Title: **Measures to address bovine TB in badgers**	Impact Assessment (IA)
IA No:	**Date:** 30/11/2011
	Stage: Final
Lead department or agency: DEFRA	**Source of intervention:** Domestic
	Type of measure: Other
Other departments or agencies:	**Contact for enquiries: TB Programme** tbbc@defra.gsi.gov.uk

Summary: Intervention and Options

RPC: RPC Opinion Status

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCB in 2009 prices)	**In scope of One-In, One-Out?**	**Measure qualifies as**
-£0.88m	-£0.29m	£0.03m	No	N/A

What is the problem under consideration? Why is government intervention necessary?

Bovine TB (bTB) is a serious infectious disease of cattle. Disease freedom is a "public good" affecting the whole cattle industry. Private actions to control or eradicate disease are likely to be non-optimal because of externalities and information asymmetry. Badgers are known to harbour bTB and without addressing TB in badgers, it will not be possible to eliminate the disease in cattle. However, badgers are an important native species, and the general public value their existence and freedom from cruel treatment. There is no practical market mechanism that could adequately internalise the trade-off between the existence and welfare of badgers and the control of bTB, so there is a need for Government policy to address this explicitly.

What are the policy objectives and the intended effects?

The objectives of a badger control policy, as part of a package of measures to tackle bTB in cattle, are to address the reservoir of the disease in the badger population; reverse the rising trend of incidence of bTB in cattle in areas with high and persistent levels of the disease; and to empower farmers and landowners to use all appropriate measures to take control of the disease in their local areas in order to minimise the risk to their cattle herds. The intended effect is to reduce the incidence of bTB in cattle in the areas where badger control measures are being applied, also reducing the cost to farmers and Government of dealing with the disease.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

Six options have been considered:

- Option 1 - continuing with the current policy with no additional badger control measures;
- Option 2 - a Government-led operation to cull badgers under the Animal Health Act 1981;
- Option 3 - a Government-led operation to vaccinate badgers under the Animal Health Act 1981;
- Option 4 - issuing licences to farmers/landowners under the Protection of Badgers Act 1992 (PoBA) to cull badgers;
- Option 5 - issuing licences to farmers/landowners under PoBA to vaccinate badgers;
- Option 6 - a combination of options 4 and 5 to issue licences under PoBA to cull and/or vaccinate badgers.

The preferred option is Option 6 which would enable farmers/landowners to take control of the wildlife reservoir of the disease at a local level. As illustrated in the IA which accompanied the 2010 public consultation, option 6 does not present the best net present value (NPV) (this was for option 4, for industry to carry out only culling) but does give greatest flexibility for farmers/landowners to formulate the most suitable local solution. Options 2 and 3 are not considered affordable in the current public spending climate.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 09 / 2015

Does implementation go beyond minimum EU requirements?			**N/A**		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro Yes/No**	**< 20 Yes/No**	**Small Yes/No**	**Medium Yes/No**	**Large Yes/No**
What is the CO2 equivalent change in greenhouse gas emissions? (Million tonnes CO2 equivalent)			**Traded:**	**Non-traded:**	

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister: ..... Date: .....

Summary: Analysis & Evidence

Policy Option 6

Description:

Issuing licences to use a combination of culling and vaccination in one area of 350m^2.

FULL ECONOMIC ASSESSMENT

Price Base Year 2010	PV Base Year 2011	Time Period Years 10	Net Benefit (Present Value (PV)) (£m)		
			Low: -£4.43m	**High:** +£1.59m	**Best Estimate: -£0.88m**

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Optional		Optional	**£3.74m**
High	Optional		Optional	**£6.38m**
Best Estimate			£0.5m	**£4.56m**

Description and scale of key monetised costs by 'main affected groups'

Farmers in cull area: surveying, culling and limited vaccination operations, administration and coordination £1.40m
Farmers in neighbouring area: financial cost of initial increase in cattle TB incidents £0.05m
Government: licensing, monitoring, policing, financial cost of initial increase in cattle TB incidents £3.11m

Other key non-monetised costs by 'main affected groups'

General public: strong aversion to a badger cull among many members of the public (no reliable estimate of valuation).
Government: policing costs depend on the extent of illegal activity to disrupt culling (see Evidence Base).

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Optional		Optional	**£1.95m**
High	Optional		Optional	**£5.34m**
Best Estimate			£0.4m	**£3.68m**

Description and scale of key monetised benefits by 'main affected groups'

Farmers in cull area: financial benefit of avoiding cattle TB incidents £1.13m
Farmers in vaccination area: financial benefit of avoiding cattle TB incidents £0.03m
Government: financial benefit of avoiding cattle TB incidents £2.52m

Other key non-monetised benefits by 'main affected groups'

Farmers in cull and vaccination areas: non-financial benefit of avoiding cattle TB incidents (includes stress of operating business under restrictions, emotional impact of loss of prized cattle), and of seeing action taken to reduce risk of TB transmission from a known wildlife reservoir.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5

This option is not prescriptive about how badger culling and vaccination are combined. For illustration, the figures are based on culling within the area of 350km^2 plus limited vaccination in the neighbouring area. Effect of culling on bTB in cattle: assumed as in RBCT, with post-cull effects persisting for as long as has been so far observed in the RBCT areas but no further (i.e. up to 6 years after culling stopped). Cost of culling operation: assumes mainly controlled shooting, with some use of cage trapping. In line with licensing conditions and guidance, barriers or buffers reduce impact in the neighbouring area. For farmers in the cull area, monetised costs exceed expected monetised benefits; any potential risk to sustained implementation would be mitigated by licensing conditions. There are considerable uncertainties around the central estimates shown here.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: 0.2	**Benefits: 0.1**	**Net: 0.0**	No	Zero Net Cost

1. Introduction

1.1. Bovine TB (bTB) is a serious infectious disease of cattle, caused by the bacterium *Mycobacterium bovis (M. Bovis).* It can be transmitted to humans and other warm-blooded animals.

1.2. Bovine TB is a pressing animal health problem and is one of the biggest challenges facing the cattle farming industry today. In England, in 2010, bTB cost the taxpayer £90m and nearly 25,000[1] cattle were slaughtered for TB control.

1.3. The Government is committed to putting in place a package of measures to tackle bTB which adds up to a balanced programme. There is no single solution, so we need to use every control tool in the toolbox to reduce the disease in cattle, in a proportional and cost-effective way. We envisage that a balanced programme should include the following key elements, many of which are already in place:

- surveillance for the disease in cattle and control measures in those herds where infection is identified;
- controlling the disease in badgers;
- enhanced bio-security and husbandry practices by cattle owners;
- advice and support to farmers;
- dealing with bTB in non-bovine kept species (including camelids (llamas, alpaca) and goats); and
- focused research and development (including development of a cattle vaccine and an oral badger vaccine).

1.4. Of these key elements, the one which is not currently being deployed is badger control. Scientific evidence indicates that in areas with high incidence of bTB in cattle, it will not be possible to eliminate the disease in cattle without addressing the transmission of disease from badgers[2]. No other country in the world has successfully tackled bTB in cattle without addressing any wildlife reservoir involved in maintaining and transmitting infection to cattle. We therefore regard this as the most pressing issue if we are to make progress on tackling the disease in cattle.

1.5. However, badger control is only one part of the programme. We are committed to a balanced package of measures which includes all the key elements above and which will be reviewed regularly as we progress towards the long term goal of eradication. Cattle measures will continue to be central to our bTB control programme.

1.6. The TB Eradication Programme for England, published in July 2011, includes the following key measures:

- cattle surveillance and control measures to address cattle to cattle transmission;
- promoting good biosecurity, to address transmission between cattle, and between badgers and cattle;
- control of TB in badgers, to reduce transmission from badgers to cattle in TB endemic areas;

[1] 2009 figure
[2] See Risks and Assumptions, Box 1.

- measures to tackle TB in non-bovine farmed species (including pigs, goats, deer, sheep, alpacas and llamas);
- advice and support for farmers;
- a targeted research and development programme; and
- robust governance, monitoring and reporting arrangements.

1.7. This Impact Assessment assesses the costs and benefits of several scenarios under the preferred option for badger control (Option 6 in the 2010 public consultation).

2. Rationale for Government intervention

2.1. The original rationale for Government's involvement in the effort to tackle the disease was to protect public health. In the 1930s, most milk was consumed untreated. Milk-borne human *M. bovis* infection was a major public health risk and a significant source of TB in humans.

2.2. A test and slaughter policy introduced in the 1950s alongside routine pasteurisation of cows' milk and inspection of cattle carcases at slaughterhouses gradually removed the risk to human health.

2.3. Today, alongside maintaining vigilance over risks to public health, the main rationale for Government intervention is to meet EU requirements and to mitigate the economic impact of the disease on the cattle farming industry. The benefits of Government controls of bTB in cattle – in terms of reduced disease spread and losses – outweigh the costs of those controls. By continuing with the current approach, costs are expected to increase further as the disease situation worsens and the cost of control measures increases.

2.4. The total costs of bTB are about 3% of gross output of GB cattle enterprises, rising to 7% in South West England. The total cost of a cattle herd breakdown is equivalent to about 25% of the output of an average cattle farm. This is the average of a very wide range including many small breakdowns to a few very large, costly and long-lasting incidents. Most of the cost currently falls to Government.

3. Policy objective

3.1. The objectives of a badger control policy, as part of a package of measures to tackle TB in cattle, are to

- address the reservoir of the disease in wildlife;
- reverse the rising trend of incidence of bTB in cattle within areas where badger control is being applied; and
- give farmers and landowners the opportunity to take all measures available to them to minimise the risk to their cattle herds.

3.2. The intended effect of the policy is to reduce the incidence of bTB in cattle in the areas where badger control measures are being applied, also reducing the cost to farmers and Government of dealing with the disease.

4. Application and scope

4.1. TB control is a devolved matter. This policy will apply to England only.

5. Analysis of Options

5.1. We considered six policy options in the 2010 consultation Impact Assessment:

Option 1: continue with the current policy (i.e. no additional control measures);

Two possible options for a Government-led policy of badger control under the Animal Health Act 1981, comprising:

Option 2: Government-led culling (using cage-trapping and shooting);

Option 3: Government-led cage-trap and vaccination;

A partnership approach between the farming industry and government, based on any, or all, of the following three options:

Option 4: issuing licences under the Protection of Badgers Act 1992 (PoBA) to cull badgers;

Option 5: promoting greater use of licences under the PoBA to trap and vaccinate badgers;

Option 6: issuing licences under the PoBA to cull, vaccinate or use a combination of culling and vaccination.

5.2. **Our preferred approach is option 6**: to issue licences under the PoBA for industry to cull badgers, subject to a specific set of licence criteria. Under existing arrangements farmers and landowners will also be able to apply for licences to vaccinate badgers either on its own or for use in combination with culling. This approach will allow farmers to manage their own situations and use all the control measures available. It also means that taxpayers will not be paying for significant additional disease control measures. We consulted further on the implementation of this option, as articulated in draft Guidance to Natural England from July-September 2011.

5.3. In the Impact Assessment which accompanied the 2010 public consultation, Option 6 illustrated a scenario in which badgers are culled in 75% of a 150 km^2 area and vaccinated in 75% of the neighbouring 2km ring (100km^2). From discussions with industry, a more realistic scenario is that badgers are culled in 70% of a 350km^2 area. Each control area will use a different mix of barriers of buffers to protect the neighbouring ring against the perturbation effect and there are a range of possible impacts that could result from different combinations of measures. For the purposes of this IA we have assumed that:

- 50% of the control area is surrounded by a hard boundary (e.g. sea coast, lakes and reservoirs, motorways);
- on 40% of the boundary, farmers with vulnerable livestock have agreed to accept any TB risks associated with culling related perturbation;
- vaccination occurs on land comprising 10% of the surrounding area.

(In practice it may be unlikely that 50% of a control area will be surrounded by a hard boundary, but this combination of assumptions is intended to reflect the effect that might

be achieved by having some barriers, buffers or other measures in place around the whole boundary.) The costs and benefits described in the next section are based on this scenario.

6. Costs and benefits

6.1. The analysis below sets out the costs and benefits of the scenario outlined above.

Costs

Table 1: Summary of costs

	Rate	Time period
Licensing	**£377,000 per area for two pilot areas**	**Total over four years (highest in the first year)**
Co-ordination	**£20,000 / area/ year**	**4 years**
Culling using cage trapping	**£2,500 / km^2 / year**	**4 years**
Culling using controlled shooting	**£300 / km^2 / year**	**4 years**
Culling using a combination of methods	**£1,000 / km^2 / year**	**4 years**
Vaccination	**£2,250 / km^2 / year**	**4 years**
Monitoring	**£737,000 per area for two pilot areas**	**4 years**
Policing	**£500,000 per area per year**	**4 years**

Licensing

6.1. Natural England will be required to exercise its powers as licensing authority under Section 10(2)(a) of the Protection of Badgers Act (1992) to issue licences for the purpose of preventing the spread of disease.

6.2. The licensing operation would consist of processing and assessing applications against fixed criteria (including site visits) and judgement will be used to arrive at a decision on such applications. This process involves mapping and analysing the proposed control area, assessing the biosecurity arrangements in place on farms and monitoring compliance (including site visits).

6.3. The licensing costs (which include the ongoing costs to Natural England of monitoring compliance with the licence conditions) have been based on Natural England's staffing costs (and travel and subsistence costs associated with visits in the control area), with costs for future years apportioned between the first two pilot areas and the additional areas which may have been granted licences if the policy is rolled out more widely.

6.4. Costs associated with legal challenges are unknown at present.

6.5. Farmers will incur costs in the licensing and monitoring process but these are taken to be included in the costs of co-ordination (see below).

Survey

6.6. Applications will need to be supported by a map which demonstrates that the area is at least 150 km^2 in size; is located within 12-month test areas; has at least 70% of the area accessible for culling; and that reasonable measures (e.g. barriers or buffers) are in place to mitigate the risk to non-participating farmers and landowners of a potential increase in confirmed new incidents of TB in vulnerable livestock within the control area and in the surrounding 2km ring. Protected areas, such as SSSIs, will also need to be identified for assessment by NE.

6.7. To produce and analyse one map has been estimated to take 12-15 hours of one FTE, plus 3.5-7.5 hours to digitise the area. Costs to produce these maps have been estimated as £3,000 for 6 applications (£500 per 150 km^2 area). These costs are included in the cost of licensing above.

Co-ordination of culling

6.8. Participants in a culling operation will be required to comply with strict conditions to ensure that culling is delivered effectively and co-ordinated across the control area over six weeks. To achieve this co-ordinated approach, costs will be incurred for communication, planning, support, management, and administration estimated at about £20,000 a year per area. Significant savings per farmer would be expected in areas above 150 km^2. These costs would be borne by participating farmers.

6.9. A co-ordinated approach would require a co-ordinated licence application. The costs above include costs for recruiting a group leader / project officer to co-ordinate the application including farm visits, collating maps, collecting data to satisfy all of the licence criteria and information required to support the Badger Control Plan, including information on bio-security awareness campaigns and the measures already in place. The group leader / project officer would liaise with the licensing authority during the application process and monitor participation and compliance throughout the cull period, including the submission of licence returns and any necessary enforcement action.

Culling Delivery

6.10. Participants will be permitted to use two culling methods (which can be used in combination, or as single control methods):

- cage-trapping followed by shooting; and
- controlled shooting.

6.11. The costs of cage-trapping and shooting are based on the estimates in Defra's 2005 cost-benefit analysis adjusted for inflation and rounded. Removing the costs of surveys and monitoring (shown separately here), these are estimated at £2,500 / km^2 of participating land / year.

6.12. The main operations, and therefore the main costs, of cage-trapping and shooting are the same as those for cage-trapping and vaccination. The major additions for shooting

are the cost of ammunition (if using frangible bullets containing bismuth, these cost about £4 each plus approximately £45 per order for carriage to a firearms dealer) and the cost of badger carcase disposal (see below).

6.13. While the estimated cost of cage-trapping and shooting is solidly based in RBCT experience (adjusted to exclude activity specific to its trial status), there is less evidence of the costs of controlled shooting. It seems likely that in some situations farmers could carry out controlled shooting at a substantially lower cost, perhaps around £300 / km^2 of participating land / year. For the "best estimates" in the assessment of industry-led culling, we assume that a combination of cage trapping and controlled shooting would be used, costing £1,000 / km^2 of participating land / year.

6.14. As part of the licence criteria, operators will require relevant training and competence to carry out culling. Industry will be responsible for running the courses, according to a syllabus approved by Government. The training will be independently audited. The costs are likely to be between £50-£250 per person, depending on the number of people attending and their previous experience and qualification.

6.15. In addition to required training, controlled shooting will be piloted in two areas in the first year to ensure that it is effective and humane. The costs of monitoring in the pilot areas are included below.

Carcase Disposal

6.16. The carcases of badgers suspected of harbouring TB (a zoonotic disease) fall within the definition of Category 1 materials under the Animal By-Products Regulation 1774/2002 (and Regulation 1069/2009 due to replace the previous Regulation on 4 March 2011). The carcases therefore must be collected, transported and identified without undue delay, and either incinerated in an approved incineration plant or processed in an approved rendering plant with the processed products being finally disposed of as waste by incineration or burial in an approved landfill. Burial without first processing is not a permitted disposal route for Category 1 material.

6.17. The cost of collecting a suitably bagged and labelled carcase is estimated at £10-20 per carcase. This is included in the culling delivery costs above.

Vaccination Delivery

6.18. Vaccination by injection of caged badgers would involve similar operations to those for cage-trapping to shoot. Unit cost of vaccine is £12 per dose and vaccination programmes are assumed to be repeated for five years. The total cost assumed for vaccination operation is £2,250 / km^2 of participating land / year.

6.19. Any necessary training of contractor staff for vaccination or for shooting is assumed to be included in the rates used.

Monitoring

6.20. The monitoring costs are divided into two elements:

- monitoring in the two pilot areas during 2012/13 to confirm our assumptions about the effectiveness and humaneness of controlled shooting; and

- the general, ongoing monitoring that will occur in all licensed areas.

Pilots

6.21. The Secretary of State has announced that the Government would take a precautionary approach through a pilot of the policy; initially licensing two areas in the first year, which will be closely monitored to ensure that controlled shooting is both effective and humane. The results of monitoring in these areas will be examined by an independent panel of experts. In the pilot areas, additional monitoring will be required during 2012/13. This is expected to cost £1.041m for three studies and the expert scientific panel.

General monitoring

6.22. In addition to Natural England's monitoring of compliance with licence conditions (the costs of which are included above in NE's licensing costs), there will be three other components to the monitoring programme which in total is estimated to cost £2.804m for the period 2011/12 to 2014/15:

i. Humaneness of culling methods
ii. Epidemiology of TB in cattle
iii. Badger activity

Monitoring humaneness

6.23. Ministers have committed to monitoring the humaneness of culling throughout the culling period to ensure that standards are maintained. We propose to take a risk based approach, decreasing the number of observations and post-mortems in later years if the results in a specific control area are satisfactory. At present, we estimate the cost to be £0.7m from 2013/14-2014/15. This estimate is based on the cost of field observations and post-mortem examinations.

Epidemiological monitoring

6.24. The incidence of bTB in cattle is already monitored. Exploratory analyses of data gathered from licensed areas and suitable comparative control areas could look for any changes in trends that might be attributable to badger control. It is estimated that this analysis will cost £394,000 over 4 years. A large proportion of these costs are fixed irrespective of the numbers of licensed areas.

Independent monitoring to confirm presence of badgers in licensed areas

6.25. The badger control policy will be an exception under Article 8 of the Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention) (which aims to conserve wild flora and fauna and their natural habitats and to promote European co-operation in that field), in conformity with Article 9, and will be reported in the biennial report to the Standing Committee. The Bern Convention prohibits 'causing local disappearance of or serious disturbance to... populations' (Article 8) and that '[any] exception will not be detrimental to the survival of the population' (Article 9).

6.26. We will monitor the presence of the surviving badger population in an area of 20km^2 in each licensed area annually over the culling period, at an estimated cost of £40,000 - 60,000 per control area over four years (£10,000 – 15,000 per area per year).

Policing

6.27. The need for additional policing arose in the RBCT. It is possible that any future culling operation will also generate policing costs depending on the extent of any illegal activity.

6.28. While we recognise the right of those opposed to badger control to undertake peaceful protest, those operators undertaking culling activities under licence have the right to do so without fear or intimidation. The police have been closely involved in the development of the policy and will liaise closely with the industry to discuss appropriate security arrangements and will monitor the situation on the ground to ensure public safety.

6.29. An estimate of police costs has been developed through discussion with the Association of Chief Police Officers (ACPO) and the Home Office. This estimate is based on certain assumptions about the likelihood of disruption to culling activities and has been a key factor considered by Ministers in reaching their decision on the policy.

6.30. The nature of the policing response will depend on specific intelligence available at the time. However, ACPO has suggested an initial estimate of the cost in the region of £0.5m/year/area for the four years when culling would take place (ie £2m per area) based on the 'basic' levels of policing required in relation to maintaining public order and safety. There is the potential for this estimate to increase to cover any unexpected increases in disorder from protests. However, the very high level of uncertainty around the likelihood and level of these costs mean that they have not been quantitatively estimated.

6.31. The police will also be required to amend firearms licences to enable the shooting of badgers with rifles. Amendments to firearm licences are free by law but costs will fall to the police for checking names with the NE licence, amending, reprinting and posting amended certificates. Many certificate holders are limited to specific land or areas first inspected by police. If this needs amending, additional costs will be incurred if the police need to inspect new areas as to its suitability for shooting over.

Badger welfare

6.32. The well-being of wildlife populations is of concern to many members of the general public. Previously, Defra commissioned economic research to investigate the possibility of valuing this concern in relation to badger control. The work used a "choice experiment" to estimate the trade-offs that people might be willing to make between changes in badger populations and the incidence of bTB in cattle. The results were that the general public's valuation of reduced cattle bTB shows they would be willing to accept the lower badger population following a control programme. Responses to the choice experiment also showed that the choice of management strategy towards badgers (e.g. whether to cull) was much more important than either badger population or number of cattle slaughtered because of bTB. The researchers did not consider their valuation estimates of management policy to be reliable enough to use in cost-benefit

analysis. Their work considered a general culling policy everywhere throughout the bTB high-risk areas and was not designed to assess a licensed cull within a limited area.

6.33. Overall, therefore, it is not possible to suggest a reliable estimate of the value the general public would place on avoiding a licensed area cull of badgers. However this is an important non-monetised cost of a culling policy that is noted in this assessment and is a relevant consideration for decision-making. Based on RBCT experience, the number of badgers culled in an area of 350 km^2 over four years might be around 2,450. Badger welfare has been essential to the choice of culling methods that could be used or licensed in any cull, and would be a subject of the monitoring activity costed into all culling options in the assessment.

Cost of increased bovine TB in cattle in neighbouring areas due to culling

6.34. Scientific analysis of the RBCT suggested that the phenomenon of badger perturbation could lead to adverse impacts of badger culling on bTB in cattle, i.e. additional confirmed new incidents (CNIs) in neighbouring areas. The scenario described in paragraph 5.3 assumes the area will take measures to mitigate the risk of perturbation. For the purposes of this modelling, we have assumed that both hard boundaries and vaccination is 100% effective at mitigating the detrimental effects of perturbation.

Benefits

Table 2: Summary of benefits

	Option 6: Industry-led cull & vaccination
CNIs prevented gross/net	141/136
Gross benefits £ present value	£3.68m
As % of CNIs baseline cost	21%

Saving the cost of cattle TB incidents prevented

6.35. Under “business as usual” (i.e. with no badger control), CNIs of bTB occur and require a series of control actions that are costly to farmers and to Government. The main control actions involve restricting movements of cattle from the herd, whole herd testing of the cattle, slaughter of any cattle that react to the test, and repeated testing and slaughter until the herd is cleared. This assessment considers only CNIs and excludes unconfirmed incidents, because analysis of data from the RBCT did not identify any significant effect of badger culling on unconfirmed incidents. Routine testing costs are also excluded, so the business as usual costs are less than the full costs of bTB surveillance and control in the area.

6.36. A programme of badger control within an area, whether culling or vaccination, is intended to reduce these control costs by reducing the number of CNIs in cattle in the area. The monetised benefits of the programme are the savings in bTB control costs compared to “business as usual”.

6.37. The costs of CNIs under “business as usual” can be calculated by multiplying the number of CNIs in an area by the unit cost of a typical CNI. These two elements are considered in turn.

Number of CNIs under "business as usual"

6.38. This assessment does not relate to any one identified area, so we do not know the current incidence of bTB in cattle in the area where any badger control might be applied. However, it is reasonable to suppose that a control area would be one with a relatively high incidence. This is likely in the case of licensed farmer action because of the higher incentive for participation and the licensing conditions envisaged.

6.39. A fair indication of the bTB incidence in cattle is therefore the incidence in the areas identified as candidates for Defra's Badger Vaccine Deployment Project (BVDP). The average incidence in ten areas of 100 km^2 over five years 2003 to 2007 was 0.186 CNI per year per km^2, and in ten areas of 300 km^2 was 0.121 CNI per year per km^2. This implies an incidence of 0.089 CNI per year per km^2 in the outer area (the part of the 300 km^2 outside the 100 km^2). For comparison, the "historic incidence" (for three year periods before 2001) in the ten RBCT proactive cull areas plus ten survey-only areas each of 100 km^2 was 0.085 and in the neighbouring areas 0.046 CNI per year per km^2. For this assessment, initial incidence within an area of 350 km^2 is assumed to be 0.15 CNI per year per km^2, and 0.10 CNI per year per km^2 in the neighbouring area up to 2 km away.

6.40. Bovine TB incidence in cattle under current policies has generally risen in recent years. In the BVDP candidate areas, incidence rose at over 10% a year in the period 2003 to 2007. AHVLA modelling projects a national increase in incidence of around 3% a year. This assessment assumes a baseline increase in CNIs of 3% a year. Combining this trend with the initial incidence rates gives a baseline total of 685 CNIs in the 350 km^2 cull area plus the vaccinated area over ten years.

Unit cost of CNIs

6.41. We estimate the average cost of a CNI using a standard approach described previously in Defra (2005) *"Cost benefit analysis of badger management as a component of bovine TB control in England"*. The method relies heavily on a previous independent study by the University of Reading but we have updated the financial values (e.g. the loss to the farm business from having a reactor slaughtered) in line with appropriate price indices and the physical values (e.g. number of cattle slaughtered per CNI, number of extra herd tests per CNI) with averages from recent VLA analysis of actual CNIs.

6.42. The largest item of CNI costs is the impact of slaughtered reactor cattle and dangerous contacts. Reading University developed a method to estimate the true economic cost of these slaughters to take account of all relevant costs, e.g. disruption of the milk output of a dairy herd, so this is not simply the same as the value of the cattle taken. The average number of slaughters per CNI is 12.8. The average cost (net of the salvage value of the animals) is estimated to be £1205, carried partly by Government (through the compensation arrangements) but leaving a residual cost to the farmer of £320 per animal. The total cost of slaughter per CNI is about £15,000.

6.43. The second largest cost item is the cost of extra tests on the restricted herd. Cattle testing is costly both to the farmer, who has to collect cattle for testing and may lose output as a result, and to Government, which pays for the vet, administrative support and tuberculin. This item also includes the cost of official veterinary input extending

beyond the tests themselves. Assuming an average herd of 200 tested cattle, with 5.3 extra whole herd tests needed as a result of the CNI, and unit costs of £3.20 to the farmer and £7.50 to Government, the total extra testing cost of the restricted herd per CNI is about £11,000.

6.44. Other costs of a CNI are the costs to the farmer of movement restrictions and isolation of animals, and the costs of consequent testing in other herds (contiguous herds and traced animals). These are estimated to total around £4,000 per CNI.

6.45. Table 3 shows the estimated total costs of a CNI. The average cost is about £30,000, split roughly one third to the farmer and two thirds to Government. Analysis of data from the Farm Business Survey for farms experiencing major TB incidents tends to confirm that this estimate of total financial cost of an average CNI is realistic. Our impact assessment calculations use the rounded figure of £30,000 cost per CNI.

Table 3: Average cost of a confirmed new incident of bovine TB in cattle

		Cost to		
		Farmer	**Government**	**Total**
Slaughter	12.8 animals	£4,096	£11,328	£15,424
Restriction	200 in herd for 250 days	£1,000	£0	£1,000
Isolation	12.8 animals 16 days	£410	£0	£410
Testing	200 in herd for 5.3 herd tests	£3,392	£7,950	£11,342
Other tests	210 contiguous/traced animal tests	£672	£1,575	£2,247
Total		**£9,570**	**£20,853**	**£30,423**

6.46. In practice, there is a wide variation in the scale and duration of CNIs. Many are minor but a small proportion are major, costly to farmer and Government, and extremely disruptive to the farm business. In this Impact Assessment, we assume that the average cost of an avoided CNI is the same as the national average but we recognise the range that exists.

Unquantified costs of CNIs

6.47. Qualitative evidence suggests that bTB can cause significant stress and ill health among the farming population. However, the impact of such stress is difficult to quantify or value. Studies looking at the social impacts of bTB have found self-reported stress among farmers. For example, from a sample of 50 farmers interviewed in the south-west, 30 said their farm's bTB breakdown had affected their own daily life, 20 that of their family or household, 10 their employees. Evidence suggests that a long period of time under movement restrictions is a significant contributor to stress across all farming groups. A standard questionnaire designed to identify psychiatric ill health found that farmers that have been under bTB movement restrictions for a long period of time showed significantly higher levels of stress than farmers who had not experienced a bTB herd breakdown.

6.48. Bovine TB incidents are also likely to have consequences for other businesses. The available evidence in this area suggests that these effects are minor compared to those for farmers themselves and that they are a mixture of positive and negative impacts. They are not considered further in this assessment.

Baseline cost of CNIs

6.49. Multiplying the "business as usual" number of CNIs by the average cost gives the baseline cost of CNIs in the 495km^2 area (350 km^2 where badger culling might take place, plus the neighbouring area up to 2 km around the boundary). The total baseline cost of CNIs over the 11 years of the assessment period is £20.55 million in cash terms or £17.54 million in present value terms.

Effect of badger culling on the number of CNIs

6.50. The RBCT has generated data on the effect on CNIs of a five year (on average) proactive badger culling operation using cage-trapping and shooting. The estimated impacts are shown in table 4. This assessment assumes that the estimated impacts of culling in the RBCT would be achieved by a culling operation satisfying the envisaged licensing conditions and carried out for four years over an area of 350 km^2 with 70% coverage, whether by cage-trapping and shooting, shooting free-ranging badgers or a combination of both. The assessment also assumes that the post-cull effects after four years' culling would be identical in size to those seen after five (the average duration of culling in the RBCT), in terms of size and duration. The 95% confidence intervals for the RBCT estimates (in parentheses in table 4) are used to calculate high and low estimates of culling impacts.

Table 4: Estimated effect of RBCT badger culling on CNIs in cattle

	within culling areas	≤2 km^2 outside
During trial	-23.2% (-32.7% to -12.4%)	+24.5% (-0.6% to +56.0%)
Post trial (from one year after culling stopped)	-28.0% (-15.0% to -39.1%)	-4.1% (-25.7% to +23.7%)

(Sources: Jenkins, Woodroffe & Donnelly (February 2010) "The Duration of the Effects of Repeated Widespread Badger Culling on Cattle Tuberculosis Following the Cessation of Culling" www.plosone.org 5(2); Donnelly, Jenkins & Woodroffe (September 2011) "Analysis of further data (to 28 August 2011) on the impacts on cattle TB incidence of repeated badger culling".)

6.51. The most recent estimates of RBCT culling impacts cover the period up to 60 months of the post-culling period (i.e. up to 5 years after culling stopped, counted from one year after the last cull). There had previously been some indication that the impacts were tapering off. This assessment assumes that effects would persist up to 60 months post-cull and then cease.

Effect of badger vaccination on the number of CNIs

6.52. There is far more uncertainty about the impact of badger vaccination on CNIs, compared to that of badger culling, since the latter is informed by comprehensive data produced by the RBCT and other culling operations, while we have no data on the impact of vaccination. Laboratory studies on captive badgers have shown that vaccination reduces the progression, severity and excretion of *M. bovis* in badgers but there is currently only limited information on the effect of vaccination of wild badgers in a naturally infected population and none on the expected impact on CNIs.

6.53. For the options in this Impact Assessment, it is assumed that vaccination is carried out for four years. The effect of badger vaccination on bTB in cattle is assumed to be proportionate to estimated impacts of badger culling in the RBCT. The impact of

vaccination on CNIs during the vaccination period is assumed to be 38% that of culling (in the control area), and during the post-vaccination period, assumed to be 68% that of culling (in the control area), in line with modelling by FERA[3].

6.54. Low and high estimates use the 95% confidence limits reported for the estimated RBCT impacts, again scaled. As for culling, it is assumed that vaccination impacts on bTB in cattle persist for as long as has been so far observed in the RBCT areas but no longer (i.e. up to 6 years after culling stopped).

6.55. The policy on badger control involves licensing a combination of culling and vaccination but is not prescriptive about the strategy adopted. For illustration, this assessment is based on a scenario using the assumptions set out in paragraph 5.3. The impact of this strategy is assumed to be to reduce CNIs within the culled area by the same percentage as found in the RBCT results, but to eliminate the increase in CNIs seen in the neighbouring area, replacing it with the percentage reduction in CNIs as scaled for vaccination.

Net impact of the policy options

6.56. Table 5 summarises the net impact of the preferred policy option shown as a change from the baseline of "business as usual".

Table 5: Net impact of the preferred policy option

	Option 6: Industry-led cull & vaccination
PV(Costs)	+£4.56m
PV(Benefits)	+£3.68m
NPV	-£0.88m
BCR	0.81
PV(Baseline)	£17.54m
% change	+5.0%

6.57. **Option 6** is a combined strategy involving culling and vaccination. As illustrated (culling 70% of 350 km^2 circle; vaccination 10% of 2km surrounding ring, this option presents a net cost of £0.88 million. This is the preferred option as it would enable farmers/landowners to take control of the wildlife reservoir of the disease at a local level.

[3] Food and Environment Research Agency (Fera) Report to Defra, 'Comparing badger (*Meles meles*) control strategies for reducing bovine bTB in cattle in England' (November 2010) available at: http://archive.defra.gov.uk/food-farm/animals/diseases/tb/documents/8control-strat-report.pdf.
Computer modelling can be used to try and assess the contribution badger vaccination can make to tackling TB in cattle. While such models do provide an important contribution to our understanding of the benefits vaccination could provide, the results cannot be considered conclusive and can vary significantly depending on the assumptions used. The authors of the Fera model assumed high vaccine efficiency (70%), that all vaccinated badgers were completely protected and therefore could not transmit disease, high vaccination compliance (100%) and a prevalence of TB in badgers of 17% (which may be lower than is typical for endemic areas). At the time of compiling this advice, the sensitivity of their results to these assumptions is being analysed in further detail and the results are not yet available.

It is the policy approach which offers greatest flexibility for farmers/landowners to formulate the most suitable local solution.

7. Risks and assumptions

Perturbation effect and boundaries of a cull area

7.1. The RBCT suggested that badger culling could lead to additional CNIs in areas neighbouring the culled area. The criteria proposed for licensing specify that the area will have boundaries or buffers to mitigate the negative effects in neighbouring areas caused by perturbation of badgers' social groups.

7.2. The main calculations throughout the Impact Assessment assume that boundaries, buffers and vaccination in the neighbouring ring will eliminate any increase in CNIs there. Table 6 shows how the main results (first column of figures) would change without vaccination, first if perturbation impacts occur, and second if choice of boundaries succeeds in eliminating the impact on cattle bTB in the neighbouring area.

Table 6: Summary impacts of preferred option with/without neighbouring area

	With boundaries, buffers and vaccination	With perturbation impact in whole neighbouring area	With no impact in neighbouring area
CNIs prevented: gross/net	141/136	139/127	139/139
PV(Costs)	£4.56m	£4.67m	£4.25m
PV(Benefits)	£3.68m	£3.68m	£3.59m
NPV	-£0.88m	-£1.00m	-£0.66m
BCR	0.81	0.79	0.85
PV(Baseline)	£17.54m	£19.67m	£19.67m
% change	+5.0%	+5.1%	+3.3%

7.3. Option 6 shows net benefits in total, but the estimated net impact on farmers actually carrying out culling and vaccination under licence is negative (a net cost). In light of this, licence applications are most likely to come only from areas where the cattle bTB problem was worse than assumed here (in terms of herd incidence, or duration and scale of CNIs), or the value of the impact of CNIs on cattle businesses was worse than assumed (perhaps because of higher than average cattle values), or the unquantified effects such as stress were a major concern for farmers. In those situations, the benefits of badger control to farmers could be higher than estimated here.

7.4. Assumptions included in these calculations are as follows:

- One 350 km^2 area plus the neighbouring area of up to 2 km.
- From the RBCT, land access for culling was on average 70% of the total land area in the treatment areas. To achieve at least the same net benefits of culling as seen in the RBCT we have assumed that there must be land access of at least 70% in a licence application. For this Impact Assessment we have assumed a 70% participation rate for all badger control measures for illustration purposes.

- Culling will take place for four years, vaccination also for four years. Impacts of culling are shown for a four year period, but are based on the effects seen in the RBCT (where culling was conducted for an average of five years).
- Benefits are calculated over 10 years.
- Culling requires that 70% of the badger population resident across the entire licensed area be removed.
- Initial cattle bTB incidence is assumed to be 0.15 CNIs / km^2 within the 350 km^2 area and 0.10 CNIs / km^2 in the neighbouring area.
- The baseline for cattle bTB incidence assumes a 3% per year increase in CNIs.
- Effect of culling on TB in cattle assumed as in RBCT. Low and high estimates use the 95% confidence limits reported for the estimated RBCT impacts. All assume impacts on cattle bTB persist for as long as has been so far observed in the RBCT areas (i.e. up to 6 years after culling stopped) but no longer.
- Effect of badger vaccination on bTB in cattle assumed proportionate to estimated impacts of badger culling in the RBCT. Impact during the vaccination period assumed at 38% that of culling. Impact achieved in the post vaccination period at 68% of the RBCT culling impact in line with modelling by Fera.[4] Low and high estimates use the 95% confidence limits reported for the estimated RBCT impacts, again scaled. All assume impacts on cattle bTB persist for as long as has been so far observed in the RBCT areas (i.e. up to 6 years after culling stopped) but no longer. Vaccination is assumed to over-ride the effect of badger perturbation on cattle bTB in the neighbouring area.[5]
- The best estimate of the cost of the culling operation assumes a mix of cage-trapping and much cheaper controlled shooting, or a controlled shooting approach involving greater effort, (and that this can achieve RBCT effects). Low cost assumes all controlled shooting, high cost assumes all cage-trapping.

7.5. Annex 1 gives a table (Table 7) of the main assumptions made in estimating the impacts of the policy options. The table summarises the source of the assumptions and the degree of certainty attached to them. It also shows how far the results of the assessment would be altered by changing each assumption to an extreme, but still plausible, value.

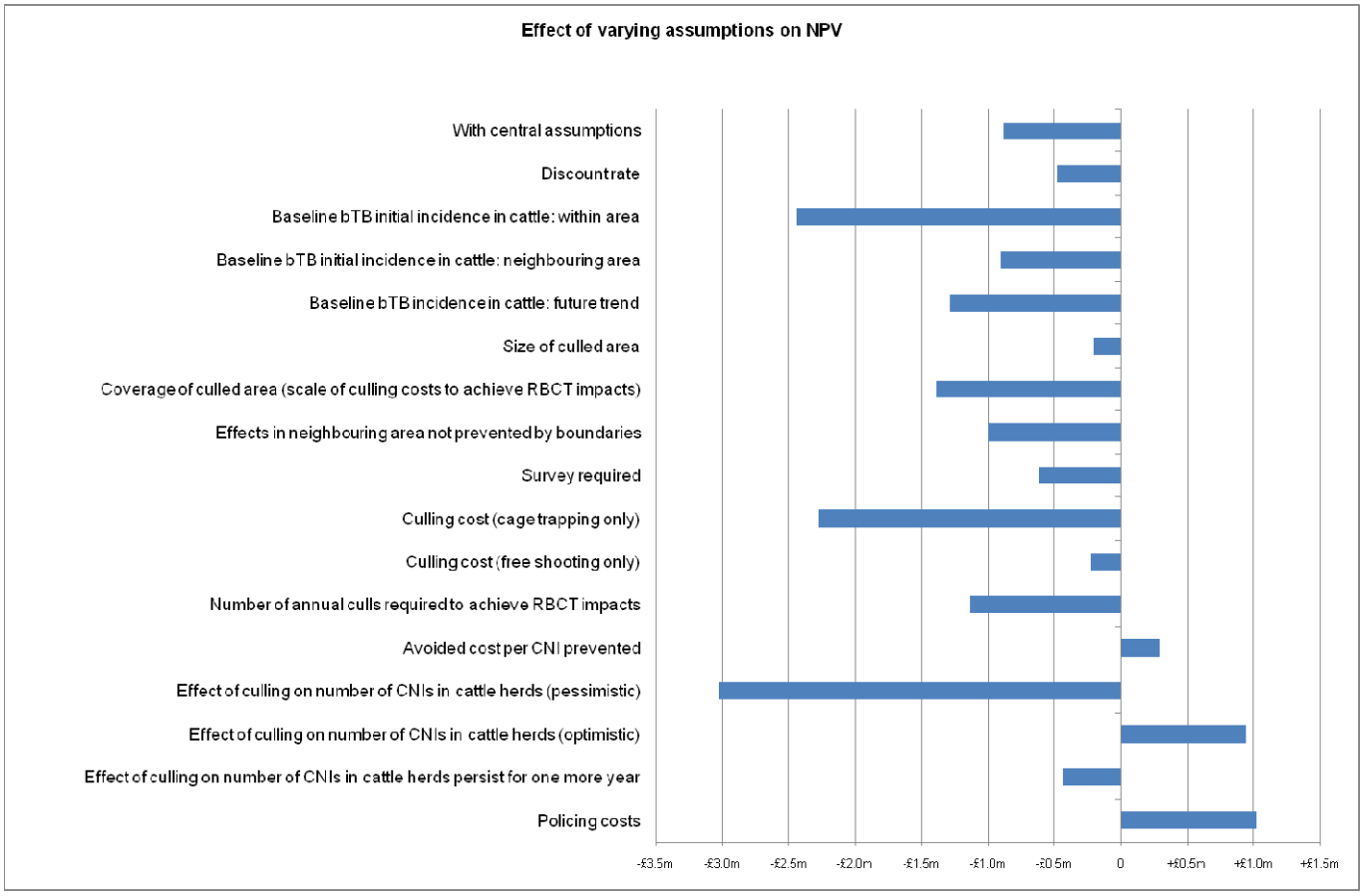
7.6. The main assumptions fall into two groups. The first group includes assumptions about the characteristics of the area where culling might take place, such as the size of the area and the incidence and trend of cattle bTB there, and whether the area has hard boundaries. These assumptions would largely be known once a specific area is being considered, and the choice of area can be based partly on whether the important characteristics of the area tend to improve the economic outcome. Proposed licensing

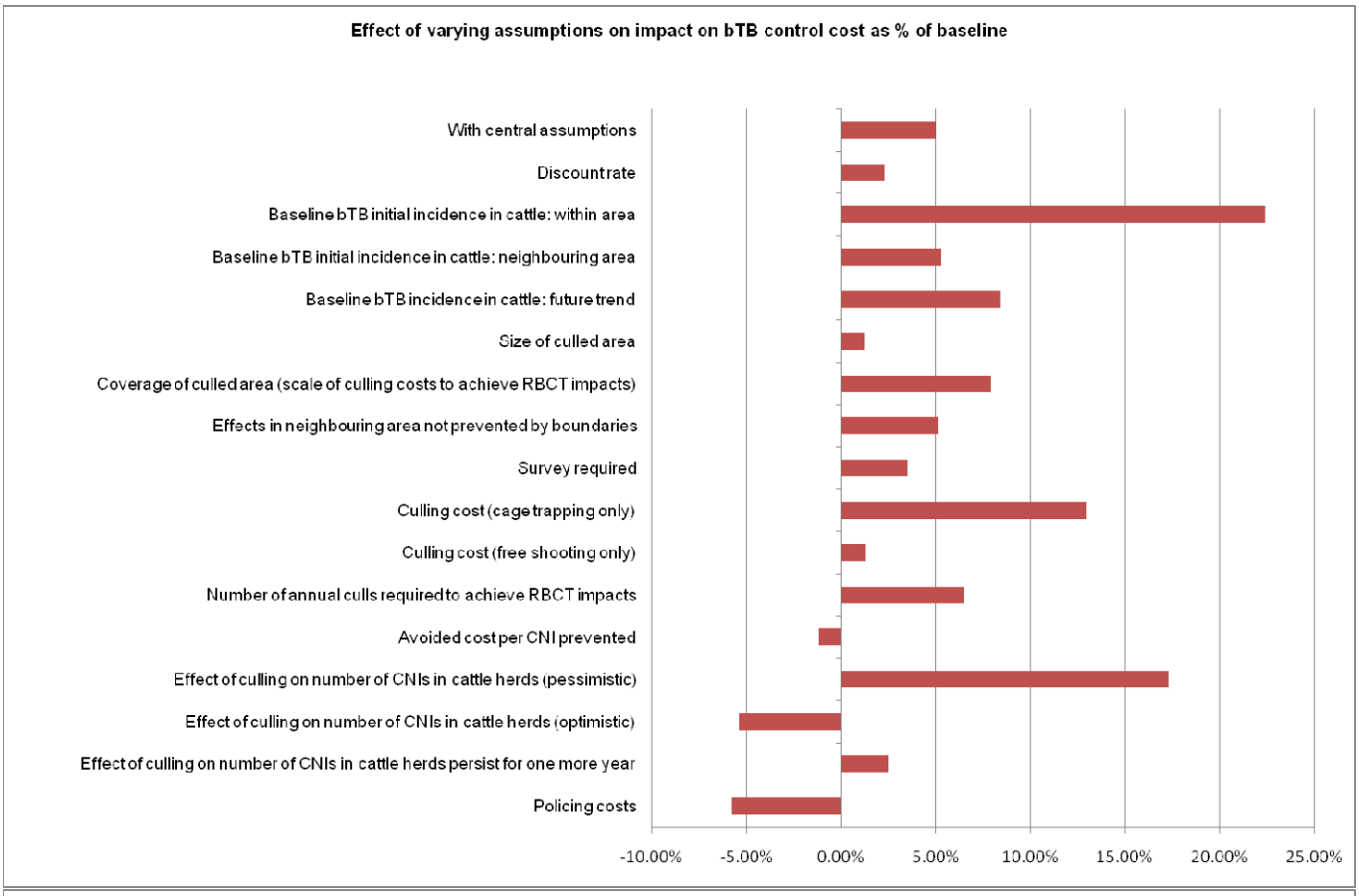
[4] Food and Environment Research Agency (Fera) Report to Defra, 'Comparing badger (*Meles meles*) control strategies for reducing bovine bTB in cattle in England' (November 2010) available at: http://archive.defra.gov.uk/food-farm/animals/diseases/tb/documents/8control-strat-report.pdf.

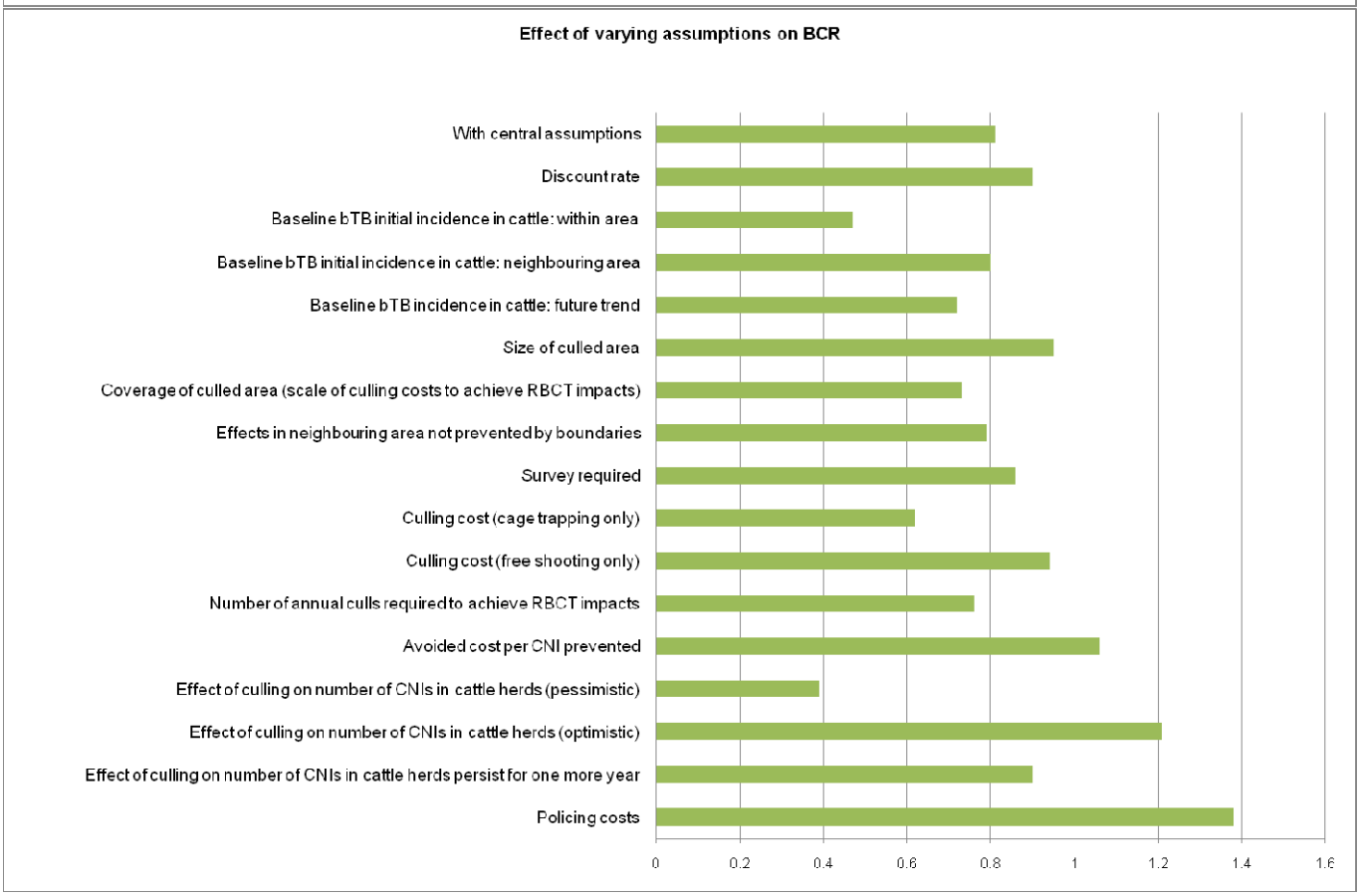
[5] For consistency, this version of the IA represents the effects of vaccination in 10% of the ring around a culling area as it was represented in the consultation stage IA. More recently, Fera specifically modelled ring vaccination around a culling area and found that the modelled disease incidence in cattle was unchanged (i.e. vaccination prevented the perturbation effect) during the control period and reduced by 30% in the following 5 years. This is slightly more beneficial than the effects assumed in this IA, but because vaccination is only applied in 10% of the ring, the difference is very small: only 0.4 net CNIs, and less than £0.01m improvement in NPV.

criteria are designed to do this. The second group are assumptions about the culling process, which are genuinely unknown or highly uncertain, are less subject to policy control, and would not become known until after any culling had taken place. The two most important ones are the impact of culling on cattle bTB, and the cost of culling needed to achieve that result.

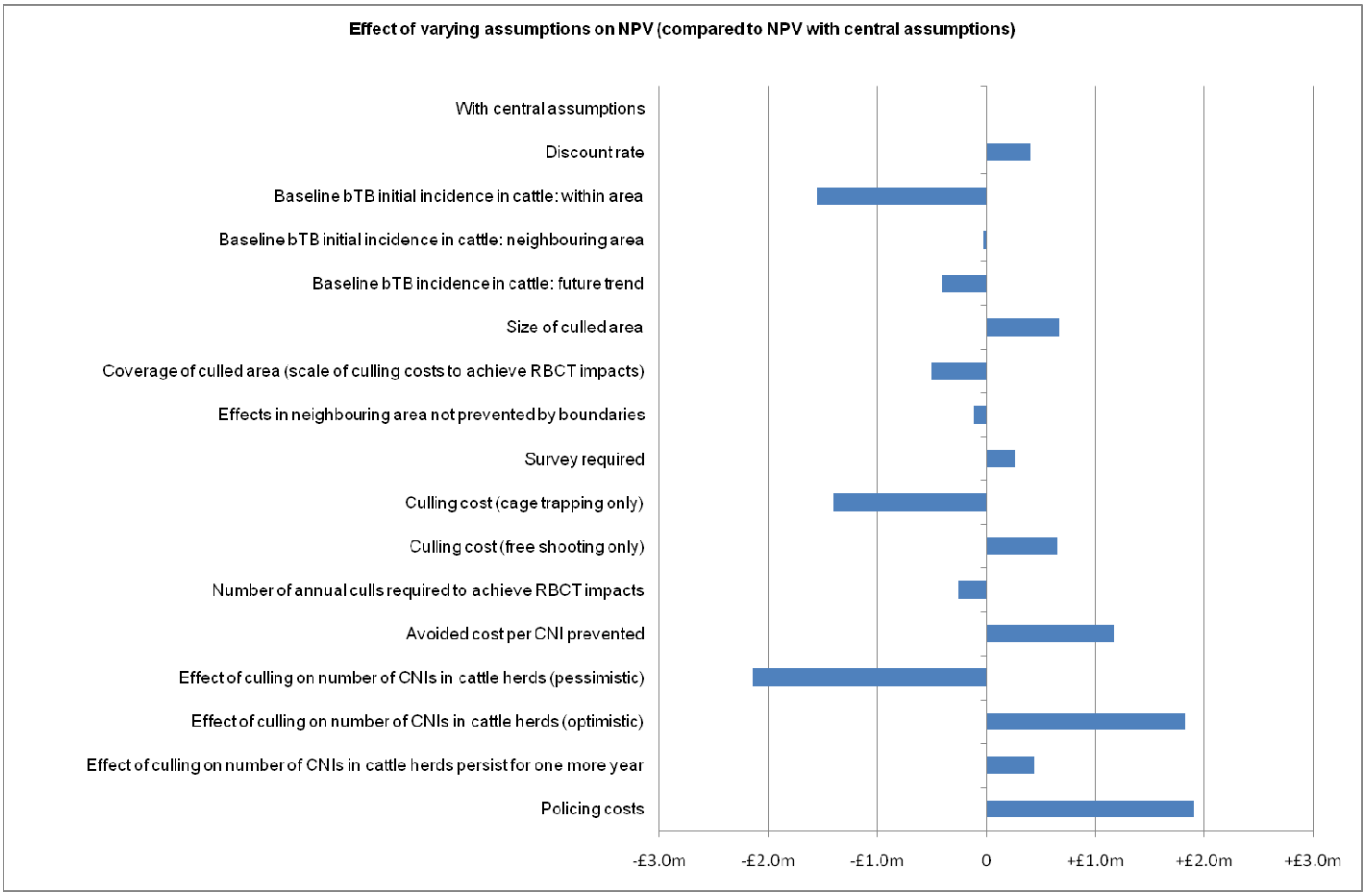
7.7. The NPV graph shows that all the assumptions affect the result, and that the NPV could be positive or negative depending on the assumptions. Changes in any one assumption mostly leave a negative NPV. The exceptions are when the cost of bTB incidents in cattle is high, when the effect of culling is at the highest end of the RBCT confidence interval, and when policing costs are excluded from the assessment.







7.8. The fourth graph below shows the same NPV results as before, but shown as changes from the NPV under the central assumptions. This means that positive values show a better result than under the central assumptions and negative values show a worse result.



Box 1: Evidence Assumptions

Efficacy of controlled shooting badgers (compared to the RBCT results)

The controlled shooting of wildlife is a technique already widely used by the rural and pest-control communities. It is commonly used to kill foxes (at night) and deer (day time), but it has not been used in any trial or field test on badgers. A report by the Game Conservancy Trust in 2006[6] concluded that, "sighting frequency [of badgers] was sufficient to be an efficient form of badger control." Controlled shooting will be piloted in two areas initially in the first year, and the culling operation will be closely monitored to ensure this method is both effective and humane. The results of the monitoring in these areas will be examined by a panel of independent scientific experts.

Relative efficacy of vaccination to culling

Based on veterinary advice and the available scientific evidence our assessment is that vaccination will not be as effective as culling in quickly lowering the weight of infection in the badger population, and therefore reducing the incidence of bTB in cattle in high incidence areas. This is because, as far as we know, vaccination only protects uninfected animals; infected animals need to die off naturally; vaccination does not affect the population density; and enough badgers in a population need to be vaccinated to develop herd immunity (which takes time to deliver).

Applicability of RBCT research

[6] The Game Conservancy Trust. 2006. *Shooting as a potential tool in badger population control. Report to Defra*. http://www.defra.gov.uk/foodfarm/farmanimal/diseases/atoz/tb/documents/badger-gct0806.pdf. Accessed 24.06.10.

The results of the RBCT, representing nearly 10 years of work (1998-2007) and nearly £50 million of taxpayer investment, are fully published and peer-reviewed and represent the most substantial and coherent evidence base for the evaluation of badger culling. The large number of biases inherent in any field trial makes interpretation of the results generated from them difficult. Any conclusions are only informed by one particular, spatially and temporally limited culling operation, therefore, extrapolation of the results to other circumstances, or the viability of culling as part of a strategy involving other measures (e.g. vaccination) is highly speculative. This said, the RBCT was a large randomised control trial with proactive culling carried out over 10 x 100 km^2 areas and based on its results we are able to make predictions about the effect of proactive culling in differing circumstances e.g. area size, starting cattle herd incidence and density, and identify conditions that a proactive culling strategy must meet in order to maximise its chance of having a beneficial effect. These predictions and minimum culling criteria are based on those first discussed by the ISG in their Final Report, and subsequently by Sir David King's review of the scientific evidence behind badgers and bTB, and have been shared and discussed with numerous independent experts, including members of Defra's Bovine TB Science Advisory Body, ex-members of the ISG and scientists at the Veterinary Laboratories Agency and Food & Environment Research Agency.

Scientific evidence on controlling TB in a wildlife reservoir

TB in cattle cannot be successfully controlled / eradicated where there is a reservoir of disease in wildlife that is left unaddressed. Countries outside Great Britain with a known wildlife reservoir include Northern Ireland (Abernethy et al., 2006), the Republic of Ireland (Good, 2006; More, 2009), Spain (Naranjo et al., 2008), and New Zealand. These countries have not been able to eradicate TB, although New Zealand has made substantial progress towards this (Ryan et al., 2006). The implicit conclusion from any study that demonstrates that a particular wildlife species causes a baseline percentage of cattle cases is that the risk has to be dealt with in one way or another otherwise transmission between the species will continue (e.g. demonstrated for badgers by Donnelly et al., 2006, 2007; Griffin et al., 2005). This was recently emphasised by Donnelly and Hone (2010), who concluded that, "The[ir] results indicate that TB in cattle herds could be substantially reduced, possibly even eliminated, in the absence of transmission from badgers to cattle."

In other countries, including in the USA and Canada, a significant wildlife reservoir became evident when bovine TB was nearing eradication, making it necessary to introduce further control measures in certain regions. Australia achieved bovine TB eradication through stringent cattle controls, combined with a control programme targeting the feral cattle and buffalo reservoir in the Northern Territory. France succeeded in becoming officially TB free in 2000, but localised wildlife reservoirs of the disease have since emerged.

8. Administrative burden and policy savings calculations

8.1. We are conscious of the need to minimise red-tape burdens. In designing the final policy, we have ensured that the administration of the policy, for farmers and for Government, is fit for purpose and proportionate.

8.2. The preferred approach would open up the option to farmers of using badger control as part of a package of measures to control bTB in cattle. Government would not require farmers to cull or vaccinate badgers. For this IA therefore, the annual cost per organisation has been left at zero.

9. Wider impacts

Economic impacts

Competition Assessment

9.1. The policy would utilise an existing licensing mechanism and will not impose any new regulation. The policy is not expected to have any impact on competition. A competition assessment has been completed with the following conclusions:

- The policy will not directly limit the number or range of suppliers as there will be no fixed quota or exclusive rights to any single tender. The policy would involve applying strict criteria for suppliers to adhere to which would apply to all suppliers alike, therefore not limiting suppliers' ability to compete.
- The policy will not indirectly limit the number or range of suppliers.
- Suppliers will be able to compete openly to take up new opportunities under the changes to the existing licensing mechanism. Suppliers will have to meet legal standards already in place. The geographic area of operation will be limited by relevance.
- The policy will not reduce suppliers' incentives to compete vigorously.

Small Firms Impact Test

9.2. The policy will not impose or reduce costs on business. The policy would not be expected to have any adverse effects on small firms, as licensing criteria will not discriminate between large and small firms. The policy has been developed with regard to farming businesses who are most impacted by bTB.

Environmental impacts

Greenhouse Gas

9.3. The proposed policy is not expected to impact greenhouse gas emissions as the number of cattle kept by farmers (and hence methane emissions) is assumed to remain steady.

Wider Environmental Impact Test

9.4. The policy will change the amount of living species. The wider environmental impacts of the policy will be monitored, including animal welfare, sustainability of the local badger population, and the effect of the control measure on disease incidence in cattle.

Protected sites will also be monitored. A full ecological impact assessment has been carried out to identify areas that may require protection and monitoring. Such requirements will be included in the conditions of the licence.

Social impacts

Health impact assessment

9.5. No significant impact on health is expected. A health impact screening test has been completed with the following conclusions:

- Human health: No significant effect on human health is expected although security concerns may have an indirect impact on crime.
- Lifestyle: No significant effect on lifestyle related variables is expected. Any effect is likely to be positive by reducing the stress associated with bTB cattle breakdowns.
- Impact on health and social care services: No effect is expected as the policy would not have any direct impact on demand.

Race/Gender/Disability Equality

9.6. The policy is not expected to have any effect on race, gender or disability equality. An equality screening test has been completed.

Human Rights

9.7. The policy is not expected to have any effect on human rights.

Justice Impact Test

9.8. The proposed policy would not be expected to increase normal court business. A Justice Impact Test has been completed and agreed with the Ministry of Justice.

Rural Proofing

9.9. The policy applies principally to rural areas as it concerns the control of wildlife delivered through services that are already available in rural communities.

Sustainable Development

9.10. The policy is in line with the shared UK principles of sustainable development. A Sustainable Development test has been completed with the following conclusion:

- The benefits outweigh the costs in the economic impact assessment. The sustainability impact in terms of the impact on the wider environment of reducing the badger population will be carefully monitored. To comply with the Bern Convention, the local badger population will not be eliminated.

10. Summary

10.1. The Government's long term goal is to eradicate bTB in cattle but this is likely to take several decades. We need a progressive approach which first aims to stop the disease getting worse and then to reduce the spread and prevalence of the disease to a point where eradication becomes an achievable goal. We will not succeed in eliminating the disease in cattle unless we also tackle the disease in badgers. The scale of badger control under these policy options is expected to be small in relation to the bTB problem as a whole.

10.2. The Impact Assessment demonstrates that there is an economic case for badger control when carried out in partnership between industry and Government, excluding the costs of policing as it is envisaged in the pilot areas. However, the preferred option does not result in a large cost saving and, because the Government bears much of the cost of dealing with TB breakdowns, most of the benefits accrue to the taxpayer. The success of the preferred option depends on a commitment and willingness from the industry to accept the costs of operating the policy for the marginal financial benefits that badger control offers and the non-financial benefits of freedom from TB in cattle. The consideration for Government is whether the net reduction in bTB, in areas where the disease is serious and growing, is sufficient to justify the cost to members of the public who may value badger populations and badger welfare.

10.3. The case for licensed culling in terms of the quantified benefits and costs depends partly on whether a badger cull employing a mix of methods (a significant element of the less expensive controlled shooting with some more expensive cage-trapping and shooting) is capable of achieving the desired impact on cattle bTB. The case also depends on the extent to which the risk of perturbation can be minimised through the use of barriers and buffers, with vaccination used in combination with other, physical, barriers and buffers.

10.4. The preferred policy option would enable farmers/landowners to take control of the wildlife reservoir of the disease at a local level. For some farmers and landowners, using vaccination may be the preferred option for tackling TB in badgers. But for most farmers, culling is likely to be the preferred option, leading to higher uptake – this is an important consideration in the context of any policy options which would require the industry to bear the direct costs of badger control. The success of the preferred option is dependent on applicants fulfilling the licensing criteria with a commitment and ability to deliver over a large enough area, with a high enough efficacy and for at least 4 years.

Annex 1

Table 7: Main assumptions showing the effect that varying them would have on the results for "Option 6 Issuing licences to use a combination of culling and vaccination in one area of 150km^2 and 2km around" (impact on results shown for: estimated NPV, % change in baseline control cost over the whole 10 year period, and Benefit Cost Ratio (BCR).

Assumption	Source	Reliability (quality of evidence) H=high M=medium L=low	Central assumption [Extreme value]	NPV with extreme value	Impact on bTB control cost as % of baseline	BCR with extreme value
				With central assumptions: -£0.88m	+5.0%	0.81
Discount rate	HMT	H	3.5% [0]	-£0.48m	+2.3%	0.90
Baseline bTB initial incidence in cattle: within area	Defra indicative based on VLA analysis of VetNet data for BVDP candidate areas	H but depends on area chosen	15 CNIs / 100km^2 / year [8.5]	-£2.44m	+22.4%	0.47
Baseline bTB initial incidence in cattle: neighbouring area	Defra indicative based on VLA analysis of VetNet data for BVDP candidate areas	H but depends on area chosen	10 CNIs / 100km^2 / year [4.6]	-£0.91m	+5.3%	0.80
Baseline bTB incidence in cattle: future trend	VLA model projection of GB trend	M	+3% [0]	-£1.29m	+8.4%	0.72
Size of culled area	Depends on area chosen and licensing conditions		350 km^2 [150]	-£0.21m	+1.2%	0.95
Coverage of culled area (scale of culling costs to achieve RBCT impacts)	Depends on area chosen and licensing conditions		70% [100%]	-£1.39m	+7.9%	0.73
Effects in neighbouring area not prevented by boundaries	Depends on area chosen and licensing conditions		boundaries & buffers [no boundary]	-£1.00m	+5.1%	0.79
Survey required	RBCT approach		£1,000/km^2 [none]	-£0.62m	+3.5%	0.86

Culling cost (mix of cage trapping and controlled shooting)	Defra & University of Reading based on analysis of RBCT costs	H (cage trapping) L (free shooting)	£1,000/km^2 [£300 - £2,500]	-£2.28m -£0.23m	+13.0% +1.3%	0.62 0.94
Number of annual culls required to achieve RBCT impacts	RBCT	H/M	4 [5]	-£1.14m	+6.5%	0.76
Avoided cost per CNI prevented	Defra based on University of Reading, updated	H but may depend on area chosen and non-quantified impacts on farmer	£30,000 [£40,000]	+£0.29m	-1.2%	1.06
Effect of culling on number of CNIs in cattle herds within area and in neighbouring area, during culling and post culling (4 combinations)	Jenkins et al from RBCT	H/M	Best estimates [pessimistic extreme of 95% CI for all 4 pairs] [optimistic extreme of 95% CI for all 4 pairs]	-£3.03m +£0.94m	+17.3% -5.4%	0.39 1.21
Effect of culling on number of CNIs in cattle herds persist for one more year		M	Effects to month 60 [month 72]	-£0.44m	+2.5%	0.90
Policing costs			Basic [Excluded]	+£1.02m	-5.8%	1.38
Ranges shown in the summary sheets reflect the most important uncertainties, namely those in the impacts of culling and/or vaccination and the cost of culling. Impacts will also depend on characteristics of the areas chosen for badger control.						