therefore, it is proposed to scope the SEA topic of Landscape and Visual Amenity out of assessment within the SEA Report. **DAERA:** Risk is insignificant as determined in the SEA. **Residual Risk:** N/A	No.

8.1.4 In addition to the risks identified through the Strategic Environmental Assessment, a number of other risks were considered as outlined in the following table. This table shows which risks (i.e. coloured green) are carried forward for further assessment and which are not considered further due to either being dealt with elsewhere in the analyses (light grey), would be relatively the same across all shortlisted badger intervention options (blue), or not applicable (dark grey). The table also shows the weight assigned to each of the risks carried forward, and the rationale for that weighting.

Table 27: Categorisation of risks

Risk factor	Category	Weighting
Risk of an approach not supporting progress toward the bTB programme objective of bTB eradication in a timely manner (i.e. by 2050)[124]. **Rationale for weighting**: This risk is considered the most significant in terms of impact as it considers congruence with the bTB programme's main objective. It has been allocated a weighting of **35/100,** therefore.	Scored	35
Risk of a perturbation effect, i.e. the risk that badger culling in one area would increase badger ranging and cause a (likely short term) higher level of herd breakdowns in a neighbouring area.	Dealt with Elsewhere (Economic Sensitivity Analysis)	0
Cost overrun	Dealt with Elsewhere (Economic Sensitivity Analysis)	0
Risk that the required level of funding is not available, thereby limiting the scale of roll out of badger intervention to a lower number of cattle bTB hotspot areas.	Relates to cost and risk of cost overruns as funding must match cost. Dealt with Elsewhere (Economic Sensitivity Analysis)	0
Risk that legislative cover is not secured or not secured at the desired time.	Updated/new legislation is required for all badger intervention options. Same risk for all options	0
Risk that sufficient widespread land access for badger intervention is not secured to allow an intervention to proceed.	Land access is required for all badger intervention options. Based on the roll-out of badger intervention for 'capture and cull' in the ROI and for 'predominant controlled shoot' in England, it is assumed that this risk is relatively insignificant, and for the purposes of this analysis, broadly the same level of risk for all options.	0
Risk of a lack of non-labour resource availability (e.g. equipment/drugs) **Rationale for weighting**: This risk is considered of medium importance. DAERA has first-hand experience with difficulties in securing sett-side tests and vaccinations. However, the sett-side test availability issue at the initial stages of planning the Regionalisation Pilot Project has since been overcome, and the vaccination shortage experienced during the Banbridge TVR Pilot was overcome with a workaround. These issues could re-emerge at some stage in the future. Therefore, this risk is given a weighting of **20/100**.	Scored	20
Risk of a lack of labour availability and/or capability **Rationale for weighting**: The main labour input is for badger access (i.e. for controlled shooting, or for badger trapping). This risk is considered to be of low to medium importance and is weighted **15/100**.	Scored	15
Risk of a negative net change to local biodiversity / ecosystems **Rationale for weighting:** The Strategic Environmental Assessment highlights that badgers have an important ecological role for the maintenance of health and diversity of ecosystems, and the removal of badgers has the potential for impacts on other species due to	Scored	30

[124] TB Partnership Steering Group (TBPSG) (2025), "Bovine Tuberculosis in Northern Ireland. Blueprint for Eradication". Bovine Tuberculosis in Northern Ireland - Blueprint for Eradication. The aim of the TBPSG, working with DAERA, is to reduce bTB herd incidence by 2% by 2030, placing NI on a pathway to halve current bTB levels by 2040 and achieve eradication by 2050. The TBSPG Blueprint has been agreed with the DAERA Minister in 2025.

alterations in ecology. This is an important risk and is given a relatively high weighting of 30 out of 100.		
Operational safety	Same – on the basis that all options have been deployed in at least one country (culling and vaccination in more than one country) and no significant operational safety issues have been reported.	0
Risk of disruption due to protestors - addressed with policing	Dealt with Elsewhere (Economic Sensitivity Analysis)	0
Risk of weather affecting access to badgers	Weather will have broadly the same impacts on all options' access to badgers	0
Risk of badger extinction in NI	N/A – Alignment with the Bern Convention limits the scale and intensity of badger intervention deployment to fully mitigate this risk	0
Sum of weights		**100**

8.2 Giving short-listed options a risk rating on the factors coloured green in Table 27

8.2.1 Each 'do something' short-listed badger intervention option was then given a Very High (VH), High (H), Medium (M), Low (L), Very Low (VL), or None risk rating in relation to each risk criterion. These ratings were given a score of 10, 8, 6, 4, 2, and 0 respectively. The rationale for the respective risk rating of short-listed options on each risk factor is explained in Table 28 below.

8.2.2 There are no operational risks associated with the 'Do Nothing' option and it is not scored in this analysis. That said, given that the objective of the bTB programme is to eradicate bTB from NI, this option would leave bTB prevalence in the badger disease vector unaddressed in bTB hotspot areas. This is contrary to the conclusion of the Scientific Opinion Paper. It said, "…to enable eradication of bTB in cattle within an area, the infection needs to be controlled in all *M. bovis* reservoir hosts connected to that area"[125]. In that sense, the 'Do nothing' option is higher risk than all do-something shortlisted badger intervention options.

[125] DAERA 2025) scientific opinion on the peer reviewed evidence on badger intervention in relation the control of bovine tuberculosis. Internal analysis. Appended to the 2026 "Bovine Tuberculosis (bTB) Consultation on Potential Wildlife Intervention Options as part of the Bovine Tuberculosis in Northern Ireland: Blueprint for Eradication".

Table 28: Explanations of the risk ratings provided to each shortlisted badger intervention option for each risk criterion.

Approach		Do N.	Cull	Cull	Cull	Cull	TVR	TVR	TVR	Vacc	Vacc	Vacc	
Access to badger		N/A	Cage	Cage	Restr	C.Shoot	Cage	Cage	Restr.	Cage	Cage	Restr.	
Deployed by public or private sector:		N/A	Public	Priv.	Priv.	Priv.	Public	Priv.	Priv	Public	Priv.	Priv.	
Risk Title and Description	**Weig't**	**Opt. 1**	**Opt. 2**	**Opt. 3**	**Opt. 4**	**Opt. 5**	**Opt. 6**	**Opt. 7**	**Opt. 8**	**Opt. 9**	**Opt. 10**	**Opt. 11**	**Scoring Rationale**
Risk of an approach not supporting progress toward the bTB programme objective of bTB eradication in a timely manner (i.e. by 2050)		**N/A**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**VH**	**VH**	**VH**	Given the steady and persistent increase in annual cattle herd incidence over a number of years, the bTB programme which currently emphasises cattle measures (and has started to introduce people measures) without badger intervention is not achieving the bTB programme objective. As bTB transmission is multifactorial, it is acknowledged that there may not be a direct correlation between badger intervention and lower herd bTB incidence in every intervention area. However, a review of the science by DAERA Epidemiologists (Science Opinion Paper) leads them to conclude that (i) all sources of disease need to be tackled if bTB eradication is the goal; (ii) as modelling outputs tend to demonstrate that methods involving a lethal component provide a faster cattle herd bTB response than vaccination only, the vaccination approach would be less effective in areas with high infection prevalence unless preceded by a reduction in infection pressure (e.g. via non-selective or selective culling). On this basis, the options with a lethal component have a Medium risk rating, and the Vaccination options have a Very High risk rating.
Unweighted score		**0**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**10**	**10**	**10**	
Weighted score	**35**	**0**	**210**	**210**	**210**	**210**	**210**	**210**	**210**	**350**	**350**	**350**	
Risk of a lack of non-labour availability (e.g. equipment/drugs)		**N/A**	**VL**	**VL**	**VL**	**VL**	**M**	**M**	**M**	**L**	**L**	**L**	Non-selective cull options require less non-labour inputs than the other options (cages, restraints, and shooting equipment are relatively easy secured). As regards TVR, a recent pilot project found preliminary difficulties in securing one sett side test (the DPP test). In addition, as regards both TVR and Vaccination approaches, experience with the TVR Pilot in Banbridge showed that the availability of vaccine can be an issue from time to time. The project commenced with Badger BCG -Danish strain. Due to a global shortage of BCG vaccines during the project, this vaccine was only available during years 1-3 (out of date stocks were used during year 3). During years 4-5, BCG Sofia (Intervax Ltd.) was used. TVR has a further complication that the vaccine used may influence the results of the sett side test, e.g. Courcier et al 2022 suggests that the BCG Sofia may affect the DPP test result (more false positives). Taking this into account, the Cull options are considered to have very low risk; the Vaccination options - low risk, and TVR options - medium risk as they need two drugs that have experienced supply issues in the past.
Unweighted score		**0**	**2**	**2**	**2**	**2**	**6**	**6**	**6**	**4**	**4**	**4**	
Weighted score	**20**	**0**	**40**	**40**	**40**	**40**	**120**	**120**	**120**	**80**	**80**	**80**	

Approach		Do N.	Cull	Cull	Cull	Cull	TVR	TVR	TVR	Vacc	Vacc	Vacc	
Access to badger		N/A	Cage	Cage	Restr	C.Shoot	Cage	Cage	Restr.	Cage	Cage	Restr.	
Deployed by public or private sector:		N/A	Public	Priv.	Priv.	Priv.	Public	Priv.	Priv	Public	Priv.	Priv.	
Risk Title and Description	**Weig't**	**Opt. 1**	**Opt. 2**	**Opt. 3**	**Opt. 4**	**Opt. 5**	**Opt. 6**	**Opt. 7**	**Opt. 8**	**Opt. 9**	**Opt. 10**	**Opt. 11**	**Scoring Rationale**
Risk of a lack of labour availability and/or capability		**N/A**	**L**	**L**	**L**	**L**	**M**	**M**	**M**	**L**	**L**	**L**	Based on the experience of the ROI and England, skills for culling and lay-vaccination can be built up with the assistance of complementary training. This, therefore, is considered generally to be a low risk across all Cull and Vaccination options. TVR, however, requires a qualified Vet to anaesthetise the animal to allow use of the sett-side test on trapped badgers. Veterinary labour is in high demand and supply is constrained. Therefore TVR options are scored medium on this risk. This will be carried forward into the risk management plan for the preferred option, and mitigation strategies considered.
Unweighted score		**0**	**4**	**4**	**4**	**4**	**6**	**6**	**6**	**4**	**4**	**4**	
Weighted score	**15**	**0**	**60**	**60**	**60**	**60**	**90**	**90**	**90**	**60**	**60**	**60**	
Risk of change to local biodiversity / ecosystems		**N/A**	**M**	**M**	**M**	**M**	**VL**	**VL**	**VL**	**VL**	**VL**	**VL**	This is not clear cut. For example, some suggestions that badger removal will have both positive and negative effects on other species, e.g. the negative impact of a potential for an increase in pest species, such as rabbits, rats and mice; a positive impact of a potential increase in the number of hedgehogs; a negative impact for the increase in the number of foxes as a rise in fox numbers can reduce populations of other animals, such as hedgehogs, hares and ground-nesting birds, due to increased predation. The SEA also highlights the potential risk of disruption to ecosystems and that the extent of disruption is correlated with the number of badgers removed. Non-selective cull options remove the largest number of badgers. E.g. The APHA modelling (Alternative Area 1, pro-rata to 100km2) illustrates that Non-sel. Cull may remove 427 badgers over five years, whereas TVR options only remove 76, and vaccination options remove zero. Under the TVR options, the model suggests that new births will almost keep pace with removals, and the population was only reduced to 90% in the core (and 96% across the whole arena) at the end of intervention. By end of year 7, the population was 99% of its original under TVR options, 102% under Vaccination options, but 42% under Cull in the core intervention area. This suggests that both TVR and Vaccination options would have minimal disruption to local biodiversity/ecosytems and should be given a VL risk rating. In contrast, Cull options secures a medium rating.
Unweighted score		**0**	**6**	**6**	**6**	**6**	**2**	**2**	**2**	**2**	**2**	**2**	
Weighted score	**30**	**0**	**180**	**180**	**180**	**180**	**60**	**60**	**60**	**60**	**60**	**60**	

Approach		Do N.	Cull	Cull	Cull	Cull	TVR	TVR	TVR	Vacc	Vacc	Vacc	
Access to badger		N/A	Cage	Cage	Restr	C.Shoot	Cage	Cage	Restr.	Cage	Cage	Restr.	
Deployed by public or private sector:		N/A	Public	Priv.	Priv.	Priv.	Public	Priv.	Priv	Public	Priv.	Priv.	
Risk Title and Description	**Weig't**	**Opt. 1**	**Opt. 2**	**Opt. 3**	**Opt. 4**	**Opt. 5**	**Opt. 6**	**Opt. 7**	**Opt. 8**	**Opt. 9**	**Opt. 10**	**Opt. 11**	**Scoring Rationale**
Risk that legislative cover is not secured, or not secured at the desired time.		**N/A**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	This risk is deemed medium. However, as updated and/or new legislation is required for all short-listed options, this risk does not differ across options, and the relativity of risk across options is the same. NB: This risk will be included in the Risk Management Plan for the preferred option, and mitigation strategies considered.
Unweighted score		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Weighted score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Risk that sufficiently widespread land access for badger intervention is not secured to allow an intervention to proceed.		**N/A**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	This risk is deemed low. Farmers are concerned about increasing levels of bTB herd incidence. Therefore, at this stage it is assumed that the majority is likely to support badger intervention on their land.
Unweighted score		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Weighted score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Operational safety		**N/A**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	Various aspects of operational safety have also been highlighted in the Strategic Environmental Assessment. Ultimately, all shortlisted options have been tested in England, Wales, the ROI, or in the NI TVR feasibility project, and this shows that all can be deployed safely. This risk can be mitigated by learning lessons from these countries, including considering their protocols. While one might consider Option 5 (predominant controlled shooting of free roaming badgers) as slightly higher risk, it appears to have been deployed with no major safety issues in England when it commenced this approach in 2013. As a result, initial and/or supplementary culls using this method continued in England for more than a decade. Therefore, all options are considered to have a low risk on this factor. This will be carried forward into the risk management plan for the preferred option, and mitigation strategies considered.
Unweighted score		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Weighted score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Risk of weather affecting access to badgers		**N/A**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	**Same**	A peer reviewed paper suggests that weather may affect badgers' roaming behaviours, and therefore the likelihood of them being trapped or accessed for controlled shooting. However, this would affect all do something options in the same way.
Unweighted score		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Weighted score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Approach		Do N.	Cull	Cull	Cull	Cull	TVR	TVR	TVR	Vacc	Vacc	Vacc	
Access to badger		N/A	Cage	Cage	Restr	C.Shoot	Cage	Cage	Restr.	Cage	Cage	Restr.	
Deployed by public or private sector:		N/A	Public	Priv.	Priv.	Priv.	Public	Priv.	Priv	Public	Priv.	Priv.	
Risk Title and Description	**Weig't**	**Opt. 1**	**Opt. 2**	**Opt. 3**	**Opt. 4**	**Opt. 5**	**Opt. 6**	**Opt. 7**	**Opt. 8**	**Opt. 9**	**Opt. 10**	**Opt. 11**	**Scoring Rationale**
Risk of a perturbation effect, i.e. the risk that badger culling in one area would increase badger ranging and cause a (likely short term) higher level of herd breakdowns in a neighbouring area.		**N/A**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	Vaccination has no badger removal, and therefore is unlikely to stimulate a perturbation effect. The TVR pilot removes fewer badgers than a non-selective cull, and the pilot of this approach in NI found no perturbation effect. Therefore this risk is deemed very low for TVR options. As regards Non-selective Cull options, the ROI found no perturbation effect in its Four Area Trial. It chose large areas, with hard boundaries as far as possible. A perturbation effect was found in England's RBCT where a cull was carried out on areas of 100km2. Any Non-selective Cull option in NI would be designed to try to mitigate the risk of a perturbation effect as far as possible, e.g. areas with a size > 100km2; hard boundaries as far as possible, etc. The residual risk is rated as low for cull options. However, this is not scored here as the impact of a perturbation effect "off" and "on" assumption for Non-selective Cull options was explored in the main economic analysis and in the economic sensitivity analysis respectively. The analysis showed that when a perturbation effect is assumed for these options, TVR becomes the highest-ranked option. The Cull options using predominantly controlled shooting and restraint trapping fall into second and third place respectively.
Unweighted score		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Weighted score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Cost overrun		**N/A**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	This risk is deemed low given that the public sector deployment cost of cage traps, the private sector deployment of restraint traps and the private sector deployment of predominant controlled shooting are based on NI, ROI and England's experience respectively. As NI only has experience of public sector deployment of cage traps, there is more risk around the estimated costs for private sector options. However, this issue was considered in the economic sensitivity analysis which considered the change to the rank order of options when it is assumed that the cost of private sector options increased by various percentages. While this is not considered again here, it will be included in the Risk Management Plan for whatever becomes the preferred option, and appropriate mitigation strategies discussed.
Unweighted score		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Weighted score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Approach		Do N.	Cull	Cull	Cull	Cull	TVR	TVR	TVR	Vacc	Vacc	Vacc	
Access to badger		N/A	Cage	Cage	Restr	C.Shoot	Cage	Cage	Restr.	Cage	Cage	Restr.	
Deployed by public or private sector:		N/A	Public	Priv.	Priv.	Priv.	Public	Priv.	Priv	Public	Priv.	Priv.	
Risk Title and Description	**Weig't**	**Opt. 1**	**Opt. 2**	**Opt. 3**	**Opt. 4**	**Opt. 5**	**Opt. 6**	**Opt. 7**	**Opt. 8**	**Opt. 9**	**Opt. 10**	**Opt. 11**	**Scoring Rationale**
Risk that the required level of funding is not available, thereby limiting the scale of roll out of badger intervention to a lower number of cattle bTB hotspot areas.		**N/A**	**Cost: Ben. Analy**	**Cost: Ben. Analy**	**Cost: Ben. Analy**	**Cost: Ben. Analy**	**Cost: Ben. Analy**	**Cost: Ben. Analy**	**Cost: Ben. Analy**	**Cost: Ben. Analy**	**Cost: Ben. Analy**	**Cost: Ben. Analy**	The funding risk is directly related to the relative cost of options. This risk will be higher for more labour intensive, and hence more expensive, options. As cage trapping requires the most labour effort, the risk will be highest for public sector cage trap options, followed by private sector cage trap options. Private sector restraint-based options have a much lower cost. The predominant controlled shoot option has the lowest cost as it has lower effort. However, the differences between options as regards their cost estimates, and costs compared to indicative modelled benefit estimates etc. are already weighed up in the quantitative cost:benefit analysis, and options are not re-ranked here. However, this is a risk that will be in the Risk Plan. Intervention will only begin in an area where there is deemed to be sufficient funds to see it through.
Unweighted score		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Weighted score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Risk of disruption due to protestors - addressed with policing		**N/A**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	**Sens. Analy.**	Cull and vaccination options have been tested in England, Wales, and in the ROI, and the TVR approach was testing in the NI TVR feasibility/pilot project. Protestors did not feature in the NI TVR Pilot, or in the ROI's culling roll-out over several decades. There was, however, protestor activity for England's badger culls. This was addressed with policing. This did not appear to curtail its roll out over 10+ years. Therefore, it is considered relatively low risk, and mitigated by policing. The policing cost is factored into the cost of options in the sensitivity analysis.
Unweighted score		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Weighted score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Risk of badger extinction in NI		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	The difference between the number of badgers removed across options has been dealt with in the non-monetary analysis, and is not repeated here. It is considered that there is no risk of badger extinction because the Bern Convention does not permit intervention across of all of NI, and because all interventions in bTB hotspot areas will be designed to mitigate this risk.
Unweighted score		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Weighted score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Approach		Do N.	Cull	Cull	Cull	Cull	TVR	TVR	TVR	Vacc	Vacc	Vacc
Access to badger		N/A	Cage	Cage	Restr	C.Shoot	Cage	Cage	Restr.	Cage	Cage	Restr.
Deployed by public or private sector:		N/A	Public	Priv.	Priv.	Priv.	Public	Priv.	Priv	Public	Priv.	Priv.
Risk Title and Description	**Weig't**	**Opt. 1**	**Opt. 2**	**Opt. 3**	**Opt. 4**	**Opt. 5**	**Opt. 6**	**Opt. 7**	**Opt. 8**	**Opt. 9**	**Opt. 10**	**Opt. 11**
Unweighted Risk Score		**0**	**18**	**18**	**18**	**18**	**20**	**20**	**20**	**20**	**20**	**20**
Weighted Risk Score		**0**	**490**	**490**	**490**	**490**	**480**	**480**	**480**	**550**	**550**	**550**
Overall Risk Ranking		**N/A**	**4**	**4**	**4**	**4**	**1**	**1**	**1**	**8**	**8**	**8**

8.3 Rank order of options on weighted risk score

8.3.1 As discussed earlier, there are no operational risks associated with the 'Do Nothing' option and it is not scored in this risk analysis. That said, given that the objective of the bTB programme is to eradicate bTB from NI by 2050, this option would leave bTB prevalence in the badger disease vector unaddressed in bTB hotspot areas. The Scientific Opinion Paper said "…to enable eradication of bTB in cattle within an area, the infection needs to be controlled in all *M. bovis* reservoir hosts connected to that area"[126]. Therefore, a 'Do Nothing' option is likely to be higher risk than all do-something shortlisted badger intervention options.

8.3.2 Considering only "Do something" badger intervention options, following on from the risk analysis above, vaccination options have the highest weighted risk scores (550). This is predominantly because of a higher risk rating on criterion 1 (risk of an approach not supporting progress toward the bTB programme objective of bTB eradication in a timely manner, i.e. eradication by 2050). This relates to the Scientific Opinion Paper's conclusion that vaccination option is "slow to act and less effective in areas with high infection prevalence unless preceded by a reduction in infection pressure (e.g. via culling or selective removal). Sustained, high-coverage badger vaccination over many years is likely to be required using a vaccination only approach in areas where the infection is endemic in badgers"[127].

8.3.3 The next riskiest options are those involving a Non-selective Cull. They have weighted risk scores of 490. They have higher risk scores than TVR options primarily because they involve removing a larger number of badgers, with consequent risks for disruption to ecosystems.

8.3.4 TVR options have the lowest weighted risk scores (480). Although they present higher implementation risks than the Non-selective Cull and Vaccination

[126] DAERA 2025) scientific opinion on the peer reviewed evidence on badger intervention in relation the control of bovine tuberculosis. Internal analysis. Appended to the 2026 "Bovine Tuberculosis (bTB) Consultation on Potential Wildlife Intervention Options as part of the Bovine Tuberculosis in Northern Ireland: Blueprint for Eradication".
[127] *Ibid*

options, particularly regarding both labour and non-labour resource availability (i.e. in relation to the availability of vets, vaccinations and sett side tests), they carry a lower overall risk. This is because modelling suggests that they have the potential to deliver a similar disease-control impact to Non-selective Cull options, but with less risk to biodiversity and ecosystems due to the removal of fewer badgers.

9. Summary of option ranks

9.1 Introduction

9.1.1 The section summarises how each shortlisted option ranks on the various analyses, and outlines next steps.

9.2 Shortlisted options

9.2.1 By way of reminder, the following eleven options were shortlisted for consideration:

Option 1 **Do Nothing (i.e. no badger intervention);**

Option 2 **Proactive non-selective cull, trapping badgers using cages, deployed by the public sector** (costed using DAERA's experience of its cage trap TVR pilot, adjusted for a cull);

Option 3 **Proactive non-selective cull, trapping badgers using cages, deployed by the private sector** (costed using DAERA's knowledge of cage trapping TVR, adjusted for a cull, and using ASHE statistics to estimate a potentially lower private sector wage rate);

Option 4 **Proactive non-selective cull, trapping badgers using restraints, deployed by the private sector** (using high level cost information from the ROI on a private sector delivered restraint-based cull);

Option 5 **Proactive non-selective cull, with predominant controlled shooting of free-roaming badgers** (complemented by cage trap and shoot where the terrain is not suitable for controlled shooting), deployed by the private sector (using high level information from the DEFRA website on a predominant C.S. cull by private sector farmer-controlled companies);

Option 6 **Proactive selective cull using Test and Vaccinate or Remove, trapping badgers using cages, deployed by the public sector** (costed using DAERA's experience of its cage trap TVR pilot);

Option 7 **Proactive selective cull using Test and Vaccinate or Remove, trapping badgers using cages, deployed by the private sector** (costed using DAERA's experience of its cage trap TVR pilot, and using ASHE statistics to estimate a potentially lower private sector wage rate);

Option 8 **Selective cull using Test and Vaccinate or Remove, trapping badgers using restraints, deployed by the private sector** (costed using high level information from the ROI on a private sector deployed restraint-based cull and adjusting it for a TVR approach);

Option 9 **Proactive non-selective vaccination, trapping badgers using cages, deployed by the public sector** (costed using DAERA's experience of its cage trap TVR pilot, adjusted for a vaccination only approach);

Option 10 **Proactive non-selective vaccination, trapping badgers using cages, deployed by the private sector** (costed using DAERA's knowledge of cage trapping TVR, adjusted for a vaccination only approach, and using ASHE statistics to estimate a potentially lower private sector wage rate);

Option 11 **Proactive non-selective vaccination, trapping badgers using restraints, deployed by the private sector** (costed using high level information from the ROI on a private sector deployed restraint-based cull, adjusting it for a vaccination approach).

9.3 Summary of how shortlisted options rank on the key analyses

9.3.1 The following table summarises how each option ranks on the key analyses conducted.

9.3.2 Column 'a' outlines the estimated variable costs per one 100km^2 area of each shortlisted badger intervention option in economic cost terms[128] in 2026/27 prices.

9.3.3 Column 'b' outlines the number of herd breakdowns that would need to be avoided for the benefits of badger intervention to match (i.e. offset) its intervention cost (where the value of a breakdown avoided is estimated to be £27,500 in 2026/27 prices).

9.3.4 The next step was to consider the question "**Does the breakeven number of herd breakdowns avoided for each shortlisted option appear achievable**?".

[128] [NB: These differ slightly from financial costs in that they do not include annual inflation uplifts over five years, and for internal government staff, economic costs include an overhead cost. This means the financial (cash) cost of internal staff is adjusted upwards to include a cost for accommodation, HR and other overheads associated with employing staff].

No Perturbation Effect Assumed for Non-selective Cull Options

9.3.5 The ROI's Four Area Trial results (i.e. the % reduction in the herd breakdown rate) is applied to the baseline number of herd breakdowns used for the APHA model to extrapolate how many herd breakdowns might be saved if NI achieved the same results as this trial. If results in NI were on a par with those achieved in the Four Area Trial, then 11 herd breakdowns would be saved per year. The comparison of the breakeven figures for shortlisted options with this ROI extrapolated result is provided in Column 'c'.

9.3.6 Option 2 has a breakeven figure just under 11, and the other Non-selective Cull options have figures that are much lower than 11, and on this comparison, their benefits may be considered potentially achievable.

9.3.7 As the Four Area Trial considered a proactive non-selective cull, there is no comparison available for options using TVR and vaccination approaches. However, modelling carried out by the Animal and Plant Health Agency (APHA) is useful as it does compare the relativity of non-selective cull, TVR and vaccination approaches. It considers a four-year initial intervention and three years of follow-up vaccination, as opposed to five years of initial intervention which is currently under consideration. This is discussed further in chapter 5, however, with caveats noted, it can illustrate how options might potentially perform relative to one another[129].

9.3.8 Column 'd' shows how the breakeven number of herd breakdowns avoided for each shortlisted option (i.e. column 'b') compares to the APHA Model's results for the core intervention area of Area 1 (alternative configuration) when there is no perturbation effect assumed for Non-selective Cull options, and benefits are assumed to last nine years. Column 'e' shows the illustrative Net Present Value (positive values) or Net Present Cost (minus values) when it is assumed that benefits last nine years, and there is no perturbation effect generated by Non-selective Cull options. A NPV means a potential net benefit to the NI economy, whereas a NPC means a potential net cost to the NI economy. Column 'f' shows the rank order of options by illustrative NPV.

9.3.9 Three non-selective cull options (Options 3, 4, 5) and one selective cull option (Option 8, TVR using restraints) all have breakeven numbers below the model results and therefore have an illustrative NPV. Option 5 (Non-selective Cull using predominant controlled shooting deployed by farmer-led organisations) ranks first on NPV, followed by Option 4 (Non-selective Cull using restraints,

[129] Budgey, R. and Smith, G.C. (2019) "A simulation model to assess the relative performance of wildlife intervention options on bTB in wildlife and cattle in Northern Ireland." National Wildlife Management Centre, Animal and Plant Health Agency (APHA).

deployed by the Private Sector), followed by Option 8 (Selective cull via TVR, using restraints, deployed by the Private Sector), with Option 3 (Non-selective Cull using cages, deployed by the Private Sector) ranked fourth.

9.3.10 Column 'g' is completed only for those options with an illustrative NPV, and it considers whether the NPV is resilient to changes in key assumptions (i.e. the results from the Economic Sensitivity Analysis). The illustrative NPVs for Options 5, 4 and 8 are all resilient to changes in key assumptions. However, the illustrative NPV for Option 3 is not resilient to changes in key assumptions (see cell with mid dark green). Its average rank is also coloured dark green to signify that while it achieved an illustrative NPV, it is vulnerable to changes in assumptions. For instance, if this option was taken forward, there would need to be very rigorous cost management, as even a 15% increase in costs would result in this option's illustrative NPV changing to a NPC.

9.3.11 Option 2 (Non-selective Cull, using cages, deployed by the public sector) originally had a breakeven number of herd breakdowns avoided below the extrapolated results from the Four Area Trial. But when the breakeven figure is compared to the results from the APHA NI parameterised model, its breakeven number of herd breakdowns avoided is above the Model's results. Therefore, based on this comparison, the breakeven number of herd breakdowns avoided per year is unlikely to be achieved for this option, and it has an illustrative NPC. To show that this option is unlikely to generate a net benefit, its monetary results and final rank is coloured grey in the summary table.

9.3.12 All other options (6, 7, 9, 10, and 11) have breakeven figures above APHA Model results and have illustrative Net Present Costs, i.e. the benefits are unlikely to be sufficient to offset the cost of operating each of these options in a 100km^2 area. Their rows are coloured grey in the summary table.

WITH a Perturbation Effect Assumed for Non-selective Cull Options

9.3.13 In the summary table, results that have a perturbation effect assumed for Non-selective Cull options are in red font. There is no perturbation effect assumed for vaccination and TVR options. This is because no badgers are removed under the vaccination approach, and because the pilot of the TVR approach in Banbridge did not show any increase in badger ranging behaviour.

9.3.14 Column 'h' shows how the breakeven number of herd breakdowns avoided for each shortlisted option compares to the APHA Model's results for the core intervention area of Area 1 (alternative configuration) when a perturbation effect is assumed for non-selective cull options. Column 'i' shows the illustrative Net Present Value (positive values) or Net Present Cost (minus

values) when it is assumed that benefits last nine years, and column ‘j’ shows the rank order of options by illustrative NPV.

9.3.15 When a perturbation effect is assumed for non-selective cull options, they perform less well, and Option 8 (Selective cull via TVR using restraints, deployed by the private sector) becomes the best ranked option on illustrative NPV. Option 5 (Non-selective Cull using predominant controlled shooting, deployed by the private sector (farmer-led orgs.)) is ranked second and Option 4 (Non-selective Cull using restraints, deployed by the private sector) is ranked third.

9.3.16 Option 2 (Non-selective Cull, using cages, deployed by the public sector) continues to have a breakeven number of herd breakdowns avoided that is higher than the Model’s results. In addition, now Option 3 (Non-selective Cull, using cages, deployed by the private sector) has a breakeven number of herd breakdowns avoided that is higher than the Model’s results. Both options have illustrative NPCs. Therefore, the breakeven targets are unlikely to be achieved under the perturbation effect assumption for Non-selective Cull options that use cage trapping. The monetary results for these options are coloured grey in the summary table.

9.3.17 Column ‘k’ is completed only for those options with an illustrative NPV, and it considers whether the illustrative NPV is resilient to changes in key assumptions (i.e. the results from the Economic Sensitivity Analysis). The illustrative NPV for Option 8 is resilient to changes in key assumptions, and that for Option 5 is reasonably resilient in that it retains its NPV in most sensitivity scenarios, but it changes to a NPC when it is assumed that a policing cost is required, and benefits only last seven years, instead of nine years.

9.3.18 However, the illustrative NPV for Option 4 is not resilient to changes in key assumptions and is coloured dark green. Its average rank under the “perturbation effect” assumed column is also coloured dark green to signify that while it achieved an illustrative NPV, it is vulnerable to changes in assumptions. For instance, if this option was taken forward, there would need to be very rigorous cost management, as even a 15% increase in costs would result in the illustrative NPV for this option changing to an NPC.

9.3.19 Columns ‘l’ and ‘n’ provide each option’s scores from the non-monetary factor analysis and risk analysis, and columns ‘m’ and ‘o’ provide each option’s rank on these scores respectively.

9.3.20 Columns ‘p’ and ‘q’ calculate the average rank of options with and without a perturbation effect assumption, i.e. each option’s rank from the economic

analysis is added to its rank from both the non-monetary and risk analyses, with the total divided by three.

9.3.21 If a perturbation effect is **NOT** assumed for non-selective cull options, then taking account of all the analyses conducted, and considering only the options where this is a likelihood of benefits offsetting the cost of intervention (i.e. those with illustrative NPVs on the original assumptions), then the best options on the basis of their average rank (across monetary costs, non-monetary and risk analyses) are:

1st (average rank of 2.3): Option 8: Selective cull via TVR, using restraints, deployed by the Private Sector

2nd= (average rank of 4): Option 5: Non-selective Cull using predominant controlled shooting (with some cage trapping/shooting, e.g. where terrain is not suitable for controlled shooting) deployed by the private sector, i.e. farmer-led organisations.

2nd= (average rank of 4): Option 4: Non-selective Cull using restraints, deployed by the Private Sector

2nd= (average rank of 4): Option 3: Non-selective Cull using cages, deployed by the Private Sector

9.3.22 Note, however, that the illustrative NPV for Option 3 is vulnerable to changes in key assumptions, and any deployment of this option would need careful control of costs.

9.3.23 If a perturbation effect **IS** assumed for non-selective cull options, then taking account of all the analyses conducted, and considering only the options where this is a likelihood of benefits offsetting the cost of intervention (i.e. those with illustrative NPVs on the original assumptions), then the best options on the basis of their average rank (across monetary costs, non-monetary and risk analyses) are:

1st (average rank of 1.7): Option 8: Selective cull via TVR, using restraints, deployed by the Private Sector

2nd= (average rank of 4.3): Option 5: Non-selective Cull using predominant controlled shooting (with some cage trapping/shooting, e.g. where terrain is not suitable for controlled shooting) deployed by the private sector, i.e. farmer-led organisations

2nd= (average rank of 4.3): Option 4: Non-selective Cull using restraints, deployed by the Private Sector

9.3.24 Note, however, that when a perturbation effect is assumed for non-selective cull options, the illustrative NPV for Option 4 is vulnerable to changes in key assumptions, and any deployment of this option would need careful control of costs.

Table 29: Summary of the rank of shortlisted options on the key analyses

Column label:	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q
Short-listed Option	**Economic Cost of option over 5 yrs for ONE 100km2 area £M**	**No. of Hd BDs Avoided needed / yr to offset costs****	**Compare with Four Area Trial (i.e. is BDs saved col. b < FAT equiv. of 11 hd BDs saved/yr?)**	**APHA** (i.e. is BDs saved col. b < NO pert results of 7.5, 7.3 or 2.3 hd BDs saved/yr for Cull, TVR and Vacc?)*****	**APHA Model - Illustrative NPV for interv. area (core) benefits if they last 9 yrs £M**	**Rank by Illust. NPV (no pert. eff. for Cull opt.)**	**APHA Model: If No Pert. Effect Assumed, modelled core impact: +ve NPV resilient to Sensitivity assumpt.?**	**APHA (i.e. is BDs saved col. b < WITH pert results of 3.6, 7.3 or 2.3 Hd BDs saved/yr for Cull, TVR and Vacc?)*****	**APHA Model - Illustrative NPV for interv. area (core) benefits if they last 9 yrs £M**	**Rank by Illust. NPV (WITH pert. eff. for Cull opt.)**	**APHA Model: If Pert. Effect Assumed, modelled core impact: +ve NPV resilient to Sensitivity assumpt.?**	**Non-monetary analy. score**	**Rank sh'listed opt. by NMF Score**	**Risk analysis score**	**Rank sh'listed opt. by Risk Score**	**Av. Rank (no pert. effect for Cull Opt.)**	**Av. Rank (WITH pert. effect for Cull Opt.)**
Perturbation Effect assumed for Cull options?				**No**	**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**						**Yes**
1: Do Nothing	£0.000	0.0	N/A	N/A	£0.000	5	N/A	N/A	£0.000	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2: Non-Select. Cull using cages - Public Sector	£2.396	10.5	Yes - appears achievable (<11)	No (>7.5)	-£0.628	8	N/A	No (>3.6)	-£1.458	10	N/A	16	4	490	4	**5.3**	6.0
3: Non-Select. Cull using cages - Private Sector	£1.609	7.0	Yes - appears achievable (<11)	Yes - appears achievable (<7.5)	**£0.111**	4	No	No (>3.6)	-£0.719	7	N/A	16	4	490	4	**4.0**	**5.0**
4: Non-Select. Cull using restraints - Private Sector	£0.726	3.2	Yes - appears achievable (<11)	Yes - appears achievable (<7.5)	**£0.909**	**2**	Yes	Yes -appears achievable (<3.6)	**£0.079**	**3**	No	15	**6**	490	**4**	**4.0**	**4.3**
5: Non-Select. Cull using predominant controlled shooting - private sector (farmer led orgs.)	£0.444	1.9	Yes - appears achievable (<11)	Yes - appears achievable (<7.5)	**£1.165**	**1**	Yes	Yes - appears achievable (<3.6)	**£0.336**	**2**	Reasonably (If pert. eff. assumed, only becomes negative when policing incl, & ben. last 7 yrs.)	14	**7**	490	**4**	**4.0**	**4.3**
6: TVR using cages -Public Sector	£2.648	11.6	N/A*	No (>7.3)	-£0.895	9	N/A	No (>7.3)	-£0.895	8	N/A	18	1	480	1	3.7	3.3
7: TVR using cages -Private Sector	£1.811	7.9	N/A*	No (>7.3)	-£0.112	6	N/A	No (>7.3)	-£0.112	5	N/A	18	1	480	1	2.7	2.3
8: TVR using restraints -Private Sector	£0.949	4.1	N/A*	Yes - appears achievable (<7.3)	**£0.668**	**3**	Yes	Yes - appears achievable (<7.3)	**£0.668**	**1**	Yes	17	**3**	480	**1**	**2.3**	**1.7**
9: Vacc. using cages, -Public Sector	£2.425	10.6	N/A*	No (>2.3)	-£1.739	11	N/A	No (>2.3)	-£1.739	11	N/A	10	8	550	8	9.0	9.0
10: Vacc. using cages -Private Sector	£1.647	7.2	N/A*	No (>2.3)	-£1.008	10	N/A	No (>2.3)	-£1.008	9	N/A	10	8	550	8	8.7	8.3
11: Vacc. using restraints -Private Sector	£0.782	3.4	N/A*	No (>2.3)	-£0.226	7	N/A	No (>2.3)	-£0.226	6	N/A	9	10	550	8	8.3	8.0

* Four Area Trial tested a Proactive Non-Selective Cull approach and its results are only relevant to Cull options.

** Animal and Plant Health Agency Simulation Model developed by R. Budgey and G. C. Smith (2019) - Alternative Configuration of Area 1 results.

*** If benefits are assumed to last nine years.

9.4 Next steps

9.4.1 This options analysis is appended to the public consultation on potential wildlife intervention options. Stakeholders should review the analysis and take the opportunity to submit any new / additional evidence for DAERA's consideration.

9.4.2 All written submissions received by DAERA during the consultation period will be carefully reviewed. The options analysis will be updated to reflect new / additional evidence, as appropriate.

9.4.3 The updated options analysis will inform a recommendation(s) on the best intervention option(s) when economic, social and environmental factors are taken into account. Recommendation(s) will be presented to the DAERA Minister, who will take the final decision(s) on what, if any, badger intervention option(s) should be deployed in bTB hotspot areas of NI.

9.4.4 Following the DAERA Minister's decision, more detailed planning of the implementation of option(s) can commence (including scale of deployment, timing, logistics of implementation, funding, etc.).

Appendix 1: Badger Intervention Analyses – Calculation Assumptions (See Annex IX of Bovine Tuberculosis (bTB) Consultation on Potential Wildlife Intervention Options as part of the Bovine Tuberculosis in Northern Ireland: Blueprint for Eradication)

Appendix 2: Strategic Fit

Table A2 – 1: Summary of how a potential badger intervention would align with relevant overarching strategies

Policy/Initiative	Details/Relevance
Protection of badgers	
The Bern Convention on the Conservation of European Wildlife and Natural Habitats	The Bern Convention is an international treaty, and appendix III of this treaty requires the UK to protect badger habitats and restrict interference. In Northern Ireland, the protections of the Bern Convention are primarily implemented under the Wildlife (N.I.) Order of 1985[130].
The Wildlife Order (NI) 1985 ("the 1985 Order")	The 1985 Order provides protection to badgers and their setts. Pursuant to Article 10(1), subject to the provisions of Part II of the Order, if any person intentionally or recklessly kills, injures or takes a badger (being an animal specified in Schedule 5 as one which is protected at all times) he shall be guilty of an offence. It is also generally an offence to have in one's possession or control a live or dead badger. Pursuant to article 11(3), notwithstanding anything in Article 10, an authorised person shall not be guilty of an offence by reason of the killing or injuring of a wild animal included in Schedule 5 "if he shows that his action was necessary for the purpose of precenting serious damage to livestock… and he notifies the Department immediately after taking such action". Article 10(1) also does not apply to anything done for the purpose of preventing the spread of disease or for the purpose of preventing serious damage to livestock if it is done under and

[130] Wildlife (NI) Order 1985 Badgers are included in the list of animals that may not be killed or taken by certain methods (Schedule 6). In Schedule 6a, badgers are listed as animals that may not be killed or taken by trapping or snaring.

	in accordance with a licence granted by the Department (see Article 18(1) and 18(3).
The Welfare of Animals Act (NI) 2011 ("the 2011 Act").	It is also a criminal offence under section 4(1) of the 2011 Act for a person, in certain circumstances, to cause unnecessary suffering to an animal. It follows from this that the level of suffering (humaneness) inflected by means of any badger intervention option considered is a relevant consideration. This is dealt with in the Non-Monetary Factor Analysis chapter.
Higher animal health status	
EU: European Animal Health Priorities	The EU aims (as per Reg. 2021/690) to contribute to a high level of safety of food and food production systems and of other products that may affect the safety of food, which improving the sustainability of food production; and to contribute to achieving a higher animal health status for the Union and to support the improvement of the welfare of animals. The badger intervention enhancements proposed considered fit with these aims, therefore ensuring that NI aligns with the requirements under the NI protocol, and protects trade with the EU.
Other relevant DAERA Strategies	
Programme for Government 2024-2027 'Our Plan: Doing What Matters Most'[131]	The Programme for Government (PfG), published on 3rd March 2025, sets out the immediate priorities which the Northern Ireland Executive will work towards from 2024 until the end of the current mandate in 2027. A bTB badger intervention strategy directly supports several core priorities of the PfG by strengthening rural resilience, protecting the environment, and enhancing the effectiveness of public services. **1. Strengthening a Sustainable, Competitive Economy** Bovine TB continues to impose severe financial pressures on farmers and government. Reducing disease transmission through badger intervention supports the PfG's goal of building a globally competitive and sustainable economy by improving herd health, reducing compensation costs, and protecting NI's agri-food industry. **2. Protecting the Environment and Biodiversity** The PfG prioritises environmental protection, including healthier ecosystems and more sustainable land management.

[131] Programme for Government 2024-2027 'Our Plan: Doing What Matters Most'- Documents | The Northern Ireland Executive

	The interventions considered address the proven reservoir of infection in badger populations in bTB hotspot areas, supporting ecosystem health. **3. Improving Community Wellbeing** The PfG is built on a Wellbeing Framework, and tackling bTB improves mental and economic wellbeing in rural communities. Reduced herd breakdowns alleviate stress, uncertainty, and financial instability for farming families. **4. Delivering Public Service Transformation** A badger intervention strategy aligns with the PfG's focus on reforming public services through collaborative, science-led approaches. The multi-stakeholder TB Partnership Steering Group already reflects PfG principles of partnership, cross-departmental teamwork, and evidence-based decision-making. **5. Supporting Safer, More Stable Rural Communities** By reducing disease pressure and economic disruption, badger intervention contributes to the PfG commitment to safer communities and more stable rural livelihoods, while strengthening trust between government and stakeholders. maximising the opportunities for sustainable growth. A bTB badger intervention strategy reinforces the PfG's Missions of People, Planet, and Prosperity, delivering tangible progress on what matters most: healthier communities, a protected environment, and a more resilient, sustainable economy.
DAERA Corporate Plan 2025-2027	DAERA has responsibility for the environment, food, farming, fisheries, forestry and sustainability policy plus the development of the rural sector in NI. Its vision is "Delivering a net zero nature positive future, supporting sustainable agriculture and thriving rural communities". A bTB badger intervention strategy provides clear, measurable contributions to DAERA's strategic outcomes for 2025–2027. It enables the Department to: • Deliver a core commitment to evidence-based bTB eradication • Improve animal health and welfare • Advance environmental and nature-positive objectives • Strengthen rural community resilience • Demonstrate leadership in science-led policy • Deepen cross-border and cross-sector collaboration This intervention is not only aligned with—but essential to—the successful delivery of DAERA's Corporate Plan and the Executive's wider environmental and agricultural ambitions.

DAERA Business Plan 2025/26	DAERA's 2025-26 vision is *"Towards 2050: Developing a Net Zero nature positive future, supporting sustainable agriculture and thriving rural communities".* DAERA and its agencies carry responsibility for environment, climate change and sustainability, food, farming, fisheries, forestry, and the development of the rural sector in Northern Ireland. Business Plan Commitment Number 25 states: We will work collaboratively with stakeholders to advance the following science-led, evidence-based measures aimed at reducing bovine tuberculosis: • Progress policy on future wildlife intervention measures, informed by public consultation.
The draft Nature Recovery Strategy for Northern Ireland (2026–2032), and its preceding Biodiversity Strategy	The draft Nature Recovery Strategy (2026–2032) is Northern Ireland's statutory Biodiversity Strategy, required under the Wildlife and Natural Environment Act (NI) 2011. It sets out how NI will halt and reverse biodiversity loss. A bTB badger intervention strategy aims to break transmission cycles by directly addressing disease as a pressure by: • Reducing bTB transmission within badger populations and between badgers and livestock. • Mitigating ecological stress linked to unmanaged disease prevalence. This removes a significant ecological pressure in line with Strategic Objective 2.
Environmental Principles Policy Statement (EPPS) (2025)	The five environmental principles (integration, prevention, rectification at source, polluter pays and precautionary principle) are not new. They already apply in many international laws, including the EU Treaties and they continue to underpin the UK's domestic implementation of many of the UK's international obligations. All NI departments and Ministers have a duty to have 'due regard' to the EPPS in their policy-making process. In relation to bTB badger intervention, a Strategic Environmental Assessment and Habitats Regulation Assessment have been carried out which aligns with these principles.
Environment Improvement Plan (2024)	Of relevance to the bTB strategy and the issue of badger intervention, this Plan included a vision/outcome of developing a culture of prevention of disease rather than cure; it also

	emphasises the need to reduce unnecessary emissions (given the need to align with statutory targets on GHG emissions). With the herd incidence of bTB increasing relatively consistently now for many years, and currently at around 11%, the disease brings significant inefficiencies into agricultural production systems. Eradicating bTB would help reduce the level of GHG emissions per unit of output.
Environment Strategy for Northern Ireland – (Consultation closed 18/1/22)	A Northern Ireland Environment Strategy ("the Environment Strategy") aims to form the basis for a coherent and effective set of interventions that can deliver real improvements in the quality of the environment and thereby improve the health and well-being of our citizens, create opportunities to develop our economy and play our part in protecting the global environment for many decades to come. A bTB badger intervention strategy contributes substantially to the Environment Strategy for Northern Ireland by: • Improving wildlife and ecosystem health • Reducing environmental pressures linked to disease disruption • Supporting sustainable agricultural production • Lowering emissions and strengthening climate resilience • Enhancing public access to healthy, thriving nature • Advancing joined-up policymaking across DAERA and the wider Executive
The Climate Change Act 2022	The proposed scheme encourages the creation of additional habitat on farms, and this closely aligns with this Act's requirement that "policies shall, as far as practicable, support nature-based projects that enhance biodiversity, protect and restore ecosystems, and support climate resilience". Agriculture remains one of NI's highest-emitting sectors, bTB causes premature culling of cattle, for which very little salvage value is secured from the food chain, thereby resulting in unnecessary emissions, never mind the operational disruption to farms. Introducing a bTB badger intervention strategy is a strategically aligned, climate-positive action as it stabilises herd health by reducing infection pressure from wildlife reservoirs, therefore strengthening agricultural emissions reductions under the Act.
NI Climate Action Plan (CAP)	The Climate Action Plan (CAP) is the central mechanism for delivering Northern Ireland's legally binding climate targets. It sets out cross-government policies to: • deliver the first carbon budget (2023–2027), • meet the 2030 and 2040 interim emissions targets, and • set a pathway to net-zero GHG emissions by 2050.

	Development of the CAP has involved significant cross-departmental collaboration to identify required policies and methodologies. A badger intervention strategy aligns with the CAP targets in several ways. **Reduce emissions associated with bTB disruption**: • reducing repeat cattle testing, • lowering unnecessary transport and movement of animals, • decreasing premature culling and replacement rates, • stabilising herd productivity and emissions efficiency. **Strengthens Agriculture's Contribution to 2030 Emissions Targets** • reducing disease-related inefficiencies that inflate methane and CO_2 emissions, • improving animal health, a key driver of emissions intensity, • allowing farmers to adopt climate-aligned practices without repeated disease setbacks. **Supports Biodiversity and Ecosystem Co-Benefits Embedded in the CAP** • supporting healthier badger populations, • reducing ecological stress from unmanaged disease, • enhancing the ecological foundations needed for nature-based climate solutions. A Badger Intervention Strategy provides a practical, evidence-based mechanism to accelerate climate mitigation within one of NI's most critical and hardest-to-decarbonise sectors.
Northern Irelands Green Growth Strategy	Northern Ireland's Green Growth Strategy focuses on reducing environmental harm, improving biodiversity, supporting sustainable agriculture, and boosting rural economic resilience through long-term, evidence-based policy. Introducing a bTB badger intervention strategy directly aligns with these priorities in several meaningful ways. **Strengthening Environmental Sustainability & Biodiversity Protection:** A well-designed badger intervention strategy—particularly one that is scientific, targeted, and evidence-based—helps maintain a healthier population and reduces disease transmission across ecosystems. **Reducing Carbon and Waste Associated with Repeated Breakdown Testing:** Reducing bTB through badger intervention directly supports the Green Growth goal of lower emissions from agriculture, through fewer cattle movements, e.g. for bTB risk and breakdown tests, and less waste from prematurely culled animals → reduced emissions and waste. **Improving Farm Resilience and Rural Economic Stability:** A badger intervention strategy strengthens rural economic

	resilience by reducing herd breakdown rates, stabilising farm productivity, enabling long-term planning and reducing government compensation costs.
NI: Economic Strategy 2030	The NI Economic Strategy sets out plans to grow a prosperous local economy over the short, medium and longer term to 2030. The Economic Vision for 2030 is: "*An economy characterised by a sustainable and growing private sector, where a greater number of firms compete in global markets and there is growing employment and prosperity for all".* A bTB Strategy and programme which reduces and ultimately eradicates bTB will be important to the NI cattle and agri-food industry to both protect and grow new markets which will increasing demand high standards for our exports including disease free status. A robust badger intervention is essential in meeting this demand.
Cross-border considerations	Under the North South Ministerial Council, a number of North South Working Groups were established, including the TB Working Group which included representatives from DAERA and the Department of Agriculture, Food and the Marine (DAFM), with the objective of co-operating on policies as far as possible. Policy and veterinary officials from both Departments meet bi-annually to exchange information and statistics in respect of bTB control and eradication and to review policy developments and research projects in both jurisdictions. There is also collaboration on breakdown management in border areas. Both Departments are committed to bTB eradication, and both are currently considering ways of enhancing their bTB programmes. It is acknowledged that bTB eradication from the island of Ireland will require ongoing close collaboration and co-operation between the two jurisdictions.
Future Opportunities for Agriculture	There are significant opportunities for NI agriculture, particularly its cattle sectors, as a result of a growing world population and an increase in the number of wealthy and more discerning consumers who drive demand for high quality food[132]. With EU exit, it is widely acknowledged that NI farms will need to be able to operate in an increasingly open and competitive international trading environment. Securing access to existing and new external markets is fundamental to the success of the NI agri-food industry. Therefore, it is important that the upward trajectory of bTB herd incidence

[132] Agri-food Strategy Board Report, 2013.

	levels of recent years is reversed so that the level of disease does not influence the perception of the quality of our livestock and livestock products or result in trade barriers.

Appendix 3: Environmental and Climate Screening Form

Consideration	Part 1: What is the likely level of impact expected? (None/minor; or Notable)	Part 2: If a notable impact is expected, is this likely to be positive or negative	If the impact is notable, indicate how this will be considered in the relevant boxes below:			
			Monetisable	Quantifiable	Qualitative	Risk
A change in land use or management	None/minor					
GHG Emissions and Climate Change Mitigation	**Notable**	Currently >22,000 cattle are compulsorily removed from farms and killed prematurely due to bTB. These carcases provide lower value to the NI Agri-Food Industry than would otherwise have been the case if they had continued in production to the natural end of production). This is an inefficiency in terms of GHG output per unit of production. To illustrate the differences between shortlisted options, modelling information can be used to provide an indicative saving in the number of cattle removed prematurely for each shortlisted option per 100km^2 of badger intervention. However, it is not possible, or in line with proportionate effort, to relate that specifically to the amount of GHG emissions per unit of output saved for each short-listed option as that would depend on multiple factors for which information is not available. However, in the non-monetary factor analysis chapter, an estimate of the number of premature cattle deaths saved per 100km^2 area of badger intervention for each shortlisted option can be provided and this is sufficient to highlight the relatively of options in this regard.		✓		
Climate Change Adaptation	None/minor					
Air Quality	None/minor					
Water body and water quality	None/minor					
Wildlife, wild vegetation and/or soil quality	**Notable**	Some of the options considered involves the removal of badgers in target areas of NI, i.e. before the time of their natural death. As per the Bern Convention, no matter the option selected, badger intervention will be		✓		

		designed to ensure that no more than 70% of the estimated NI badger population is removed as a maximum (some options remove less badgers than others). In addition, a Strategic Environmental Assessment and Habitats Regulation Assessment have been carried out to consider the relative impact of shortlisted options. In the Non-monetary Factor Analysis, an estimate of the number of badgers removed per 100km^2 of badger intervention can be estimated (quantified) for each short-listed option.				
The supply of raw materials	None/minor					
Green jobs						
Outdoor recreation	None/minor					
Relevant section of the Economic Case			Monetary analysis	Non-monetary analysis		Risk analy.

Appendix 4: Glossary of Terms

AFBI - Agriculture-food and Biosciences Institute
Agri-Food - Agricultural-Food
APHA - Animal and Plant Health Agency
ASHE – Annual Survey of Hours and Earnings
BAU - Business as Usual
BCG - Bacillus calmette-guerin
BD - Breakdown
bTB - Bovine Tuberculosis
BVFF – Badger Vaccination Field Force
CA - Competent Authority
CAP - Climate Action Plan
CPD - Central Procurement Directorate
CVO – Chief Veterinary Officer
DAERA - Department of Agriculture, Environment and Rural Affairs
DAFM - Department Agriculture, Food and the Marine
DEFRA - Department for Environment, Food and Rural Affairs
DoF - Department of Finance
DPP - Dual Path Platform
EAC - Equivalent Annual Cost
EPPS - Environmental Principles Policy Statement
EU - European Union
GB - Great Britain
GHG - Green House Gas
HRA - High risk area
ICT – Information and Communication Technology
IFNG - Interferon gamma blood test
LRA - Low risk area
M. bovis - *Mycobacterium bovis*
MTBC - Mycobacterium tuberculosis complex
M.tuberculosis - Mycobacterium tuberculosis (Humans)
NI - Northern Ireland
NIEA - Northern Ireland Environment Agency
NISRA - Northern Ireland Statistics and Research Agency
NMF - Non-Monetary Factor
NPC - Net Present Cost
NPV - Net Present Value
OTF - Officially Tuberculosis Free
OTW - Officially Tuberculosis free status withdrawn
PfG - Programme for Government
PPE - Personal Protective Equipment
RBCT - Randomised Badger Culling Trials

ROI - Republic of Ireland
SEA - Strategic Environmental Assessment
TVR – Test and Vaccinate or Remove
TB - Tuberculosis
TBPSG – Tuberculosis Partnership Steering Group
TBSPG - Tuberculosis Strategic Partnership Group
UK – United Kingdom
VFM - Value for Money