

Report for the
National Tree Safety Group

Trees and the Risk of Harm

Prepared by

**Centre for Decision Analysis and Risk
Management
Middlesex University**

John Watt & David J. Ball

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Executive summary

This report is one part of a work package commissioned in 2008 by the National Tree Safety Group aimed at determining what would constitute a reasonable and appropriate inspection regime for trees in relation to public safety. The purpose of this report is to quantify the risk to public health from falling or fallen trees or parts of trees. To assist in placing these risks in perspective they are compared with a) risk criteria published by the Health and Safety Executive and previously The Royal Society and b) the risks posed by other hazards to which the public are exposed.

A data base of tree-related fatalities in the UK has been compiled for the 10-year period from 1 January 1999 with much help from The National Trust and other agencies representing land owners and arboriculturalists. The conclusion is that within the UK there are approximately 6.4 public fatalities per year which are attributable to the specified cause. Of these 30 per cent, possibly more, occur during episodes of strong wind, suggesting trees themselves, and tree-management regimes, are less culpable. Non-fatal injury data for 2000-2002 attributable to similar tree-related causes also indicate a very small number of cases in the UK. From this it can be deduced that the average individual risk of death to a person in the UK is in the region of 1 in 10 million per year. This is by any standard an exceptionally small risk and lies well within in the 'broadly acceptable' risk region as identified by the Health and Safety Executive and The Royal Society.

For risks as low as this it is difficult to find new interventions which will reduce risk, which are reasonably practicable, and which do not have unintended consequences which outweigh their benefits.

Note

Throughout this report the following definitions apply:

Hazard – an object or situation with a potential to cause harm

Risk – the probability, likelihood or chance that a specified outcome will occur

1. Introduction

This document is produced as the first element of the response to the contract placed in autumn 2008 by the National Tree Safety Group (NTSG) with the Centre for Decision Analysis and Risk Management (DARM) at Middlesex University. The background to the contract is the interest of landowners, the arboricultural industry and other professional bodies in the appropriate level of inspection and management which should be employed to control the risk to the public posed by falling or fallen trees.¹

An important consideration² in deciding what measures are appropriate for controlling the risk posed by any hazard is the numerical or absolute value of the risk. A conceptual model of The Health & Safety Executive's risk philosophy is shown in Figure 1. What is important here is that the vertical dimension, one of increasing risk as one moves upwards, is divided into three zones. These are the upper or 'unacceptable region,' the intermediate or 'tolerable region,' and the lower or 'broadly acceptable region.'

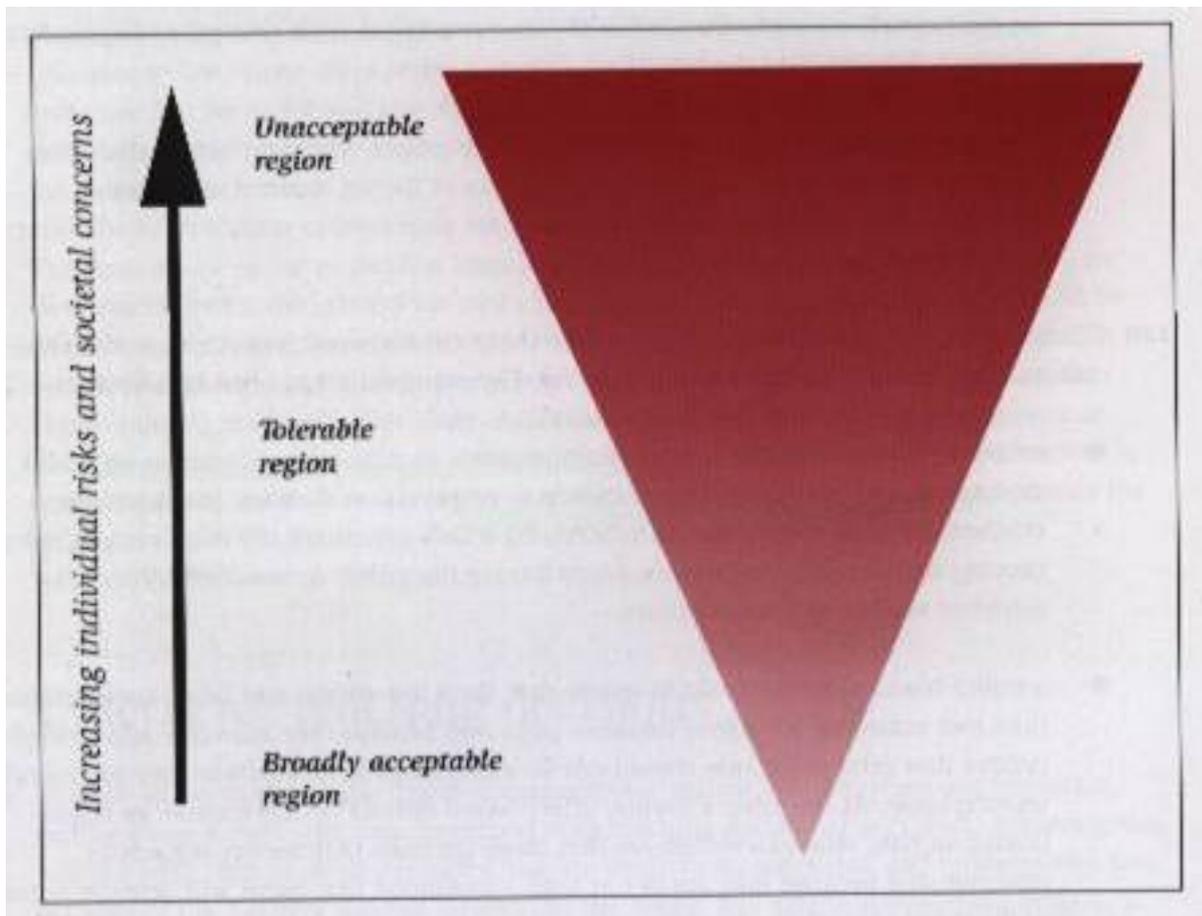


Figure 1: HSE framework for the tolerability of risk³

¹ Building damage is not included in this assessment since the driver for health and safety measures is primarily human health.

² Other potentially important factors are the cost and difficulty of control, any indirect or unintended consequences of control, and any social, perceptual or legal factors.

³ Health and Safety Executive (2001) Reducing risks, protecting people – HSE's decision making process. HSE Books: Sudbury.

The HSE says that for practical purposes any activity or practice giving rise to risk in the upper zone would be prohibited unless exceptional reasons could be given. The bottom zone, in contrast, represents a level of risk which is taken as broadly acceptable. The HSE says as follows: “Risks falling in this region are generally regarded as insignificant and adequately controlled. We, as regulators, would not usually require further action to reduce risks unless reasonably practicable measures are available. The levels of risk characterising this region are comparable to those that people regard as insignificant or trivial in their daily lives.”

For hazards with risk levels falling in the intermediate band, these may be tolerated in order to secure the associated benefits, but with the expectation that:

- The nature and level of the risks are properly assessed and the results used properly to determine control measures. The assessment of the risk needs to be based on the best available scientific evidence and, where evidence is lacking, on the best available scientific advice;
- The residual risks are not unduly high and kept as low as reasonably practicable (the ALARP principle⁴); and
- The risks are periodically reviewed to ensure that they still meet the ALARP criteria, for example, by ascertaining whether further or new control measures need to be introduced to take into account changes over time, such as new knowledge about the risk or the availability of new techniques for reducing or eliminating risks.

An obvious question relating to the above concerns the numerical risk values associated with the boundaries between the three zones. The HSE says that it is often unnecessary to specify these boundaries because good practice is often spelled out or implied in legislation, approved codes of practice (ACoPs) or other guidance. But, based on its experience, HSE has proposed guidelines⁵ for where these boundaries lie and this is relevant in the context of the NTSG’s work which is seeking to define what is a reasonable standard of control in the absence of specific standards and ACoPs.

Accordingly, HSE has identified an individual risk of death of one in a million per annum for both workers and the public as corresponding to a very low level of risk that should be used as a guideline for the boundary between the broadly acceptable and tolerable regions. It points out that this level of risk is extremely small when compared with the general background level of risk which people face and which is voluntarily engaged with.

Of less importance here, but of some interest, is the boundary between the tolerable and unacceptable zones. HSE has proposed that, for members of the public who have a risk imposed on them ‘in the wider interest of society’

⁴ ALARP is shorthand for ‘as low as reasonably practicable.’

⁵ These are not rigid benchmarks and should be interpreted with common sense.

this limit should be 1 in 10,000 per annum risk of death.⁶ These estimates are based upon a pattern of reasoning set out earlier by The Royal Society.⁷

2. Assessing the risk posed by trees

2.1 Methodology

A preliminary list of incidents, focussing mainly on fatalities was drawn up, based largely on news cuttings and internet searches (extending work initially undertaken by the National Trust). This was distributed in two ways - initially in paper form to the Arboricultural Association membership as an insert in their newsletter and then by being placed on an internet survey site (using SurveyMonkey). The latter was distributed to the Confederation of Forest Industries, the Visitor Safety in the Countryside Group, the Institute of Chartered Foresters and the Royal Forestry Society.

In all cases members of the organisations were asked to review the list and add relevant missed incidents or to correct details if appropriate.

To date 301 people have completed online version (only 14 of which added incident data, some already known). A number of paper/email responses were also received.

Data on non-fatal tree related injuries were collected by interrogating the former Department of Trade and Industry's LASS (Leisure Accident Surveillance System). This records accidents which come to the attention of a representative sample of UK hospital accident and Emergency Departments. All cases involving or mentioning 'trees' were filtered out of the data base for the years 2000-2002⁸ and the descriptions of what happened examined to categorise them. National estimates of persons being struck by trees were then made by multiplying by the appropriate scaling factor for each year.

2.2 Quantifying the risk

Appendix 1 lists 64 fatalities during the 10 year period from 1 January 1999. The brief descriptions indicate that 18 of these fatalities occurred during windy weather. It is likely that this is an underestimate of the number of wind-related cases. For example, although over the 10 year period there was roughly one fatality per two month period, on 27 October 2002 alone five people were killed during windy weather and again on 18 January 2007 three people were killed. It is intended to further examine the fatality record in relation to extreme weather events, but as it stands it would seem that the mean annual fatality rate is 6.4, but falling to ≤ 4.6 if high wind events are excluded. Taking the UK population as 60 million over this period, leads to an estimate of 1 in 10 million per year individual risk of

⁶ This limit is set at 1 in a 1,000 per annum for workers.

⁷ The Royal Society (1983) Risk assessment – a study group report. The Royal Society: London.

⁸ These are the most recent data available.

death from this cause (0.8 in 10 million per year, or less, if high wind occasions are discounted).

	Slipped on/tripped/collided with	Playing on/descending/fell from	Working on	Hit by	Other	Total
2000	307	190	85	4	18	604
2001	236	195	126	3	17	577
2002	259	167	109	2	8	545

Table 1: Accident and emergency cases recorded in the Leisure Accident Surveillance System data base which are associated with trees.

So far as non-fatal injury cases are concerned, a few have been picked up in Appendix 1, but the main source used has been the DTI's LASS data base which is based on a sample (roughly 5%) of national A&E attendances. The scale factors for the three years from 2000-2002, which must be used to get a national estimate, are 17.74, 17.85 and 20.50. The main interest here will be in the column in Table 1 headed 'hit by' which could possibly although not necessarily refer to trees or tree parts falling onto people. However, using these figures as an upper estimate it would appear that the nationally estimated average number of A&E attendances per year attributable to trees and the 'hit by' mechanism is about 55, but with a fair degree of uncertainty because of the small numbers of cases recorded in the data base.

3. Significance of the identified risks

The individual risk of death attributable to trees identified in the previous section, even if one were not to discount those cases arising during high wind episodes, falls well below, by a factor of ten, the threshold of 1 in a million per year which has been identified by the HSE as extremely small when compared with the general background level of risk which people face and which are voluntarily engaged with.

Risks of this magnitude of course fall well within HSE's 'broadly acceptable range,' and are generally regarded by HSE as "insignificant and adequately controlled." Indeed, trying to reduce risks already as small as this could be construed as a lost cause. This is because reducing such a small risk is on the one hand extremely difficult. Given the huge number of trees in the UK the quest to identify the handful which will cause harm is akin to looking for a needle in a haystack. Secondly, the very low risk necessarily implies that the benefit of any intervention will itself be small (an x% reduction in a small quantity is itself small however big x is), and consequently, for the intervention to be reasonably practicable,⁹ the resource allocated could only be small. For national scale interventions the sums are thus loaded totally

⁹ For an intervention to be reasonably practicable its cost should not be grossly disproportionate to the benefit.

against the controller of the risk. Thirdly, and also important, are the possible unintended consequences of safety interventions which may introduce their own disadvantages including new risks. Given that the benefit in terms of life saving will necessarily be very small, this could easily be outweighed were safety interventions to introduce any such effects. These issues illustrate not the weakness but the strength of the underlying tolerability of risk philosophy which is about achieving a rational approach to safety investment decision making..

Table 2 is included for comparative purposes. It is reproduced from HSE's 'Reducing risk, protecting people' with the risk of falling and fallen trees added as an additional category.

Cause of death	Annual risk	Basis of risk and source
Cancer	1 in 387	England & Wales 1999
Injury and poisoning	1 in 3,137	UK 1999
All types of accidents and other external causes	1 in 4,064	UK 1999
All forms of road accident	1 in 16,800	UK 1999
Lung cancer from radon in dwellings	1 in 29,000	England 1996
Gas incident (fire, explosion or carbon monoxide poisoning)	1 in 1,510,000	GB 1994/95 – 1998/99
From trees	1 in 10,000,000 or less if high wind incidents are excluded	This study
From lightning	1 in 18,700,000	England & Wales 1995-99

Table 2: Annual risk of death for various causes over entire population (Adapted from HSE (2001)).

So far as non-fatal injuries are concerned, the number of A&E cases attributable to being struck by trees (about 55 a year on average) is exceedingly small compared with the total number of leisure-related A&E cases per year in the UK which is about 2.9 million. Items such as footballs (262,000), children's swings (10,900) and even wheelie bins (2,200) are involved in many more incidents.

4. Conclusions

The risk of fatal and non-fatal injuries to the UK public associated with falling and fallen trees or tree parts has been quantified. The individual risk per year has been confirmed to be extremely small. It lies well within the band known as the 'broadly acceptable region' in the HSE's tolerability of risk framework. It is recognised that trees are currently managed for a

variety of reasons. This analysis indicates that it would be unlikely that adjustments to the current management regime would reduce the risk the health and safety in any significant way. Any proposed new measures should also be considered in terms of their practicability and potential for generating unintended and unwanted consequences.

Acknowledgements

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Appendix 1: Tree fatalities in the UK 1999-2008

Date	Location	Brief description of incident including whether fatal or serious injury	No. of fatalities
4 Feb 1999	Bradley Gairs Wood, Bradley, Grimsby	Walker killed by falling dead oak. Advanced state of degradation, fell in high wind	
3 Dec 1999	Kings Heath, Birmingham	Three killed when diseased ash tree fell during high winds onto busy road and crushed two cars.	3
18 Dec 1999	Lady Park Wood, Forest of Dean, Glos	Man seriously injured by falling ash tree while using footpath in darkness	
29 Jan 2000	Burbage, Leicester	Ash tree blew down and hit motorist, partially paralysed. Cause <i>Perenniporia fraxinea</i>	
29 Oct 2000	Hindhead, Surrey	Two people died and 1 seriously injured when a tree hit two cars on the A3 near Hindhead	2
30 Oct 2000	Taunton, Somerset	Motorcyclist killed by falling tree	1
11 Aug, 2001	Frome, Somerset	Motorcyclist injured by fallen ash tree	
31 Oct 2001	Weston Park, Staffs	Branch fell onto A5. Van hit branch in dark, went across road and collided with oncoming car. All 4 occupants of car killed	4
26 Jan 2002	Dunkeld, Scotland	Man died within minutes of tree falling on him outside the Hilton Dunkeld Hotel. Woman later died in hospital	2
1 Feb 2002	Honley, nr Huddersfield, W Yorkshire	Two people died after a beech tree crashed across their car.	2
14 Mar 2002	Polhill, Sevenoaks	Man (21), killed when a tree crashed onto his truck as it was parked in a lay-by during strong winds	1
26 April 2002	Blenheim Palace	Two women injured by falling tree in weak tornado	
27 Oct 2002	Costessey, nr Norwich	Boy (12) died saving his older brother from a falling tree during storms	1
27 Oct 2002	Felixstowe, Suffolk	Boy (3) died when tree fell on his pushchair during high winds	1
27 Oct 2002	Oxford	Woman (22) crushed to death as she sat in a parked car. 3 other family members injured	1
27 Oct 2002	Whittington, Norfolk	Man died after he was hit by a falling tree in his garden	1
27 Oct 2002	Shropshire	Girl (11) killed when the branch of a tree fell on the car in which she was a passenger	1
27 Oct 2002	Brecon, Wales	Man killed when a branch hit the roof of his car	1
29 Oct 2002	A3, Hindhead, Surrey	Trees fell on vehicles killing one man and seriously injuring his wife who became tetraplegic and died prematurely	2
10 Dec 2002	Wandsworth, SW London	Two people in their 20s died after a strong gust of wind caused a	2

Date	Location	Brief description of incident including whether fatal or serious injury	No. of fatalities
		15ft section of tree to fall on their car in south-west London	
28 Jan 2003	Barnet, N London	Falling tree killed driver in soft-top car	3
30 Jan 2003	West Ashtead, Surrey	Child, aged 8, was killed and several others injured when a falling tree crushed them in school playground during windy weather.	1
9 Feb 2003	County Down, N. Ireland	A man (22) died after his car hit a tree. Some hours later, 18-year-old man, who had also been in the car, died in hospital from his injuries	2
9 Feb 2003	Dungannon to Ballygawley road, N. Ireland	Branch fell off tree on main A4 road killing a man	1
6 May 2003	Richmond Park, London	Boy (11) suffered head and chest injuries when he was hit by the branch of a 400-year-old oak tree. Died later in hospital	1
27 June 2003	Salisbury, Wiltshire	Field tree fell on victim who subsequently died	1
31 Jan 2004	Kidderminster, Worcestershire	Man died after he hit a tree which had fallen across a Worcestershire road	1
31 Jan 2004	Essex	Car collided with tree which had fallen into road causing extensive injuries	
20 Mar 2004	Strelley village, Nottingham	Beech tree growing in a roadside shelterbelt uprooted and fell onto a car fatally injuring female driver	1
20 Mar 2004	Blundeston, nr Lowestoft, Suffolk	A man and woman died when strong gales blew a beech tree (deemed to be in good condition) on to their car.	2
3 July 2004	Horsham, West Sussex	Limb of tree fell on vehicle causing extensive injury	
31 Aug 2004	Caterham, Surrey	A motorcyclist died after he came off his machine as he tried to avoid part of a tree lying in on the dual carriageway	1
29 Oct 2004	Corfe Castle, Dorset	Woman, 57, was killed when a pine tree spilt and fell on her during a mini tornado.	1
1 Jan 2005	Dunham Massey nr Altrincham	Boy (8) killed by falling tree while in park during unusual winds	1
8 Jan 2005	Darlington	Tree fell on motorbike and seriously injured rider	
12 Oct 2005	Cannon Hill Park, Moseley, Birmingham	Woman killed after a 60ft tree fell on her in a park.	1
21 June 2006	Bristol	Woman partially paralyzed down one side due to failure of large branch	
4 Aug 2006	A385 between Totnes and Dartington	Girl (16) died after a tree branch fell on the roof of the car she was travelling in	1
30 Dec 2006	Cheadle, Staffordshire	Young woman (18) died when a tree fell on to the caravan she was staying in during 50mph winds	1

Date	Location	Brief description of incident including whether fatal or serious injury	No. of fatalities
08 Jan 2007	Woodcote, Oxfordshire	Man seriously injured by a falling branch from an Atlantic cedar, while in his garden during high winds	
11 Jan 2007	Blackdown Hills, Somerset	Man died after his car hit a tree which was marked for felling and had blown down in high winds.	1
18 Jan 2007	Altringham, Cheshire	Elderly gentleman killed by falling tree in worst winds for many years	1
18 Jan 2007	Byley, Cheshire	Man working on a site when killed by falling tree	1
18 Jan 2007	Streatley on Thames, Berkshire	Man was killed when a tree fell onto the car he was driving during storms	1
18 Jan 2007	London	Beech tree fell on victim walking by causing extensive injury	
19 Jan 2007	Nr Bridgnorth	Man killed by branch falling on car on B4373.	1
19 Mar 2007	Lapworth, Warwickshire	Man was killed instantly when a 60-foot oak tree fell on his pick-up truck	1
21 May 2007	Londonthorpe, Grantham	Driver, 20, and passenger, 23, died when their car hit a tree on a Lincolnshire road	2
26 June 2007	Felbrigg Hall, Norfolk	10 year old school boy killed by falling branch while on orienteering exercise in woods at Felbrigg. Two others injured.	1
12 July 2007	Saffron Walden, Essex	A motorcyclist suffered fatal injuries when he was hit by a falling tree branch in Essex	1
Aug 2007	Englefield Green, Surrey	Branch fell from oak tree. Victim was removing cycle from cycle rack on his car at the time, parked on a public road. Fatal injuries.	1
15 Nov 2007	A149 between Sheringham and Weybourne	Young driver killed after hitting sycamore roadside tree	1
10 Jan 2008	Bodiam, East Sussex	Woman died after a falling tree crushed the front of her car	1
22 Feb 2008	Whitburn, West Lothian	Man (25) killed when tree next to A705 fell onto his van	1
February 2008	Livingston, Scotland	Van driver killed when roadside tree came down in heavy winds, crushing him and his van. Instantly killed.	1
29 Feb 2008	Saltburn, Riftswood Woodland	Two elderly ladies injured	
20 May 2008	Tower Bridge Road, London	One woman killed, four others seriously injured, when double-decker bus hit branch of roadside tree.	1
26 May 2008	Huddersfield, West Yorks	Girl (13) suffered fatal injuries from a falling tree in Reinwood Park	1
13 Aug 2008	Clapham Common, South London	A man died after a large tree fell and crushed the vehicle he was in	1
5 Sept 2008	Scotch Corner, North Yorkshire	Man died when his bike hit a tree which had fallen into a road during bad weather	1

Date	Location	Brief description of incident including whether fatal or serious injury	No. of fatalities
9 Oct 2008	Cottingham, East Yorkshire	A man died and a woman has been critically injured in a crash involving a tree in Hull	1
24 Oct 2008	Fife, Scotland	A boy (12) was taken to hospital by ambulance last night when he was struck by a falling tree branch, after a day of heavy winds	

This Appendix is a living document. Every effort has been made to ensure completeness and with the help of correspondents this effort continues.