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# Fireworks Legislation and Impacts: International Evidence Review



**CRIME AND JUSTICE**



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# 1. Executive Summary

## 1.1. Background

Fireworks are an important part of Scottish celebrations and festivals, such as Hogmanay, Bonfire Night and Diwali. However, fireworks can potentially have negative consequences and need to be used safely and handled with care to avoid serious injury. A public consultation and omnibus survey were recently carried out by the Scottish Government (2019a; 2019b) to gather views on potential changes to fireworks legislation and regulations in Scotland. To further complement the consultation and omnibus survey, a desk-based review of the evidence has been carried out to provide an evidence-based understanding of the key issues relating to fireworks.

## 1.2. Purpose

This report sets out the findings of a desk-based review of the evidence on the impact of fireworks in the context of international legislation and regulations. The review includes a summary of current fireworks legislation and regulations internationally, and a review of the available evidence on the impact of fireworks, relating to social and environmental factors. The key findings of the review are summarised below.

## 1.3. Key Findings

### **International regulations on the sale and use of fireworks**

- EU countries largely follow the guidelines set out in two EU Directives. These split fireworks into four categories and set minimum distances, maximum noise levels and minimum age limits for the sale of each.
- The UK has additional regulations that restrict sales to certain periods, raise minimum age limits and impose curfews on fireworks use.
- Further restrictions exist in Northern Ireland, which require those who both buy and sell fireworks to have valid licences.
- Other EU countries also have tighter regulations. For example, in Belgium, the types of fireworks legal to sell to the public are stricter than EU regulations, and both Germany and the Netherlands have restrictions on when and where fireworks can be used.
- In the US legislation varies between states, with some imposing total bans and others permitting the sale and use of fireworks year-round.
- In Canada, fireworks regulations are set by individual provinces and territories. Some have total bans on fireworks and others permit their sale and use around dates such as Canada day and Halloween.
- Most states and territories in Australia completely outlaw fireworks.
- There are restrictions on when fireworks can be sold in New Zealand, but their use is permitted throughout the year.

## **Injury**

- The limited evidence available within the scope of this review suggests that the number of fireworks related injuries is not decreasing over time.
- Research consistently finds a spike in fireworks related injuries around festivals.
- Most fireworks related injuries occur at private displays (e.g. in gardens) or in streets and other public places, not at formally organised displays.
- Both bystanders and operators are at risk of injury, with young people and males consistently found to be most at risk.
- Common fireworks related injuries affect hands and heads, with mortars and rockets responsible for the majority of serious eye and hand injuries. However, sparklers, fountains and firecrackers are also frequent sources of injury.
- Fireworks related injuries often require specialist treatment and surgical intervention, and can sometimes be fatal. There have also been cases of suicides involving fireworks.

## **Environment**

- Fireworks pollute the air with gases and particles, which can contain metals and other elements that are potentially harmful to human health.
- Fireworks can also cause fires that further pollute the air with carbon emissions.
- Some of these particles can dissolve in water and contaminate water sources too.
- Local air pollution, the frequency of cultural traditions involving fireworks and meteorological factors can all influence the impacts of fireworks on the environment.
- The extent of these impacts in Scotland is unknown.
- Switching from micro to nano-sized powders, using sulphur-free propellants or applying nitrogen-rich compounds could help to minimise fireworks related pollution.

## **Noise**

- Fireworks can raise background noise levels by several dozen decibels (dB), with peak sound levels of up to 137 dB.
- These high peak sound levels are more harmful to human hearing than increased background noise. Increased noise levels can cause particular distress to those with noise sensitivity, including Autistic people.
- The extent of these impacts in Scotland is unknown.
- Some of these risks could be minimised by providing remote launch platforms for fireworks operators.

## **Animal welfare**

- The fear response to noise from fireworks can have adverse impacts on animals, though most research is based on studies with dogs.
- If left untreated, fear of noise from fireworks can lead to phobias in dogs, but this varies between dog breeds.
- Cats, small mammals such as guinea pigs and rabbits, horses and birds are also impacted by the noise from fireworks.
- Preventive measures to mitigate these effects include behavioural measures, medication and counter-conditioning, which are mostly successful. However, few animal owners seek professional help and instead try to self-manage the problem.
- Ingesting fireworks and injuries from fireworks also present issues for animal welfare.

## **Anti-social behaviour**

- Between 2002/03 and 2018/19 the most commonly reported fireworks related charges in Scotland were throwing, casting or firing a firework in a public place and underage possession of adult fireworks.

## **Culture**

- It has been argued by Ashcroft (2018) that integration of traditions from different cultures can facilitate social cohesion.
- This suggests that if the use of fireworks is restricted to specific festival dates, then consideration should be given to allowing fireworks for celebrations from all cultures and religions (ibid.). However, there is limited wider debate on this theory in the literature.

## **2. Introduction**

### **2.1. Purpose**

This report sets out the findings of a desk-based evidence review on the impact of fireworks in the context of international legislation and regulations. This aims to support a programme of work that ensures fireworks are used safely and handled with care, and do not cause harm, distress or serious injury.

The review is split into two parts, namely:

1. a summary of current fireworks legislation and regulations internationally; and
2. a review of the available evidence on the impact of fireworks, relating to social and environmental factors.

### **2.2. Background and context**

Fireworks are an important part of Scottish celebrations and festivals, such as Hogmanay, Bonfire Night and Diwali. However, fireworks can potentially have negative consequences and need to be used safely and handled with care to avoid serious injury.

Following a series of high profile incidents targeting emergency service workers during Bonfire Night 2017 and further firework related incidents over Bonfire Night 2018, a public consultation was held to gather views on potential changes to fireworks legislation and regulations in Scotland (Scottish Government, 2019a). While much of the legislation on the sale of fireworks is reserved to Westminster, the Scottish Government consultation aimed to identify gaps, issues and unintended consequences with the current regulatory framework.

The consultation received over 16,000 responses, and an omnibus survey was commissioned by the Scottish Government (2019b) to provide findings that were representative of the adult population of Scotland.

To further complement the consultation and omnibus survey, a review of the evidence has been carried out to provide a full evidence-based understanding of the key issues relating to fireworks. This critical part of the ongoing programme of fireworks work will provide evidence that can be used to assess the likely consequences of either keeping or changing current fireworks legislation and regulations in Scotland.

### **2.3. Methods and evidence-base**

The body of evidence identified in this report consists of 67 studies, including academic journal articles, government reports, surveys, case studies, laboratory experiments, evaluations, evidence reviews, interviews and books. 25 of these studies were based in the UK; 14 in the US; 14 in European countries; 6 in Australia and New Zealand; 4 internationally and 3 from Asian countries including China, India and Japan. For one study identified, the country of origin was unclear.

The studies covered a range of themes, including injury (29), culture (1), the environment (14), animal welfare (36), health (8), noise (7), the impact of legislation/regulations (13) and antisocial behaviour (2).

The studies identified, their key characteristics and limitations are summarised in [Appendix A](#). As well as the limitations highlighted in Appendix A, it is important to note that the evidence base suffered from some key shortcomings. In particular, there was a distinct lack of evidence based in Scotland or even the wider UK, and it is unclear how findings apply to the Scottish context. Further, there was a lack of literature on several themes present in the consultation and omnibus survey, including underage sales and anti-social behaviour. Where studies did exist on these topics, there were other limitations such as small sample sizes or lack of empirical data. A detailed methods section can be found in [Appendix B](#).

## **2.4. Report structure**

The report begins by summarising international legislation on fireworks. It then presents the key findings from the evidence review structured by theme, including findings on the impact of legislation on these themes.

# 3. International regulations on the sale and use of fireworks

This section summarises international regulations on the sale and use of fireworks. It begins by providing an overview of regulations which cover all European Union (EU) member states, before describing the current regulations in the UK and Northern Ireland (NI). The regulations in the United States (US), Canada, Australia and New Zealand are also described.

Fireworks regulations of other EU member states that deviate from the standard EU regulations with tighter or more lenient controls are summarised in [Appendix C](#).

## 3.1. Europe

### 3.1.1. Relevant legislation

There are two EU directives which standardise EU member states' regulations on fireworks:

- [Directive 2013/29/EU](#) which sets harmonised rules for fireworks in the EU
- [Directive 2014/58/EU](#) which sets up a system for the traceability of fireworks on the market

### 3.1.2. Manufacture, labelling and supply

Directive 2013/29/EU sets out essential safety requirements for fireworks in the EU. A range of requirements are specified. For example, fireworks must:

- be designed and manufactured in a way that they can be disposed of safely
- function correctly when used for their intended purpose
- be tested under realistic conditions
- only be constructed of materials that minimise risk to health, property and the environment from debris

Under the Directive, fireworks are divided into 4 categories relating to hazard, explosive content, safety distances, noise level etc.:



**Table 1: EU firework classification**

Category	Description	Conditions
F1	Fireworks which present a very low hazard, negligible noise level and which are intended for use in confined areas (e.g. sparklers)	<ul style="list-style-type: none"><li>• Safety distance of at least 1m</li><li>• Maximum noise level must not exceed 120 dB</li><li>• Must not comprise bangers, banger batteries, flash bangers and flash banger batteries</li><li>• Must not contain more than 2.5 mg silver fulminate</li><li>• Must be protected against inadvertent ignition</li></ul>
F2	Fireworks which present a low hazard and low noise level and which are intended for outdoor use in confined areas	<ul style="list-style-type: none"><li>• Safety distance of at least 8m</li><li>• Maximum noise level must not exceed 120 dB</li><li>• Must be protected against inadvertent ignition</li></ul>
F3	Fireworks which present a medium hazard, which are intended for outdoor use in large open areas and whose noise level is not harmful to human health	<ul style="list-style-type: none"><li>• Safety distance of at least 15m</li><li>• Maximum noise level must not exceed 120 dB</li><li>• Must be protected against inadvertent ignition</li></ul>
F4	Fireworks which present a high hazard, which are intended for use only by persons with specialist knowledge and whose noise level is not harmful to human health	<ul style="list-style-type: none"><li>• The detonative explosive cannot be easily extracted from the pyrotechnic article</li><li>• The pyrotechnic article is designed and intended not to function in a detonative manner</li><li>• Must be protected against inadvertent ignition</li></ul>

In order to demonstrate compliance with safety requirements, manufacturers must ensure the fireworks undergo conformity assessment procedures.

When compliance has been demonstrated, manufacturers must draw up an EU declaration of conformity and affix the 'CE' marking. Other labelling requirements include:

- Name of manufacturer or importer
- Name and type of article
- Minimum age limit
- Category of article
- Instructions for use
- Explosive quantity/content
- Category F1-F3 fireworks: 'for outdoor use only' and a minimum safety distance

- Category F4 fireworks: ‘for use only by persons with specialist knowledge’ and minimum safety distance(s)

To ensure pyrotechnic articles are traceable, they must also be labelled with a registration number, which is assigned by the body carrying out the conformity assessment procedure.

### **3.1.3. Sale, possession and use**

Importers and distributors of fireworks must ensure that fireworks available on the market have followed the conformity assessment procedures. In particular, they must verify that fireworks:

- have a registration number;
- include the CE marking;
- are accompanied by the required documents and;
- include instructions and safety information in a language which can be easily understood by consumers.

Minimum age limits for the purchase of each category of firework are also set, which importers and distributors must enforce:

- Category F1: 12 years
- Category F2: 16 years
- Category F3: 18 years

Category F4 fireworks are restricted to professionals throughout the EU. Individual member states are allowed to prohibit the sale, possession and usage of other categories by consumers as well.

Member States must set out penalties for infringements of the laws adopted in light of Directive 2013/29/EU.

## **3.2. United Kingdom**

### **3.2.1. Relevant legislation**

In the UK, there are several Acts of Parliament and regulations which cover the supply, possession and use of fireworks:

- [Consumer Protection Act 1987](#)
- [Fireworks Act 2003](#)
- [Fireworks Regulations 2004](#), as amended by the [Fireworks \(Amendment\) Regulations 2004](#)
- [Fireworks \(Scotland\) Regulations 2004](#)
- [Pyrotechnic Articles \(Safety\) Regulations 2015](#)
- [Explosives Act 1875](#)
- [Explosives Regulations 2014](#)

- [Product Safety Amendment and Revocation Regulations 2012](#)
- [Health and Safety at Work etc. Act 1974](#)

Other relevant legislation includes:

- The [Environmental Protection Act 1990](#) and the [Anti-Social Behaviour Act 2003](#) (including legislation to tackle excessive noise from fireworks)
- The [Animal Welfare Act 2006](#) (including legislation to promote the welfare of animals)

### **3.2.2. Manufacture, labelling and supply**

The Pyrotechnic Articles (Safety) Regulations 2015 implement the requirements of the EU Directives with regards to manufacturing, importing, storing and selling fireworks. Fireworks in the UK must:

- satisfy the essential safety requirements;
- have been subject to conformity assessment procedure;
- have had the CE marking affixed to them;
- have been properly labelled and;
- not endanger the health and safety of persons.

### **3.2.3. Sale, possession and use**

The Fireworks Regulations 2004 introduced a package of measures to regulate the sale, possession and use of fireworks in the UK. The Regulations apply to England, Wales and Scotland with the exception of Regulation 7 relating to curfews, which is covered by the Fireworks (Scotland) Regulations 2004.

The regulations created a new system which requires those intending to supply fireworks to the public outside the traditional selling periods to hold a licence. The traditional selling periods are:

- November 5 - (from 15th October to 10 November)
- New Year - (from December 26th to 31st)
- Chinese New Year - (on the first day of the Chinese New Year and the 3 days immediately preceding it)
- Diwali - (on the day of Diwali and the 3 days immediately preceding it)

To sell fireworks outwith these periods, a licence must be obtained from the Local Authority at a cost of £500. The penalty for operating without a licence is an unlimited fine and/or up to six months in prison.

The regulations also prohibit supplying the public with category F3 fireworks whose noise levels exceed 120 decibels (dB), in line with the EU standard. In addition, under the Pyrotechnic Articles (Safety) Regulations 2015, a retailer must not sell:

- a Christmas cracker to anyone under the age of 12 years
- F1 category fireworks to anyone under the age of 16 (higher than the EU requirement of 12 years)
- F2 category fireworks to anyone under the age of 18 (higher than the EU requirement of 16)
- F3 category fireworks to anyone under the age of 18
- F4 category fireworks to members of the public

F4 category fireworks are only available to professional fireworks companies with all year insurance and licenced storage.

Under the 2015 Regulations, retailers are also required to display a notice at the point of sale stating the age restrictions on fireworks.

Certain firework items are also banned in the UK. These include bangers, air bombs and jumping jacks, regardless of whether these are CE marked and approved for sale in other EU countries.

With regards to the possession of fireworks, under the Fireworks Regulations 2004 it is an offence for anyone under the age of 18 to possess category F2, F3 and F4 fireworks in a public place. "Public place" includes any place that the public have or are permitted access to, on payment or otherwise. It is also an offence for anyone other than a firework professional to possess category F4 fireworks. The Police can serve a fixed penalty notice of £80 on anyone under the age of 18 possessing a firework in a public place.

The Fireworks Regulations 2004 also impose a curfew on when fireworks can be let off in England and Wales. Specifically, there is an 11pm curfew on the use of fireworks, with later exceptions for seasonal celebrations, including:

- November 5<sup>th</sup> – midnight curfew
- New Year's Eve – 1am curfew (following day)
- Chinese New Year – 1am curfew (following day)
- Diwali – 1am curfew (following day)

The curfew does not apply to the use of category F1 type fireworks or category F2 sparklers. Local authorities are also permitted to put on displays outside these times for local purposes and for national and commemorative events.

The curfew is enforced by the police, with any breach subject to fines/imprisonment.

In Scotland, under the Fireworks (Scotland) Regulations 2004 fireworks are prohibited from use during night hours (between 23.00 and 07.00). Exceptions to this are as above, plus:

- Local authority employees running local authority firework displays, national public celebrations or national commemorative events

- Other dispensations granted by the local authority

Curfews are enforced by Police Scotland.

In addition, under section 80 of the Explosives Act 1875 (as amended) it is an offence to throw or discharge a firework in a street or public place. This is enforced by the police, and a fixed penalty notice of £80 applies. Fireworks can only be let off on private land (such as a garden) or on land where the landowner has given permission.

### **3.3. Northern Ireland**

#### **3.3.1. Relevant legislation**

During the Troubles, fireworks were completely banned in NI, except for public displays. The ban was lifted in 1996 at the time of the parliamentary ceasefire, but in May 2002 new laws were brought in to limit the misuse of fireworks:

- [Explosives \(Fireworks\) Regulations \(Northern Ireland\) 2002](#) covers the supply, possession, purchase, sale, acquisition, handling and use of fireworks
- [Manufacture and Storage of Explosives Regulations \(Northern Ireland\) 2006](#) covers the manufacture and storage of fireworks

This legislation, along with the [Pyrotechnic Articles \(Safety\) Regulations 2015](#), regulate the sale and use of fireworks in NI.

#### **3.3.2. Manufacture, labelling and supply**

The requirements of manufacturers, importers and distributors of fireworks in NI conform to the EU regulations. The packaging of fireworks must be written in English and have the EU standard CE marking printed on it.

Fireworks and their sale and storage is regulated in NI by the Department of Justice (DOJ). Retailers of fireworks must be registered with the DOJ, and can be fined up to £5,000 and/or imprisoned if they sell fireworks without permission from DOJ or breach conditions of their registration. As well as being registered, retailers of fireworks must display their current licence or certificate of registration.

Retailers must also keep a record of all category F2, F3, or F4 fireworks sold including:

- The name and address of the customer
- The date of each sale and the quantity and type of fireworks sold
- The customer's firework licence number

These records must be retained for at least two years and must be available on demand for inspection by a Constable or representative from an enforcing authority.

Some types of fireworks are illegal in NI, including aerial wheels, bangers, batteries, jumping crackers, spinners, mini rockets and shot tubes.

### **3.3.3. Sale, possession and use**

A valid fireworks licence, issued by DOJ, is required for an individual to buy, possess and use most category F2, F3 and F4 fireworks in NI. It is an offence to buy or have fireworks without one. A licence is not required for category F1 fireworks. In line with EU regulations, the general public must not buy or use category F4 fireworks.

A fee must be paid to the DOJ to obtain the licence, with the amount varying by the number of persons attending the fireworks display. Where the number of persons at the fireworks display will be:

- Fewer than 100, the fee is £30
- 100 or more but fewer than 1000, the fee is £80
- More than 1000, the fee is £160

Licences are only valid for the time stated. The DOJ states that it will not normally issue a licence for use between 23:00 and 07:00, though exceptions are sometimes made for New Years' Eve.

The age limits for who can purchase fireworks are in line with the Pyrotechnic Articles (Safety) Regulations 2015. Shops in NI must display a warning notice with these limits.

Fireworks offences carry a maximum fine of £5,000 or a three month prison sentence, or both.

Fireworks regulations of other EU member states, who deviate from the standard EU regulations with tighter or more lenient controls, are summarised in [Appendix C](#).

## **3.4. The US**

### **3.4.1. Relevant legislation**

Federal laws govern the use of fireworks in the US. These are set out in [title 27 of the Code of Federal Regulations](#). The federal law is a minimum standard only and each state is free to enact more stringent laws, meaning that the laws governing consumer fireworks vary widely across the US. The American Pyrotechnics Association maintains a [directory](#) of state laws pertaining to fireworks. Counties and municipalities may also have stricter laws than their states do.

### **3.4.2. Manufacture, labelling and supply**

The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) enforces the federal explosives laws and regulations in the US. Fireworks are split into two categories: consumer and display fireworks.

Consumer fireworks are any small firework designed to produce visible effects by combustion. These fireworks, unless restricted by state or local laws<sup>1</sup>, can be sold to the general public.

The Consumer Product Safety Commission (CPSC) regulates the manufacture and supply of consumer fireworks. In order to be classified as consumer fireworks, the fireworks must be tested by the CPSC and meet requirements with regard to composition, the quantity of pyrotechnic material, and the stability of the product. Consumer fireworks must have prominent warning labels describing the hazard and function of the firework.

Fireworks that do not meet this certification are classified as display fireworks and require a Federal licence which is granted by the ATF.

### **3.4.3. Sale, possession and use**

Forty-six states plus Washington, D.C. allow consumer fireworks in some form. The following states allow the sale and use of small non-aerial and non-explosive fireworks:

- Arizona
- California
- Colorado
- Connecticut
- Delaware
- Florida
- Hawaii
- Idaho
- Illinois
- Maryland (except for some counties which only allows snap-and-pop noise makers, snakes, and party poppers)
- Minnesota
- New York
- New Jersey
- North Carolina
- Ohio
- Oregon
- Rhode Island
- Virginia
- Wisconsin
- District of Columbia
- Vermont (sparklers only)

The sale of these is sometimes restricted to particular periods, such as around the 4<sup>th</sup> of July. The age limits on these also differ between states (typically between 16-18 years old), and in some cases a permit is required.

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<sup>1</sup> Some states do not allow the use of consumer fireworks or have restrictions on the size, type, or time period in which they may be used.

In the following states, the majority of consumer fireworks are permitted:

- Alabama
- Alaska
- Arkansas
- Georgia
- Hawaii
- Iowa
- Mississippi
- Missouri
- Montana
- Nebraska
- Nevada
- New Hampshire
- New Mexico
- North Dakota
- Oklahoma
- Indiana
- Kansas
- Kentucky
- Louisiana
- Maine
- Michigan<sup>2</sup>
- Pennsylvania
- South Carolina
- South Dakota
- Tennessee
- Texas
- Utah
- Washington
- West Virginia
- Wyoming

Many of these states have selling seasons around the 4th of July and/or Christmas and New Year's Eve; Utah also allows the sale and use of fireworks around Pioneer Day, July 24. However, many of these states also allow local laws or regulations to further restrict the types permitted or the selling seasons.

The only state with a complete ban on consumer fireworks is Massachusetts.

## 3.5. Canada

### 3.5.1. Relevant legislation

The [Explosives Act](#) and the [Explosives Regulations 2013](#) set out the requirements and guidelines for fireworks in Canada.

### 3.5.2. Manufacture, labelling and supply

Fireworks are separated into three classes:

- Consumer fireworks: low-hazard and designed for recreational use (e.g. roman candles, sparklers, fountains)
- Display fireworks: high-hazard and designed for professional use (e.g. aerial shells, cakes, wheels)

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<sup>2</sup> Michigan allows the sale and use of all consumer fireworks, however, sellers must pay a fee (\$600–1000) to sell higher-power consumer

fireworks, and a tax will be added to fireworks purchases.



- Special effect pyrotechnics: high-hazard and designed for professional use (e.g. gerbs, mines, comets)

Fireworks that are illegal in Canada include cherry bombs, snaps, m-80 salutes, flash crackers, torpedoes, cigarette loads, trick matches and sprite bombs.

Fireworks are regulated federally by the Explosives Regulatory Division (ERD). It is legal in Canada to purchase a wide variety of consumer fireworks, but all products must be tested and approved by the ERD.

Under the Explosives Act, fireworks offences are punishable by a fine of up to \$250,000 and/or imprisonment of up to 2 years; or on indictment, to a fine up to \$500,000 and/or imprisonment of up to 5 years.

### **3.5.3. Sale, possession and use**

In Canada, different certificates are required for different fireworks. For display fireworks and special effects pyrotechnics, certification from Natural Resources Canada is required, which involves undertaking safety and awareness courses.

In general, certification from Natural Resources Canada is not required to use consumer fireworks, but regulations regarding the dates when fireworks may be purchased, venues for operating fireworks, and other restrictions are set by the individual provinces and territories. This means that there is variation between provinces and municipalities:

- Alberta: In Calgary, there is a total ban on fireworks. Edmonton allows fireworks, but only upon obtaining a permit first.
- British Columbia: Fireworks can be bought in Vancouver, Burnaby, West Vancouver and North Vancouver, as long as it is within a week of Halloween (and with a permit) and Canada day, but cannot be purchased in Surrey, Richmond, Langley, and Abbotsford, and much of the lower mainland.
- Ontario: Fireworks may be purchased in the two weeks preceding Canada Day and Victoria Day without a permit, and (barring local prohibitions) may be set off on the three days surrounding each holiday without a permit. Some municipalities have allowed fireworks on Diwali.
- Quebec: St. Jean-Baptiste Day is a major fireworks celebration, however the focus is generally on display fireworks as opposed to consumer fireworks. Fireworks are prohibited on the Island of Montreal, though allowed in the rest of the province.
- Atlantic Canada: fireworks are legal and can be used all year round, except on Prince Edward Island.

Under the Explosives Regulations 2013, fireworks cannot be sold to those under 18 years of age.

## 3.6. Australia

### 3.6.1. Relevant legislation

In Australia, the Commonwealth, states and territories are responsible for regulating and enforcing fireworks laws in their jurisdictions.

- New South Wales: the [Explosives Act 2003](#) and [Explosives Regulation 2013](#)
- Queensland: the [Explosives Act 1999](#) and the [Explosives Regulation 2017](#)
- South Australia: [the Explosives Act 1936](#) and the [Explosives \(Fireworks\) Regulations 2016](#)
- Tasmania: the [Explosives Act 2012](#) and the [Explosives \(Fireworks\) Regulations 2018](#)
- Victoria: the [Dangerous Goods Act 1985](#) and the [Dangerous Goods \(Explosives\) Regulations 2011](#)
- Western Australia: the [Dangerous Goods Safety Act 2004](#) and the [Dangerous Goods Safety \(Explosives\) Regulations 2007](#)
- Australian Capital Territory: the [Dangerous Substances Act 2004](#) and the [Dangerous Substances \(Explosives\) Regulation 2004](#)
- Northern Territory: the [Dangerous Goods Act 1998](#) and the [Dangerous Goods Regulations 2012](#)

### 3.6.2. Manufacture, labelling and supply

Despite the different legislation across states and territories in Australia, most outlaw fireworks. Their sale is illegal in every Australian jurisdiction except the Northern Territory and Tasmania.

### 3.6.3. Sale, possession and use

In the Northern Territory, fireworks may only be sold and used on the 1st of July in celebration of Territory Day between 5pm-11pm. Any unused fireworks must be surrendered the following day.

Tasmania allows citizens to apply for a permit to use fireworks in certain circumstances. An application must be submitted at least 21 days in advance of the intended display, and at least seven days' notice must be given to police and fire services, landowners and managers of the site, and any neighbours within 1km. The permit carries restrictions on time, length of use, amount of fireworks and supervision. It also ensures minimum distances from spectators and particular buildings like schools and churches. A licence is required for the storage of fireworks if they are not set off the same day as purchase.

In all other states and territories, only small novelties such as party poppers and sparklers are legal, with a licence required to use any other fireworks. Generally, to obtain a licence, the individual must be a pyrotechnician who is over the age of 18 or 21, and has successfully completed training in the safe use of fireworks.

## 3.7. New Zealand

### 3.7.1. Relevant legislation

Fireworks are regulated by the Hazardous Substances (Fireworks) Regulations 2001, amended in 2007<sup>3</sup>. The [Health and Safety at Work \(Hazardous Substances\) Regulations 2017](#) are also of relevance.

### 3.7.2. Manufacture, labelling and supply

Fireworks have a number of requirements that need to be met before they can be manufactured, imported, stored and sold in New Zealand. An application for the approval of fireworks must be made to the Environmental Protection Authority (EPA), who assess the risks of the firework and determine the controls around it. When the EPA approve the firework, a test certificate is given which confirms the firework meets the requirements of the regulation.

When importing fireworks, an import certificate must be obtained from the EPA for each consignment. A sample of each consignment must also be tested for safety and have a certificate issued by or on behalf of the EPA.

WorkSafe New Zealand is responsible for enforcing the fireworks rules in retail shops, warehouses and other places of work. Councils are responsible for enforcing the sale of fireworks rules when they are sold outside of these places.

### 3.7.3. Sale, possession and use

Fireworks may only be displayed and sold for the four days leading up to and including the 5<sup>th</sup> of November. In order to sell fireworks at other times, retailers must seek written approval from the Ministry for the Environment. This is only granted where the fireworks are to be sold for use at a gathering of people held for cultural or religious purposes, and the use of fireworks is a feature of the cultural or religious traditions of people at the gathering.

Although there are restrictions on when fireworks can be sold in New Zealand, fireworks can be used at any time of year. However, many local councils have laws that stop people from lighting fireworks in public places such as parks.

The 2007 amendments to the Hazardous Substances (Fireworks) Regulations have also decreased the explosive content of fireworks sold by retailers. The types of fireworks available to the public are multi-shot 'cakes', Roman candles, single shot shooters, ground and wall spinners, fountains, cones, sparklers, and novelties, such as smoke bombs and pharaoh's serpents. Further, as of 2007, sparklers cannot be sold individually. 50 sparklers must be purchased at a time in packs with at least three other fireworks. This is to prevent the destructive use of sparklers in the form of 'sparkler bombs'.

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<sup>3</sup> The 2007 amendment was the result of an investigation into the sale and misuse of fireworks called for by the Minister for the Environment in 2004, following increasing numbers of people, animals and property being harmed by fireworks.

Fireworks can only be sold to people aged 18 years and over.

If holding an outdoor pyrotechnic display a compliance certificate is necessary. In addition, a certified handler has to be present and responsible for the safe handling and management of the pyrotechnics.

## 4. Impacts of fireworks

This section reviews the evidence on the impacts of fireworks. It begins by summarising the literature on fireworks related injuries, before turning to environmental impacts and their health effects, and noise and its health effects. Finally, it explores issues related to animal welfare, underage sales and culture.

It is important to note that while this review covers a range of evidence on fireworks, it should not be regarded as a comprehensive or definitive account of the evidence. Rather, it constitutes a collation of relevant material which could be identified and accessed within a relatively short period of time.

As well as the specific issues highlighted in the quality assessment of the evidence available (see [Appendix A](#)), a number of other issues are worth noting from the evidence reviewed. Although the studies were generally robust, there was a distinct lack of evidence based in Scotland and the wider UK, and it is not always clear how findings will apply to the Scottish context. For example, environmental impacts are found to be influenced by a range of factors that vary from one country to the next and so findings from other countries may not apply to Scotland. Further, there was little literature available on some of the more prominent themes in the consultation and omnibus survey commissioned by the Scottish Government (2019a; 2019b), including underage sales and anti-social behaviour.

### 4.1. Injury

#### When are fireworks related injuries occurring?

**The limited evidence available suggests that the number of fireworks related injuries may be remaining stable or increasing over time, rather than decreasing.**

In England, it is unclear how the number of fireworks related injuries has changed over time. The number of fireworks related emergency department attendances in England has increased from 2,141 in 2009/10 to 4,506 in 2014/15 (Macneal et al., 2018). However, analysis of fireworks related injuries referred to one regional tertiary burns and plastic surgery unit in Chelmsford in England, found no increasing or decreasing trend between 2004 and 2014, with between 3 and 10 patients referred for firework related injuries in any given year (Nizamoglu et al., 2018).

The available data in Scotland suggests a similar picture. The number of emergency hospital admissions as a result of fireworks related injuries in Scotland shows no obvious trend from 2001/02 to 2017/18, with between 6 and 15 admissions in any given year (Information Services Division Scotland, 2019). These numbers do not account for instances where patients with injuries resulting from fireworks have attended Accident and Emergency departments without being admitted to hospital, so this figure may be an underestimation. However, data collected between 31st October and 10th November at the Royal Hospital for Children in Glasgow shows that the number of injuries among children resulting

from fireworks and sparklers increased from 3 patients in 2015 to 7 patients in 2018 (Watson et al., 2019).

### **Research consistently finds a spike in fireworks related injuries around festivals.**

Around the world, fireworks related injuries clearly spike around festivals. This has been found for eye injuries internationally (Jeyabal et al., 2019), as well as burns and trauma (Chang et al., 2016, Tadisina et al., 2014) and emergency department admissions in America (Canner et al., 2014). This is also seen in the UK, both with eye injuries (Knox et al., 2008) and burns and plastic surgery referrals (Nizamoglu et al., 2018).

A study from Australia also found that the 34.5% of injuries occurring on a day other than Territory Day were evenly distributed throughout the calendar year, and were more likely to have involved alcohol consumption and to injure the operator as opposed to a bystander (Read et al., 2017).

The studies above suggest that fireworks related injuries could be prevented by regulating the use of fireworks during festival periods, and focusing on alcohol consumption and operator instructions at other times of the year.

### **Where are people most likely to get injured by fireworks?**

#### **Most fireworks related injuries occur at private displays (e.g. in gardens) or in streets and other public places, not at formally organised displays.**

The evidence, although limited, suggests that the majority of fireworks related injuries in the UK occur at private firework displays at homes, and in streets and other public places (Macneal et al., 2018; Khanna, 2003; Knox et al., 2008). As of 2010, there had only been one reported incident of severe eye injury resulting from organised public firework displays in the UK (Pringle et al., 2010, cited in Jeyabal et al., 2019). If Scottish statistics relating to fireworks related injuries from 2010 to 2019 show a similar pattern, this could suggest that a focus on private use of fireworks could target the majority of injuries. Further research would be required to determine whether this is the case.

### **Who is most likely to be injured by fireworks?**

#### **The limited evidence available suggests that both bystanders and operators are at risk.**

Studies from the UK (Knox et al., 2008 and Macneal et al., 2018) and Australia (Janagaraj, 2019) suggest that fireworks related injuries affect both bystanders and operators, however it is unclear which group is more at risk.

There is anecdotal evidence to suggest that operator injuries have the scope to be more serious than bystander injuries (Clark and Watson, 2006 and Tadisina et al., 2014), and that females and children may be more likely to be injured as bystanders (Read et al., 2017), but further research would be required to determine whether this applies in Scotland.

## **Research consistently finds that young people and males are most at risk.**

Studies from America, Australia and international reviews find that males are most likely to suffer fireworks related injuries (Canner et al., 2014; Cao et al., 2018; Chang et al., 2016; Jeyabal et al., 2019; Moore et al., 2014; Read et al., 2017; Sandvall, Jacobsen et al., 2017; and Witsaman et al., 2016), with the largest gender difference amongst young people (Jeyabal et al., 2019; Canner et al., 2014 and Moore et al., 2014).

These studies also find that young people, often defined as those under 18 or aged 5-20 years, sustain most fireworks related injuries (Canner et al., 2014; Cao et al., 2018; Janagaraj, 2019; Jeyabal et al., 2019; Moore et al., 2014; and Witsaman et al., 2016). Other studies of arguably more serious fireworks related injuries have found the mean age of patients to be between 20 and 27 (Chang et al., 2016; Sandvall, Jacobsen et al., 2017; and Tadisina et al., 2014), suggesting that more serious injuries may typically involve young adults as opposed to children.

An increased risk for young people (Ahmad, 2010; Knox et al., 2008; Macneal et al., 2018; and Nizamoglu et al., 2018) and males (Knox et al., 2008 and Nizamoglu et al., 2018) is also found in the UK. According to records from the Royal Hospital for Children in Glasgow, fireworks related injuries affected more males than females, with 14 males compared to 4 females (aged between 2 and 15) injured by fireworks and sparklers between 2015 and 2018 (Watson et al., 2019). This highlights the potential need for awareness and prevention programmes to target young males in particular.

## **What are the most common fireworks related injuries?**

### **Common fireworks related injuries affect hands and heads, and involve burns.**

According to international reviews, the most common fireworks related injuries involve the head and neck region, followed by hands (Jeyabal et al., 2019), with head injuries often damaging eyes (Cao et al., 2018). Studies from the US find the majority of fireworks related injuries affect the head and neck, shoulder and upper arm region, and hands, with the most common type of injury being burns (Moore et al., 2014 and Canner et al., 2014). Burns, hand and eye injuries prevail in Australia too (Read et al., 2017).

Going into more detail, research from the US suggests spectators are more likely to sustain ocular than non-ocular injuries (Chang et al., 2016), and hand injuries most commonly damage the thumb and first web space (Sandvall, Keys et al., 2017).

In the UK, studies suggest that hand injuries are most common, followed by those to the head and neck (Ahmad, 2010; Nizamoglu et al., 2018; and Watson et al., 2019). Burns and impact from the force of blasts were found to cause most of these injuries (Nizamoglu et al., 2018).

## How severe do fireworks related injuries tend to be?

### **Fireworks related injuries often require specialist treatment and surgical intervention.**

In the UK, fireworks related injuries have been found to require referral to burns centres or admission for supportive treatment and specialty management in up to half of cases (Ahmad, 2010). Of those referred to burns centres and specialty management, around a third of patients may require surgery for their wounds (Macneal et al., 2018 and Nizamoglu et al., 2018). In Glasgow, cases have been reported of patients with permanent disfiguration of the hands after fireworks have exploded in them (Clark and Watson, 2006). Similarly, surgery has been found to be required for over half of patients with fireworks related eye injuries in the UK, with over half of patients suffering severe vision loss 6 months after injury (Knox et al., 2008).

This trend persists internationally, with between 16% and 38% of eye injuries resulting in permanent vision loss (Cao et al., 2016; Chang et al., 2016; and Jeyabal et al., 2019). In Australia, fireworks related injuries are more often classified as moderate and severe injuries than mild ones, with almost half of patients requiring hospital admission for further treatment (Janagaraj, 2019). It was also found that children were more likely to require hospital admission for treatment than adults (ibid.). In the Netherlands, there have been cases of patients requiring multidisciplinary treatment and multiple reconstructive surgeries (Molendijk et al., 2016), highlighting the potential severity of fireworks related injuries to the face.

### **Fireworks related injuries can sometimes be fatal.**

Cases of fireworks related deaths have been reported in the US, with some patients dying as a result of severe injuries to the face after being directly involved with fireworks (Tadisina et al., 2014) and another as a result of severe injuries to the heart and liver after trying to light a large, modified firework (Fulcher et al., 2015). Another case study from Italy reports a case of accidental death involving the explosion of more than 1.5 kg of professional fireworks in a private residence (Romolo et al., 2014).

These highlight the serious nature of the injuries that can result from both commercial and professional grade fireworks.

There have also been cases of suicides involving fireworks in the US and Switzerland (Hlavaty et al., 2019 and Zwirner et al., 2017).

## Which types of fireworks are typically involved in injuries?

### **Mortars and rockets cause the majority of serious eye and hand injuries.**

Eye injuries in the US (Chang et al., 2016) and the UK (Knox et al., 2008) are most commonly caused by mortars and rockets, with shells/mortars disproportionately causing permanent eye and hand impairments (Sandvall, Jacobsen et al., 2017). A modified mortar firework has also been responsible for a death in the US (Fulcher et al., 2015).



Rockets have also been found to be responsible for serious eye injury internationally, injuring both operators and bystanders (Jeyabal et al., 2019) and two cases of severe blast injuries to the face in the Netherlands (Molendijk et al., 2016).

**However, sparklers, fountains and firecrackers are also frequent sources of injury.**

Sparklers and fountains/flares can cause minor burns but if igniting clothes could get hot enough to cause third degree burns (Cao et al., 2018 and Jeyabal et al., 2019). In the US, the majority of emergency department admissions are caused by firecrackers, sparklers and novelty devices, as well as aerial devices, with sparkler injuries mostly affecting children under the age of 10 (Moore et al., 2014).

### **How can legislation help to reduce fireworks related injuries?**

**Bans and restrictions reduce the number of fireworks related injuries, but do not completely prevent them.**

In the US, states with legislation banning or restricting the use of fireworks have 7 times fewer fireworks related eye injuries (Jeyabal et al., 2019) and up to 3 times fewer burns and trauma injuries (Epstein et al., 2018). Case studies of severe facial injuries are reported from states both with laws against fireworks and with little restriction (Tadisina et al., 2014), suggesting that while average numbers of injuries may be reduced, serious fireworks injuries can still occur regardless of regulation.

We see similar trends in Europe. In Norway there was a 50% reduction in the number of incidents of fireworks related eye injuries after bottle rockets were banned in 2008 (Jeyabal et al., 2019).

In Northern Ireland, fireworks related eye trauma increased after the ban on fireworks was lifted in 1996, and reduced again when restrictions were reintroduced in 2002 (Chan et al., 2004). In Newcastle in England, it was found in 2008 that no banger-related injuries to children had occurred since legislation was introduced banning banger fireworks in 1996/97 (Edwin et al., 2008), though this situation could have changed since. In addition, after sales were restricted in 2003/04, 83% of children's fireworks related injuries occurred during the period where sales were permitted (ibid.).

**Restrictions or regulations may be most effective if targeting consumer fireworks during festival periods.**

As of 2010, there had only been one reported incidence of severe eye injury resulting from public firework displays in the UK (Pringle et al., 2010 cited in Jeyabal et al., 2019), suggesting that public firework displays pose significantly lower risks to injury and need not be restricted.

The majority of fireworks related injuries in the UK occur in October and November, with half occurring in November alone (Nizamoglu et al., 2018). This coincides with high use and availability of fireworks in the UK, a trend also seen in other countries

including America (Canner et al., 2014; Chang et al., 2016; Jeyabal et al., 2019; and Tadisina et al., 2014) and Australia (Read et al., 2017). This suggests that new restrictions and regulations could be most effective in reducing injuries by targeting fireworks festival periods.

**It has been suggested that introducing graphic warnings on fireworks packaging may reduce the number of fireworks related injuries.**

The British Association of Plastic Reconstructive and Aesthetic Surgeons (BAPRAS) have suggested that introducing graphic warning images on firework packaging, which show the potential injuries caused by misuse, could help to reduce the number of fireworks related injuries in the UK (BAPRAS, 2018). A poll carried out by YouGov found that nearly 70% of parents in the UK would support this use of graphic warnings to warn of the dangers of and deter the misuse of fireworks (ibid.). However, there is no evidence to show how effective this approach may be.

**How else might we reduce the number of injuries?**

**Offering free protective equipment could reduce firework-related eye injuries.**

An international literature review on firework-related eye injuries found that, in Norway, there was a reduction in the number of incidents after protective glasses were offered for free with the purchase of fireworks (Jeyabal et al., 2019). In the UK, it has also been argued that protective glasses could avoid serious ocular injury to those handling fireworks (Knox et al., 2008).

**Awareness campaigns have been found to reduce fireworks related injuries in countries abroad, and could be particularly effective if targeting parents.**

Increased public awareness through campaigning by both government and nongovernment organisations has been shown to reduce the incidence of burns from fireworks around Diwali in India (Puri et al., 2009 cited in Nizamoglu et al., 2018). Some resources and good practice guides already exist in the UK, such as the Explosives Industry Group guides (2018a and 2018b) and the [Fireworks Code](#).

However, it is unclear who these should target. While young people have been found most at risk of fireworks injuries, some evidence suggests adult supervision has no influence on the risk of injury to children (Jeyabal et al., 2019). On the other hand, almost half of the 15-16 year olds planning to get hold of fireworks in Scotland planned to do so by asking their parents to buy them for them (Under Age Sales, 2016). This suggests that targeting parents could help to limit injuries to children by reducing underage sales of fireworks.

## **4.2. Environment**

**How do fireworks contribute to air pollution?**

**Fireworks pollute the air with fine and coarse particulate matter, however the extent of this in Scotland is unclear.**

Fireworks explosions emit gases as well as small particles referred to as particulate matter. This particulate matter is generally classified in terms of size, with particles less than 2.5 µm in diameter classed as 'fine' and those with diameters between 2.5 and 20 µm classed as 'coarse'.

Internationally, the concentrations of both kinds of particulate matter during fireworks festivals are between 0.42 - 5 times higher than background values (Cao et al., 2018 and Seidel and Birnbaum, 2015). However, these increased concentrations seem to last for an average of 6 hours (Cao et al., 2018) and drop off within 16 hours in the US (Seidel and Birnbaum, 2015), suggesting that the environmental impact may not be long term, and be limited to the aftermath of the firework.

No evidence was identified for this review on the extent to which fireworks pollute Scotland's air. However, in the face of insufficient information on the pollution caused by fireworks in Malta, a study used fireworks emission factors and trade information to estimate the total load of coarse dust particles emitted (Camilleri and Vella, 2016). Their data and modelling approach could potentially be used to assess the environmental risk from display fireworks in Scotland, depending of the robustness of the method and replicability within the Scottish context.

### **The particulate matter emitted by fireworks can contain metals and other heavy inorganic elements.**

Internationally, particulate matter sampled during fireworks has been found to contain greater amounts of metals than during the rest of the year, which if sufficiently high can have adverse effects on the environment (Lin, 2016). A study from Hungary also found higher levels of heavy inorganic elements in settled dust after a fireworks display. However, there was more deposited dust on foliage and leaves after the show in general, suggesting that the pollution from fireworks affects inhalable air more than settled dust (Baranyai et al., 2014).

### **Fireworks may also cause fires that pollute the air with carbon emissions, although the extent of this in Scotland is unknown.**

Fireworks cause about 18,000 fires a year in the US, with more fires reported to fire departments on July 4th than any other day of the year (Ellis and McWhirter, 2015). However, states with strict laws restricting fireworks sales have 50 times fewer fireworks related fires than those with no laws (Jeyabal et al., 2019).

### **How do fireworks contribute to water contamination?**

#### **Fine particulate matter can dissolve in water and contaminate various water sources, however there is no evidence of this in the UK.**

Internationally, higher concentrations of ultra-fine particles (with diameters less than 1 µm) that can dissolve in water have been found during and shortly after fireworks displays (Lin, 2016). These particles have the potential to contaminate water sources.

Fireworks are one of the main contributors of one such particle, called perchlorate (Sijimol and Mohan, 2014). Perchlorate contamination affects both groundwater and surface water, particularly in areas surrounding fireworks manufacturing and displays. In Malta, perchlorate contamination is almost entirely caused by fireworks, with this pollution affecting the quality of its limited water resources (Pace and Vella, 2019 and Vella et al., 2015). However, it is important to note that no studies from the UK have identified perchlorate contamination as an issue (Sijimol and Mohan, 2014).

### **How do geological factors mediate the extent of pollution caused by fireworks?**

**Local air pollution, the cultural significance of fireworks and meteorological factors can all influence the impacts of fireworks on the environment.**

For example, although the absolute increase caused by fireworks is higher in India, its higher background concentration from local air pollution means that the *relative* increase for both fine and coarse particulate matter concentration is lower than in Western countries (Lin, 2016).

The influence of cultural connections to fireworks can be seen in Malta, where celebration of religious festivals over the summer months leads to a greater number of fireworks being set off over a longer period of time, which can cause higher particle concentrations (Sijimol and Mohan, 2014). This intense and sustained use of fireworks has led pollution to affect the quality of its limited water resources, in a seemingly unique way that would not apply to the UK (Pace and Vella, 2019).

Further, Malta's urban landscape and small size means that perchlorate pollution may be longer lasting than in other countries as settled dust may be re-suspended and deposited (Vella et al., 2015). A different meteorological factor at play in the Netherlands is stagnant weather, as ultra-fine particles absorb water from the humid weather and increase in size. Their increased size causes them to scatter and absorb more visible light, thus reducing visibility (ten Brink et al., 2018). However, it is unclear whether these factors apply to Scotland, as no evidence was identified for this review which explored the Scottish context.

### **What are the main health risks associated with fireworks emissions?**

**Fireworks emit particulate matter and gases made up of elements that are potentially toxic to human health.**

The effects of inhaling and touching gas and particle pollutants from fireworks are unclear, but may involve short and long term health effects (Cao et al., 2018). Short term health effects may include asthma attacks, coughs, fever and severe asthma, and even pneumonia (Hirai et al., 2000). Longer term health effects may also include respiratory and cardiovascular system diseases, and an increased risk of cancer. Even short term reductions in air quality can cause these kinds of non-cancerous health issues (Lin, 2016), however the size of these effects is unclear.

High build-up of metal elements through both fine and coarse particulate matter in the body can adversely affect human health. According to the World Health

Organisation, the threshold for concern is 50 µg/m<sup>3</sup> for coarse particulate matter (2006). However, there is evidence to suggest that fine and ultrafine particles from fireworks have worse health effects than coarse particles (Lin, 2016). During fireworks events in the UK, concentrations of potentially toxic elements in fine particles are higher at night than during the day (Hamad et al., 2015). This study found that these elements pose non-cancerous risks to both adults and children at night, but only children during the day (ibid.).

Studies specifically looking at the impact of perchlorates, which are emitted during the production and emission of fireworks, have found these particles can disrupt thyroid function. This results in hormonal deficits, which can cause difficulty in processing visual-spatial information, poor sensorimotor coordination, and memory/attention deficits. However, no studies from the UK have identified this as an issue in the literature (Sijimol and Mohan, 2014).

### **How can the environmental impacts of fireworks be minimised?**

**There is some evidence from outwith Scotland to suggest that restricting firework use could benefit the environment by reducing pollution from fireworks emissions as well as secondary fires.**

In the US, more fires are reported to fire departments on July 4th than any other day of the year (Ellis and McWhirter, 2015) and states with strict laws restricting fireworks sales have 50 times fewer fireworks related fires than those with no laws (Jeyabal et al., 2019). Restricting firework use could therefore reduce the number of fires and consequent pollution.

In China, two cities that had banned fireworks were found to have peak pollutant concentrations 4-6 times lower than two that permit the sale and use of fireworks for certain festival periods in 2016 (Cao et al., 2018). The findings from this study suggest that restricting or banning fireworks could also reduce the amount of *direct* pollution caused by fireworks emissions.

However, no evidence was identified for this review that explored these potential impacts in Scotland.

**Switching from micro to nano sized powders, using sulphur-free propellants or applying nitrogen-rich compounds could help to minimise fireworks related pollution.**

While using nano size powders in fireworks could reduce the volume of mixture required to produce a given sound level and therefore reduce pollution, these would be highly flammable and pose health and safety risks in the production and handling of fireworks (Azhagurajan and Selvakumar, 2014).

Alternatively, a sulphur-free propellant has been found to be a suitable replacement for black powder, with low sensitivity and excellent storage performance (Sun et al., 2017).

If such composition changes are not feasible, it has also been suggested that applying nitrogen rich compounds can help to lessen the effects of perchlorate contamination caused by fireworks (Sijimol and Mohan, 2014).

### 4.3. Noise

#### How much noise do fireworks produce?

**Fireworks can raise background noise levels by several dozen dB, with peak sound levels of up to 137 dB.**

The international mean noise level during fireworks has been found to be 90 dB, which is 1.2 times higher than the background value in commercial areas at night (Cao et al., 2018). This background noise level exceeds permissible levels in Spain, India and China (ibid.).

Sound recordings taken in Japan, Poland and Portugal have found similar results, with continuous sound levels as high as 97 dB (Tanaka et al., 2016), and peak sounds of up to 137 dB (Passos et al., 2015), high enough to be harmful to human hearing (Kukulski et al., 2018).

#### What are the main health risks associated with the noise created by fireworks?

**Peak sound levels from fireworks are more harmful than increased background noise levels.**

Exposure to loud, impulsive noise poses a greater risk to human health than exposure to loud, continuous noise (Passos et al., 2015). Young people and pregnant women may be particularly at risk, as the maximum peak sound level limit is set 5 dB lower for these groups (Kukulski et al., 2018). Maximum background sound levels from fireworks can be as high as 95-97 dB for spectators (Tanaka et al., 2016).

The sound levels from fireworks often exceed EU limits for occupational noise (80-85 dB), such as for police officers and sound, lights and fireworks operators (Passos et al., 2015). Peak sound pressure levels recorded in Poland (Kukulski et al., 2018) and Japan (Tanaka et al., 2016) have been found to exceed their respective occupational noise limits. This suggests that the noise from fireworks could be damaging to those working with and around them.

**The loud noise created by fireworks can cause distress to those with noise sensitivity, including Autistic people.**

According to the NHS Information Centre (2012), more than 1 in 100,000 people in the UK are Autistic. A common symptom of Autism is extreme noise sensitivity, which can lead children to develop avoidance reactions, such as leaving noisy places to find quieter ones. This may lead them to miss out on social opportunities at festivals that involve loud fireworks. Additionally, the noise from fireworks may induce panic in Autistic children, leading them to leave their home, get lost, or even suffer a serious accident (Valentinuzzi, 2018).

## **How can the effects of fireworks noise be minimised?**

### **Remote launch platforms could reduce the impacts of fireworks noise on operators.**

If pyrotechnicians could use remote launching devices 20-30 m from the launch site this could reduce the peak sound levels that they are exposed to by approximately 35 dB, keeping them under harmful levels (Tanaka et al., 2016).

## **4.4. Animal welfare**

### **How does the noise from fireworks impact on animal welfare?**

#### **The fear response to noise from fireworks can have adverse impacts on animals, though most research is based on studies with dogs.**

Many animals have an acute sense of hearing, with various types of mammals and birds shown to have broader hearing ranges than humans and to hear noises of frequencies multiple times higher (Carlson, 2004 cited in Hargave, 2015). As a result, sensitivity to the sounds caused by fireworks is common in many types of domestic and wild animal.

Sensitivity to novel, loud or sudden sounds is particularly common in dogs (Levine, 2009), with three quarters of dog owners reporting noise sensitivity of their dog (Iimura, 2006 cited in Blackwell et al., 2013). This means that fear of noise is a commonly reported behavioural problem (Blackwell et al., 2013; Dale et al., 2010, Fatjó and Ruiz-de-la-Torre, 2006, cited in Dale et al., 2010). The unpredictable, intermittent and high-intensity nature of fireworks noise may explain why dogs fear them (Cracknell and Mills, 2008, cited in Blackwell et al., 2013).

Fireworks, along with thunder and gunshots, are one of the noises most feared by dogs (Blackwell et al., 2013; Landsberg et al., 2003 cited in Gates et al., 2019 and Shull-Selcer and Stagg, 1991, cited in Dale et al., 2010), with between 46% and 63% of dog owners recognising this fear of noise in their dogs (Blackwell et al., 2013; Dale et al., 2010; and Gates et al., 2019). However, this could be an underestimation as inexperienced owners may miss signs of fear in their dog (Storengen and Lingaas, 2015).

The behavioural signs of fear and anxiety in response to noise from fireworks in dogs can include trembling, cowering or hiding, soliciting human attention, increased vigilance or startle response, loss of appetite and barking (Blackwell et al., 2013 and Landsberg et al., 2003 cited in Gates et al., 2019). The most chronic stress responses can include vomiting, severe self-injury and accidental trauma (Sheppard and Mills, 2003 and Bowen, 2008, both cited in Gates et al., 2019).

#### **If left untreated, fear of noise from fireworks can lead to phobias in dogs.**

A phobia is a sudden, excessive and profound fear (Storengen and Lingaas, 2015). Phobic symptoms can persist after the feared stimulus is removed, interfering with normal functioning (Palestrini, 2009). Research has shown that dogs commonly develop phobias where fear of noise from fireworks is left untreated (Blackwell et

al., 2013). This means that everyday noises similar to the sound of fireworks can become phobic stimuli, leading dogs to become increasingly resistant, aggressive, and have reduced capacity to engage with their environment (Blackwell et al., 2005 and Estelles et al., 2005 cited in Dale et al., 2010). Noise fears and phobias can therefore present a significant welfare concern for dogs, as well as being distressing for owners (Dreschel and Granger, 2005 and Sherman and Mills, 2008, both cited in Blackwell et al., 2013).

### **Fear of noise from fireworks can vary between dog breeds, as well as with age, sex and other risk factors.**

Generally, pure breeds tend to be more likely to show fear responses to noises than cross-breeds (Blackwell et al., 2013), suggesting that some breeds may be predisposed to fear loud noises. Significant differences in noise sensitivity have been found between breeds of dog, with Norwegian Buhund, Irish Soft Coated Wheaten Terrier and Lagotto Romagnolo breeds most likely to fear noise and Boxer, Chinese Crested and Great Dane dogs least likely to be noise sensitive (Storengen and Lingaas, 2015).

Fear has also been found to be higher in older and female dogs (Storengen and Lingaas, 2015). Other risk factors include traumatic experiences of noise exposure, learning fear from other fearful dogs, and owners responding in a way that reinforces the dog's fear (Landsberg et al., 2003 cited in Gates et al., 2019).

### **Cats and small mammals such as guinea pigs and rabbits are also impacted by the noise from fireworks, but this is underreported.**

Although much of the evidence on the negative impact of the noise of fireworks on animals is based on research with dogs, there is evidence to suggest that cats and other small mammals (e.g. rabbits, rats, ferrets, chinchillas, and guinea pigs) experience adverse effects.

Noise sensitivity is reported less in pets other than dogs (Levine, 2009), however this may be due to how they cope with exposures (Hargrave, 2015). In particular, cats and other small mammals are more likely to run from loud sounds, attempt to escape, exhibit hiding, shivering and cowering behaviours, or freeze (Bolster, 2012; Dale et al., 2010; Gale et al., 2019, and Gates et al., 2019). As a result of these less 'owner-identifiable' fear responses, distress of cats and small mammals is often perceived as less serious by owners (Gale et al., 2019), even going unnoticed (Hargrave, 2015).

Further, given that the first response of cats is typically flight, they have less opportunity for gradual desensitisation compared to dogs, meaning that in some cases cats are more likely to suffer anxiety on repeated exposure (Hargrave, 2015).

### **Fireworks noise also affects horses and birds.**

Horses are considered highly unpredictable flight animals, and are reactive to loud noises and flashing lights (LeGuin et al., 2005, cited in Gronqvist et al., 2016). As such, fireworks have been shown to cause significant stress for horses (Gronqvist



et al., 2016), with between half and four fifths of horse owners reporting that their horse was frightened of or anxious around fireworks (Gates et al., 2019 and Gronqvist et al., 2016). Fear of the sound of fireworks played from a CD can cause higher cortisol (stress hormone) levels in horses than the sound of coat clippers or social isolation (Young et al., 2012).

Fear of fireworks in horses can lead to weaving, decreased appetite, bucking/rearing, hiding, trembling/shivering, sweating and running/escaping behaviours (Gates et al., 2019 and Gronqvist et al., 2016). The most common fear behaviours reported by horse owners are escaping, followed by shivering and hiding (Gates et al., 2019). Running/escaping is a particularly dangerous fear response as it sometimes leads to physical injuries from running into fences or other objects (Gronqvist et al., 2016).

There is also a small body of evidence which indicates that the noise of fireworks can negatively affect birds. A survey of pet owners found that of the 3,370 chickens and aviary birds owned, 9.3% were reported to be frightened of fireworks, with the majority hiding in response, followed by shivering and covering (Gates et al., 2019). Further, research from the Netherlands suggests that wild birds are also disturbed by firework use, flying up to altitudes of several hundred metres for at least 45 minutes after New Year's fireworks were set off (Shamoun-Baranes et al., 2011). As such, while fireworks may not be directly lethal to birds, they could potentially result in mortality due to disorientation, stress, crashing into obstacles, or encountering inclement weather usually avoided once in the air (ibid.).

### **How can the effects of fireworks noise on animals be mitigated?**

**There are short-term and long term measures available to mitigate the impact of noise from fireworks on animals, though preventive approaches are the most successful.**

In the short-term, there are immediate control methods available to help manage fear of noises (Dale et al., 2010). These include keeping animals indoors and ensuring they have access to safe places, such as dens (Bolster, 2012 and Hargrave, 2015). Owners can also close windows, darken rooms, and play background noise such as the television (ibid.). It is also important that owners do not react to their pet's fear with comforting behaviours, as these can increase the severity and duration of fear responses over time in dogs and cats (Dale et al., 2010).

In addition to behavioural measures, animals with extreme fear responses can benefit from the administration of anxiolytic drugs, such as sedatives and benzodiazepines (Seksal and Lindeman 2001, cited in Dale et al., 2010; Mills et al., 2003, cited in Dale et al., 2010). However, it is not advised to use these on a long-term basis (Bolster, 2012).

There are also longer term measures which can be put in place to address noise-related fears. In particular, a system of desensitisation and counter-conditioning can be used to reduce the emotional effect of fireworks (Mills et al., 2003 cited in Dale et al., 2010; Levine et al., 2007; Levine and Mills, 2008, cited in Dale et al., 2010),

which involves gradually exposing the animal to a recording of fireworks at increasing levels, usually in association with some form of reward (Bowen and Heath, 2005, cited in Dale et al., 2010). This procedure typically takes several weeks or months to complete, and therefore requires long-term owner commitment (Cracknell and Mills, 2008, cited in Dale et al., 2010).

Although there are short and long term measures available to mitigate the impact of noise from fireworks on animals, prevention has been shown to be the most effective approach (Hargrave, 2015). In particular, exposing young animals to the noise from fireworks very gradually at a low volume can habituate them to these noises, so that they are less likely to develop fears as they get older (Hargrave, 2015). Indeed, research has shown that animals that have experienced fewer opportunities for socialisation and habituation are predisposed to sound sensitivity (Hunthausen, 2009 and Seksel, 2009). As such, putting effort into early socialisation and habituation can mitigate the behavioural problems associated with noise from fireworks in later life (Hunthausen, 2009 and Seksel, 2009).

**Despite the measures available to treat and manage fear of fireworks in animals, there is evidence that few owners seek professional help for the problem and self-manage the situation.**

Dale et al. (2010) reported that only 16% of owners of dogs that displayed a fearful response to fireworks sought professional treatment, while Blackwell et al. (2013) found that 30% of owners sought help, with most of indicating that their own management was sufficient.

The evidence suggests this is mostly explained by owners thinking that the behaviours are mild enough that they can be managed without help (Blackwell et al., 2013). It is thought that owners may not fully appreciate the implications of failing to prevent, manage and treat sound sensitivities, may not be aware of the treatment options available (ibid.), or may not be willing to dedicate a significant amount of effort to follow available strategies (Talamonti et al., 2015). Owners of cats are less likely to engage in distractive and preventative measures than dog owners, as the less active fear responses of cats are perceived as less severe (Dale et al., 2010).

Blackwell et al. (2013) note the importance of increasing awareness among pet owners that treatment is both available and effective in dealing with fears of loud noises, and directing them towards appropriate sources of help.

### **What other impacts can fireworks have on animal welfare?**

**Ingesting fireworks and injuries from fireworks also present issues for animal welfare.**

Ingesting fireworks can also be extremely dangerous for animals (Gahagan and Wismer, 2012). Most evidence relates to this in dogs, with potential consequences identified including gastroenteritis, vomiting, diarrhoea, lethargy, abdominal pain and salivation, and in more severe cases, oesophageal ulceration, gastrointestinal haemorrhage and cancer (Means, 2016).

A case of a dog ingesting a sparkler highlights the potential for life-threatening toxicosis, as barium poisoning resulted in muscle paralysis, muscle contractions, excess saliva and an irregular heart rhythm (Stanley et al., 2017).

Animals can also be injured by fireworks, either directly or indirectly (Dale et al., 2010). The majority of injuries to cats and dogs appear to occur indirectly through attempts to escape from fireworks (e.g. attempted avoidance of fireworks causing a road traffic accident and injuries from striking doors, windows and fences while attempting to escape), however there is also evidence of direct injury through accidental and deliberate misuse (ibid.). Similar injuries have been found for other pets, in addition to stress exacerbating existing medical conditions and injuries from chewing or scratching objects (Gates et al., 2019). Lacerations, strains/sprains and broken limbs are the most common injuries to horses, many resulting from horses breaking through fences while trying to escape from fireworks (Gronqvist et al., 2016).

## 4.5. Anti-social behaviour

**The most commonly reported fireworks related charges in Scotland are throwing, casting or firing a firework in a public place and underage possession of adult fireworks.**

According to data from the Crown Office and Procurator Fiscal Service (COPFS) (2019), the most common fireworks related charge between 2002/03 and 2018/19 was throwing, casting or firing a firework in a public place (Explosives Act 1875 S80). There were 655 of these charges over this time period, with 284 dealt with through direct measures (e.g. fixed penalty notice) and 217 through summary measures (less serious case heard in front of a Sheriff or Justice of the Peace, without a jury).

According to the same data (ibid.), the second most common fireworks related charge in Scotland between 2002/03 and 2018/19 was possession of an adult firework by a person under 18 years (Firework (Scotland) Regulations 2004 R4(1)). There were 322 of these charges, and most (205) were dealt with through direct measures.

**Most 15-16 year olds in Scotland who plan to obtain fireworks say they will do so by asking their parents to buy them for them.**

A UK-wide survey of 15-16 year olds regarding their attitude to purchasing age restricted products found that one in five (20.20%) respondents said that they would be getting fireworks, with boys slightly more likely to get fireworks than girls (21.75% boys; 18.70% girls). Interestingly, 15/16 year olds in Scotland (13.75%) were significantly less likely to be getting hold of fireworks (Under Age Sales, 2016).

Of those 15/16 year olds that said they would be getting fireworks in Scotland (n=11), 5 said they would ask their parents to buy them and 4 said they would ask an older friend to buy them. 2 said they would buy the fireworks themselves without

using any form of ID and dressing normally. Despite the small sample size, this highlights the need to target parents in awareness campaigns.

## **4.6. Culture**

**Celebrating the 5<sup>th</sup> November and other religious and cultural festivals equally may be key to maintaining a shared sense of identity in our multicultural society.**

Ashcroft (2018) argues that tensions may develop in society when the value of different traditions is questioned, with one deemed more important than the other, especially when there is a political power imbalance behind this. Conversely, the respect and integration of traditions from different cultures can facilitate better social cohesion (Ashcroft, 2018). Therefore, if the use of fireworks is restricted to specific festival dates, then consideration must be given to allowing fireworks for celebrations from all cultures and religions.

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## 6. Appendices

### 6.1. Appendix A: Quality assessment of studies

Table 2: Quality Assessment of Studies

Author(s)	Year	Title	Location	Methods	Theme(s)	Limitations
Ahmad, Z.	2010	Playing with fire and getting burnt—a retrospective analysis of injuries presenting to the emergency department during ‘firework season’	UK	Retrospective study in emergency departments	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Only data from Exeter</li> <li>• Potentially outdated, data from October 2006 to January 2007</li> <li>• Small sample size n=18 so not generalisable</li> <li>• Emergency department records only</li> </ul>
Ashcroft, A.	2018	“Remember, remember the fifth of November” – A time now to be forgot? The psychology and politics of remembering and forgetting, celebrating and commemorating	UK	Journal article	<ul style="list-style-type: none"> <li>• Culture/ cohesion</li> </ul>	<ul style="list-style-type: none"> <li>• Theoretical only – not tested with data</li> </ul>
Azhagurajan, A. and Selvakumar, N.	2014	Impact of nano particles on safety and environment for fireworks chemicals	India	Review	<ul style="list-style-type: none"> <li>• Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Limited studies reviewed</li> <li>• Unclear if applicable to UK</li> </ul>
The British Association of Plastic Reconstructive and Aesthetic Surgeons (BAPRAS)	2018	British public support plastic surgeons’ call for government to introduce graphic warnings on all firework packaging	UK	Press release	<ul style="list-style-type: none"> <li>• Injuries</li> <li>• Regulations</li> </ul>	<ul style="list-style-type: none"> <li>• Quality of YouGov poll unclear</li> <li>• No evidence to suggest approach would be effective</li> </ul>
Baranyai, E., Simon, E., Braun,	2015	The effect of a fireworks event on the amount and elemental	Hungary	Dust samples	<ul style="list-style-type: none"> <li>• Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Data only from urban city Debrecen, Hungary</li> </ul>

M., Tóthmérész, B., Postalstván, J. and Fábíán, I.		concentration of deposited dust collected in the city of Debrecen, Hungary				<ul style="list-style-type: none"> <li>• Potentially outdated and cannot be applied to other years, data only from 2011</li> </ul>
Blackwell, E. J., Bradshaw, J. W. S., Casey, R. A.	2013	Fear responses to noises in domestic dogs: Prevalence, risk factors and co-occurrence with other fear related behaviour	UK	Structured interviews of pet owners	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Reliant on owners' recollections</li> </ul>
Bolster, C.	2014	Fireworks are no fun for pets	UK	Feature article: review of fear of fireworks in animals and treatments	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• No primary data collection</li> </ul>
Camilleri, R., Vella, A.J.	2016	Emission Factors for Aerial Pyrotechnics and Use in Assessing Environmental Impact of Firework Displays: Case Study from Malta	Malta	Measurement of emission factors	<ul style="list-style-type: none"> <li>• Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Theoretical only – not tested with data</li> </ul>
Canner, J. K., Haider, A. H., Selvarajah, S. et al.	2014	US emergency department visits for fireworks injuries, 2006-2010	US	2006-2010 Nationwide Emergency Department Sample	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Data only from US</li> <li>• Potentially outdated, data from 2006 to 2010</li> <li>• Emergency department records only</li> </ul>
Cao, X.Y., Zhang, X.L., Tong, D.Q., Chen, W.W., Zhang, S.C., Zhao, H.M., Xiu, A.J.	2018	Review on physicochemical properties of pollutants released from fireworks: environmental and health effects and prevention	Primarily Asia, also Europe and North America	Systematic international review	<ul style="list-style-type: none"> <li>• Environment</li> <li>• Health</li> <li>• Injury</li> <li>• Noise</li> </ul>	<ul style="list-style-type: none"> <li>• Few studies from Europe so unclear how applicable to UK</li> </ul>
Chan, W.C., Knox, F.A., McGinnity, F.G., Sharkey, J.A.	2004	Serious eye and adnexal injuries from fireworks in Northern Ireland before and after lifting of the firework ban–	Northern Ireland	Analysis of injuries at Department of Ophthalmology in the Royal Victoria Hospital, Belfast	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Data from Belfast only</li> <li>• Outdated, data from 1990 to 2001</li> <li>• Serious eye injuries only</li> </ul>

		an ophthalmology unit's experience.				<ul style="list-style-type: none"> <li>• Small sample size n=23 so not generalisable</li> </ul>
Chang, I.T., Prendes, M.A., Tarbet, K.J., Amadi, A.J., Chang, S., Shaftel, S.S.	2016	Ocular injuries from fireworks: the 11-year experience of a US level I trauma center	US	Review of fireworks injuries	<ul style="list-style-type: none"> <li>• Injuries</li> </ul>	<ul style="list-style-type: none"> <li>• Data only from Washington, US</li> <li>• Potentially outdated, data from 2003 to 2013</li> <li>• Trauma centre admission only</li> <li>• Eye injuries only</li> </ul>
Clark, R.R. and Watson, S.B.	2006	Pollicisation of the index metacarpal based on the first dorsal metacarpal artery	UK	Case study of operations on two fireworks related injuries	<ul style="list-style-type: none"> <li>• Injuries</li> </ul>	<ul style="list-style-type: none"> <li>• Case study so not generalisable</li> </ul>
Crown Office and Procurator Fiscal Service	2019	Fireworks related charges between 2002/03 and 2018/19.	UK	COPFS data provided on request	<ul style="list-style-type: none"> <li>• Anti-social behaviour</li> </ul>	<ul style="list-style-type: none"> <li>• Only captures cases proceeded against, so likely underestimates total incidence rates</li> </ul>
Dale, A. R., Walker, J. K., Farnworth, M. J., Morrissey, S. V. and Waran, N. K.	2010	A survey of owners' perceptions of fear of fireworks in a sample of dogs and cats in New Zealand	New Zealand	Survey of pet owners	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Reliant on owners' recollections</li> <li>• Low response rate</li> <li>• Self-selecting sample so not generalisable</li> <li>• Unclear whether findings applicable to Scotland</li> </ul>
Edwin, A., Cubiso, T., Pape, S.	2008	The impact of recent legislation on paediatric fireworks injuries in the Newcastle upon Tyne region	UK	Longitudinal review of fireworks injuries	<ul style="list-style-type: none"> <li>• Injuries</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Data from Newcastle only</li> <li>• Outdated, data from 1998 to 2008</li> <li>• Children only</li> </ul>
Ellis, L., McWhirter, C.	2015	Firework Sales Skyrocket as More States Lift Bans	US	News article	<ul style="list-style-type: none"> <li>• Environment</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• News article not peer reviewed</li> <li>• Unclear whether applicable to UK</li> </ul>



Epstein, S., Lyons, T.W., Hintza, R., Keys, K.A.	2018	Fireworks Legislation and the Incidence of Severe Fireworks related Injuries in Washington State	US	Institutional fireworks injury database	<ul style="list-style-type: none"> <li>• Injuries</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Potentially outdated, data from 2005 to 2015</li> <li>• Applies only to Washington, US</li> <li>• Level 1 trauma centre injuries only</li> </ul>
Fulcher, J., Luttrell, H., Harvey, W., Ward, M.	2015	Misuse and Modification of Fireworks With Fatal Injury	US	Case study	<ul style="list-style-type: none"> <li>• Injuries</li> </ul>	<ul style="list-style-type: none"> <li>• Case study cannot be generalised</li> </ul>
Gahagan, P. and Wismer, T.	2012	Toxicology of explosives and fireworks in small animals	US	Review of different types of materials/chemicals, clinical signs of toxicosis, and their treatment	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• No primary data collection – review of existing evidence</li> </ul>
Gates, M. C., Zito, S., Walker, J. K. and Dale, A. R.	2019	Owner perceptions and management of the adverse behavioural effects of fireworks on companion animals: an update	New Zealand	Survey	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Reliant on owners' recollections</li> </ul>
Gronqvist, G., Rogers, C. and Gee, R.	2016	The Management of Horses during Fireworks in New Zealand	New Zealand	Survey	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Reliant on owners' recollections</li> </ul>
Hamad, S., Green, D., Heo, J.	2016	Evaluation of health risk associated with fireworks activity at central London	UK	Risk analysis	<ul style="list-style-type: none"> <li>• Environment</li> <li>• Health</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Data from central London only</li> <li>• Potentially outdated, data from 2014 only</li> <li>• No year round data – 16<sup>th</sup> October 16 to 16<sup>th</sup> November only</li> </ul>
Hargrave, C.	2015	Helping companion animals with noise phobia	UK	Review of literature on companion	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• No primary data collection – review of existing evidence</li> </ul>

				animals and noise phobia		<ul style="list-style-type: none"> <li>• No quality assessment of studies used</li> </ul>
Hlavaty, L., Kasper, W., Sung, L.	2019	Suicide by Detonation of Intraoral Firecracker Case Report and Review of the Literature	US	Case study and review of literature	<ul style="list-style-type: none"> <li>• Injuries</li> <li>• Suicide</li> </ul>	<ul style="list-style-type: none"> <li>• Case study cannot be generalised</li> </ul>
Hunthausen, W.	2009	Preventative behavioural medicine for dogs	UK	Book chapter	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• No primary data collection – based on existing evidence</li> </ul>
Information Services Division Scotland	2019	Emergency Hospital Admissions as a result of an Unintentional Injury from Firework (W39), Scotland, 2001/02 to 2016/17	UK	Analysis of FWRI in emergency hospital admissions	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Emergency hospital admissions only</li> <li>• Listing object causing injury not mandatory on system so likely underestimate</li> </ul>
Janagaraj, P.D.	2019	Fireworks related injury in the Northern Territory 2018	Australia	Analysis of FWRI between 30 June and 6 July 2018	<ul style="list-style-type: none"> <li>• Injuries</li> </ul>	<ul style="list-style-type: none"> <li>• Data from Australia only</li> <li>• Applies from 30 June and 6 July 2018 only, not year round</li> </ul>
Jeyabal, P., Davies, L., Rousselot, A. et al.	2019	Fireworks: boon or bane to our eyes'	International	Literature review	<ul style="list-style-type: none"> <li>• Injuries</li> <li>• Environment</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Eye injuries only</li> </ul>
Khanna, T.	2003	Bang goes my quiet night (fireworks)	UK	Review	<ul style="list-style-type: none"> <li>• Injuries</li> <li>• Noise</li> </ul>	<ul style="list-style-type: none"> <li>• Only applies from 2002-2003, outdated</li> </ul>
Knox, F.A., Chan, W.C., Jackson, A.J., Foot, B., Sharkey, J.A. and McGinnity, F.G.	2008	A British Ophthalmological Surveillance Unit study on serious ocular injuries from fireworks in the UK.	UK	Surveillance study of ocular injuries in UK	<ul style="list-style-type: none"> <li>• Injuries</li> </ul>	<ul style="list-style-type: none"> <li>• Only applies to 2004-2006</li> <li>• Eye injuries only</li> </ul>

Kukulski, B., Wszolek, T., Mleczo, D.	2018	The Impact of Fireworks Noise on the Acoustic Climate in Urban Areas	Poland	Assessment of noise during NYE 2016-17	• Noise	<ul style="list-style-type: none"> <li>• Applies only to New Years 2016-2017</li> <li>• Data from Poland only</li> </ul>
Landsberg, G. M. and Denenberg, S.	2009	Behaviour problems in the senior pet	UK	Book chapter	• Animal welfare	<ul style="list-style-type: none"> <li>• No primary data collection – based on existing evidence</li> </ul>
Levine, E.	2009	Sound sensitivities	UK	Book chapter	• Animal welfare	<ul style="list-style-type: none"> <li>• No primary data collection – based on existing evidence</li> </ul>
Levine, E. D., Ramos, D. and Mills, D. S.	2007	A prospective study of two self-help CD based desensitization and counter-conditioning programmes with the use of Dog Appeasing Pheromone for the treatment of firework fears in dogs (Canis familiaris)	UK	Intervention evaluation using owner reports and videos of behaviour	• Animal welfare	<ul style="list-style-type: none"> <li>• Owner reports subject to bias</li> <li>• Significant attrition rate during study</li> </ul>
Lin, C-C.	2016	A review of the impact of fireworks on particulate matter in ambient air	International	Evidence review	<ul style="list-style-type: none"> <li>• Environment</li> <li>• Health</li> </ul>	<ul style="list-style-type: none"> <li>• Unclear how applicable to UK</li> </ul>
Macneal, P., Torres-Grau, J., Atkins, J., Williams, G.	2018	High numbers of firework related injury referrals to the London Burns Service during the recent 'Bonfire night' period, is it time for new regulations?	UK	Analysis of FWRI referred to the London Burns Centre from 14th October to 12th November 2018	• Injuries	<ul style="list-style-type: none"> <li>• Data from London only</li> <li>• Applies only from 14th October to 12th November 2018 only</li> <li>• Burns injuries only</li> </ul>
Means, C.	2016	Illuminating the Toxicity of Fireworks	US	Guide to treating toxic fireworks ingredients in dogs	• Animal welfare	<ul style="list-style-type: none"> <li>• Only covers dogs</li> </ul>
Mills, D., Braem, D. M. and Zulch, H.	2013	Stress and Pheromonotherapy in Small Animal Clinical Behaviour	UK	Book based on authors' research experience	• Animal welfare	<ul style="list-style-type: none"> <li>• No primary data collection – based on existing evidence</li> </ul>

Molendijk, J., Vervloet, B., Wolvius, E.B., and Koudstaal, M.J.	2016	The Big Bang: Facial Trauma Caused by Recreational Fireworks	Netherlands	Case study	<ul style="list-style-type: none"> <li>• Injuries</li> </ul>	<ul style="list-style-type: none"> <li>• Case studies cannot be generalised</li> <li>• Unclear whether applicable to the UK</li> </ul>
Moore, J. X., McGwin G. Jr., Griffin, R. L.	2014	The epidemiology of firework-related injuries in the United States: 2000–2010	US	Analysis of nat. rep. sample of FWRI	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Potentially outdated, data from 2000 to 2010</li> <li>• Data from US only</li> <li>• Emergency department injuries only</li> </ul>
Nizamoglu M, Frew Q, Tan A, Band H, Band B, Barnes D, et al.	2018	The Ten-Year Experience of Firework Injuries Treated at a UK Regional Burns & Plastic Surgery Unit	UK	Review of patients attending burns and plastic surgery unit	<ul style="list-style-type: none"> <li>• Injury</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Data from Chelmsford only</li> <li>• Potentially outdated, data from 2004 to 2014</li> <li>• Cases referred to burns unit only</li> </ul>
Pace, C. and Vella, A. J.	2019	Contamination of water resources of a small island state by fireworks-derived perchlorate: A case study from Malta	Malta	Water samples	<ul style="list-style-type: none"> <li>• Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Case study cannot be generalised</li> </ul>
Palestrini, C.	2009	Situational sensitivities. In Canine and Feline Behavioural Medicine.	UK	Book chapter	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• No primary data collection – based on existing evidence</li> </ul>
Passos, R. S., Carvalho, A. P. O. and Rocha, C. A. A. C.	2015	Exposure to firework noise in festivals	Portugal	Noise measurements at 5 events and survey	<ul style="list-style-type: none"> <li>• Noise</li> <li>• Health</li> </ul>	<ul style="list-style-type: none"> <li>• Data from Portugal only</li> <li>• May not apply to years other than 2015</li> <li>• Survey not representative</li> </ul>
Pringle E, Eckstein MB, Casswell AG, Hughes EH.	2012	New firework caused severe eye injuries at a public display	UK	Case study	<ul style="list-style-type: none"> <li>• Injury</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Case study cannot be generalised</li> </ul>

Read, D. J., Bradbury, R. and Yeboah, E.	2017	Firework-related injury in the Top End: a 16-year review	Australia	Audit of admitted patients with injury from fireworks	<ul style="list-style-type: none"> <li>• Injuries</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• May be outdated, data from 2000 to 2015</li> <li>• Data from Australia's Northern Territory only</li> </ul>
Romolo, F., Aromatario, M., Bottoni, E. et al.	2014	Accidental death involving professional fireworks	Italy	Case study	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Case studies cannot be generalised</li> </ul>
Sandvall, B., Jacobson, L., Miller, E et al.	2017	Fireworks type, injury pattern, and permanent impairment following severe fireworks related injuries	US	Retrospective case series of patients with fireworks related injuries	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Potentially outdated, data from 2005 to 2015</li> <li>• Level 1 trauma centre injuries only</li> <li>• Data from Washington, US only</li> <li>• Severe injuries only</li> </ul>
Sandvall, B., Keys, K. A., Friedrich, J. B.	2017	Severe Hand Injuries From Fireworks: Injury Patterns, Outcomes and Fireworks Types	US	Retrospective cohort study	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Potentially outdated, data from 2005 to 2015</li> <li>• Data from Washington, US only</li> <li>• Severe hand injuries only</li> </ul>
Seidel, D.J., Birnbaum, A.N.	2015	Effects of Independence Day fireworks on atmospheric concentrations of fine particulate matter in the United States	US	Atmospheric measurements around July 4 <sup>th</sup> from 315 sites across US	<ul style="list-style-type: none"> <li>• Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Data from US only</li> <li>• Potentially outdated, data from 1999 to 2013</li> </ul>
Seksel, K.	2009	Preventative behavioural medicine for cats	UK	Book chapter	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• No primary data collection – based on existing evidence</li> </ul>
Shamoun- Baranes, J., Dokter, A. M., Gasteren, H., Loon, E. E.,	2011	Birds flee en mass from New Year's Eve fireworks	Netherlands	Operational weather radar	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Data from Netherlands only</li> <li>• Potentially outdated, data from 2008</li> </ul>

Leijnse, H. and Bouten, W.						
Sijimol, M. R. and Mohan, M.	2014	Environmental impacts of perchlorate with special reference to fireworks—a review	International	Review	<ul style="list-style-type: none"> <li>• Environment</li> <li>• Health</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• No studies from the UK found for review so unclear how applicable</li> </ul>
Stanley, M. K., Kelers, K., Boller, E. and Boller, M.	2019	Acute barium poisoning in a dog after ingestion of handheld fireworks (party sparklers)	Australia	Case study	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Case study findings not generalisable</li> </ul>
Storengen, L. M. and Lingaas, F.	2015	Noise sensitivity in 17 dog breeds: Prevalence, breed risk and correlation with fear in other situations	Norway	Survey	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Data only from Norway</li> </ul>
Sun, Y., Han, Z., Du, Z., Li, Z., Cong, X.	2017	Preparation and performance of environmental friendly Sulphur-Free propellant for fireworks	China	Laboratory testing of new firework propellant	<ul style="list-style-type: none"> <li>• Environment</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Not tested in realistic UK conditions so unclear how viable</li> </ul>
Tadisina, K.K., Abcarian, A., and Omi, E.	2014	Facial Firework Injury: A Case Series	US	Case series	<ul style="list-style-type: none"> <li>• Injury</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Case series not generalisable</li> </ul>
Talamonti, Z., Cassis, C., Brambilla, P. G., Scarpa, P., Stefanello, D., Cannas, S., Minero, M. and Palestrini, C.	2015	Preliminary study of pet owner adherence in behaviour, cardiology, urology and oncology fields	Italy	Survey	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Questionnaires subject to response/desirability bias</li> <li>• Convenience sampling subject to sampling bias</li> </ul>
Tanaka, T., Inaba, R., Aoyama, A.	2016	Noise and low-frequency sound levels due to aerial fireworks and prediction of the occupational exposure of pyrotechnicians to noise	Japan	Sound measurements 100m from the launch site of a firework display	<ul style="list-style-type: none"> <li>• Noise</li> <li>• Health</li> <li>• Impact of legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Data from one city in Japan only</li> <li>• Potentially outdated, data from 2013</li> </ul>

ten Brink H, Otjes R, Weijers E, Henzing B.	2018	Visibility in the Netherlands during New Year's fireworks: The role of soot and salty aerosol products	Netherlands	Integrating Nephelometer to measure light-scattering	<ul style="list-style-type: none"> <li>• Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Unclear if applies to UK and its weather conditions</li> </ul>
The NHS Information Centre, Community and Mental Health Team, Brugha, T. et al.	2012	Estimating the prevalence of autism spectrum conditions in adults: extending the 2007 Adult Psychiatric Morbidity Survey.	UK	Analysis of survey results	<ul style="list-style-type: none"> <li>• Noise</li> <li>• Health</li> </ul>	<ul style="list-style-type: none"> <li>• Potentially outdated, data from 2007</li> <li>• Unclear if UK rate applies to Scotland</li> </ul>
Under Age Sales	2016	An analysis of intended firework purchasing by young people celebrating Bonfire Night in 2016	UK	Survey	<ul style="list-style-type: none"> <li>• Underage sales</li> </ul>	<ul style="list-style-type: none"> <li>• Small Scottish sample of young people intending to buy fireworks n=11</li> <li>• Only applies to 2016</li> </ul>
Valentinuzzi, M. E.	2018	Fireworks, Autism, and Animals What "fun" noises do to sensitive humans and our beloved pets	Unclear	Journal article	<ul style="list-style-type: none"> <li>• Noise</li> <li>• Health</li> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Limited review of other studies</li> <li>• No empirical evidence to support theory</li> </ul>
Vella, A.J., Chircop, C., Micallef, T. and Pace, C.	2015	Perchlorate in dust fall and indoor dust in Malta: An effect of fireworks	Malta	Dust samples analysed	<ul style="list-style-type: none"> <li>• Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Data from Malta only</li> <li>• Unclear to what extent applies to other urban areas</li> </ul>
Watson, S., Dobby, J. and Ramsay, S.	2019	Incidence of Firework Related Injuries at Royal Hospital Children for Glasgow	UK	Analysis of firework related injuries from 2015-2018	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Children's injuries only</li> <li>• Glasgow only</li> <li>• Small sample size n=30</li> </ul>
Witsaman, R.J., Comstock, R.D., Smith, G.A.	2018	Pediatric fireworks related injuries in the United States: 1990–2003.	US	Analysis of fireworks related injuries	<ul style="list-style-type: none"> <li>• Injury</li> </ul>	<ul style="list-style-type: none"> <li>• Data from US only</li> <li>• Outdated, data from 1990 to 2003</li> <li>• Children's injuries only</li> </ul>
Young, T., Creighton, E.,	2012	A novel scale of behavioural indicators of stress for use with domestic horses	UK	Testing of new scale for behavioural	<ul style="list-style-type: none"> <li>• Animal welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Stereotypical behaviours may confound self-</li> </ul>

Smith, T. and Hosie, C.				scores to assess stress in horses		soothing with lack of stress
Zwirner J, Bayer R, Japes A, Eplinius F, Dressler J, Ondruschka B.	2017	Suicide by the intraoral blast of firecrackers - experimental simulation using a skull simulant model	Switzerland	Case study and simulation	<ul style="list-style-type: none"> <li>• Injury</li> <li>• Suicide</li> </ul>	<ul style="list-style-type: none"> <li>• Case studies cannot be generalised</li> </ul>



## 6.2. Appendix B: Methods

To conduct this review, a systematic process of search and assessment was followed, involving four broad stages:

1. Evidence search
2. Application of inclusion and exclusion criteria for assessing relevance
3. Quality assessment of studies
4. Synthesis of the body of evidence

The details of stages 1-3 are described below. The synthesis of evidence is presented in [Section 4](#).

### 6.2.1. Search

In the first instance, the search for studies was carried out by the Scottish Government Library Service using KandE. KandE is an online search engine which covers a range of high quality databases, which are detailed below.

**Table 3: List of databases searched**

Search Engines
Academic Search Ultimate (asn)
AGRIS (edsagr)
Australian Research Data Commons (edsard)
BioOne Complete (edsbio)
Bloomsbury Collections (edsblc)
British Standards Online (edsbsi)
Business Source Index (bsx)
Cochrane Database of Systematic Reviews (edschh)
Credo Reference (edscrc)
Credo Reference: Academic Core (edscra)
Criminal Justice Abstracts with Full Text (i3h)
DigitalNZ (edsdnz)
Emerald Insight (edsemr)
ERIC (eric)
FT.com (edsfit)
GreenFILE (8gh)

Military & Government Collection (mth)
New Palgrave Dictionary of Economics Online (edsdeo)
Oxfam Policy & Practice (edsoxf)
Oxford Bibliographies (edsobb)
Oxford Dictionary of National Biography (edsodb)
Oxford Reference (edsoro)
Oxford's Who's Who & Who Was Who (edsoww)
Political Science Complete (poh)
Public Information Online (edspio)
RePEc (edsrep)
SAGE Knowledge (edsskl)
SAGE Research Methods (edsrem)
ScienceDirect (edselp)
Sociology Source Ultimate (sxi)
<b>Journals</b>
Directory of Open Access Journals (edsdoj)
JSTOR Journals (edsjsr)
<b>Books</b>
Books at JSTOR (edsjbk)
eBook Collection (EBSCOhost) (nlebk)
<b>Library Services</b>
Biodiversity Heritage Library (edsbhl)
British Library Document Supply Centre Inside Serials & Conference Proceedings (edsbl)
British Library EThOS (edsble)
Canadian Electronic Library (edscl)
E-LIS (Eprints in Library & Information Science) (edseli)
Library, Information Science & Technology Abstracts (lxh)
<b>Archives</b>
Archive of European Integration (edsupe)

This search was informed by a range of key words and phrases, including ‘fireworks’ combined with:

- Sale
- Licencing
- Impact
- Use / misuse
- Anti-social behaviour
- Crime
- Noise
- Air quality / environmental
- Animal welfare
- Regulations / Legislation

To ensure the evidence identified was up-to-date and relevant, the specified time coverage for the search was from 2009-2019. The geographical coverage included the UK, Europe, North America, Canada, Australia and New Zealand. These countries were selected because they are comparable to Scotland in terms of culture, attitudes to health and safety and air quality.

A series of broader searches were then conducted using Google and Google Scholar, as a sweep of studies that may not have been found in the initial search. In addition, a snowballing technique was employed whereby the references of studies were reviewed for additional evidence.

### 6.2.2. Inclusion and exclusion criteria

Using the initial search results, the relevance of the studies was assessed. The table below provides a summary of the inclusion and exclusion criteria applied to the selection of the studies.

**Table 4: Inclusion and exclusion criteria**

	<b>Inclusion criteria</b>	<b>Exclusion criteria</b>
<b>Study design</b>	Primary empirical research (qualitative or quantitative), evaluation or secondary reviews	Primarily theoretical or conceptual in nature, lacking empirical evidence or explanation of methodology
<b>Language</b>	Written or available in English	Not written or available in English
<b>Country</b>	UK, Europe, North America, Australia and New Zealand, International	Asia <sup>4</sup> , Africa, South America

<sup>4</sup> While the majority of studies from Asia were out of scope, 3 such studies were included as they proposed ways of minimising the impacts of fireworks, which could be implemented in Scotland.

<b>Publication date</b>	From 2009 to 2019	Pre-2009 <sup>5</sup>
<b>Publication format</b>	Journal articles, peer-reviewed materials, working papers, evaluation, government reports, discussion papers, books and book chapters, other academic research	Student paper, dissertation, conference paper, news articles without clear indication of source
<b>Aim of study</b>	Studies exploring key issues around fireworks, including misuse/ASB, injury, noise, pollution, impact on vulnerable groups, animal welfare	Studies exploring other issues relating to fireworks, e.g. technical elements

Applying these criteria led to an evidence base comprising a wide range of sources, including academic journal articles, government reports, surveys, case studies, laboratory experiments, evaluations, evidence reviews, interviews and books.

25 of these studies were based in the UK; 14 in the US; 14 in European countries including Northern Ireland, Hungary, Italy, Malta, Netherlands, Norway, Poland, Portugal and Switzerland; 6 in Australia and New Zealand; 4 internationally and 3 from Asian countries including China, India and Japan. For one study identified, the country of origin was unclear.

### 6.2.3. Quality assessment

Each of the studies identified was then quality assessed. This involved identifying the key characteristics of the studies and their limitations, which are summarised in Appendix A.

The body of evidence identified in this report consists of 67 studies, many of which used high quality methods. In particular, 28 used quantitative methods such as surveys or analysis of injuries data, including 5 which used nationally representative data. There were also 10 studies based on case studies and/or qualitative methods such as interviews, providing a more in-depth insight into fireworks use.

However, as well as the limitations highlighted in Appendix A, the evidence base suffered from other shortcomings. In particular, there was a distinct lack of evidence based in Scotland or even the wider UK, and it is unclear how findings will apply to the Scottish context. For example, environmental impacts are found to be influenced by a range of factors that vary from one country to the next and so findings from other countries may not apply to Scotland. Further, there was a lack of literature on several themes present in the consultation and omnibus survey, including underage sales and anti-social behaviour.

<sup>5</sup> While the majority of studies identified for this review were conducted in this timeframe, in some cases, older studies cited within more recent research were also included.

### 6.3. Appendix C: Summary of firework regulations in other EU countries

Relevant legislation	Manufacture, labelling and supply	Sale, possession and use
<b>Republic of Ireland</b>		
<ul style="list-style-type: none"> <li>Explosives Act 1875</li> <li>Criminal Justice Act 2006</li> </ul>	<ul style="list-style-type: none"> <li>The Republic of Ireland does not have any fireworks manufacturers, but fireworks imported and distributed must meet EU standards</li> </ul>	<ul style="list-style-type: none"> <li>Category F1 fireworks are available for public sale, possession and use. These can only be sold to those aged 12+</li> <li>Category F2-F4 fireworks are illegal and can be used only by pyrotechnicians for public displays, who hold a licence from the Department of Justice</li> <li>It is an offence to light an unlicensed firework, throw a firework at a person or property or have an unlicensed firework</li> <li>Firework related offences carry fine of up to €2,500 or imprisonment for six months, or both</li> <li>Offences which go to the Circuit Court have a fine of €10,000 and 5 years imprisonment, or both</li> <li>The Gardaí have wide powers to investigate firework offences</li> </ul>
<b>Germany</b>		
<ul style="list-style-type: none"> <li>German Explosives Act (Sprengstoffgesetz) (1978)</li> </ul>	<ul style="list-style-type: none"> <li>Fireworks manufactured, imported and distributed in Germany must meet the EU standards</li> <li>All fireworks in Germany have to be approved by the Federal Institute for Materials Research and Testing (BAM)</li> <li>As well as displaying the EU CE approval mark, fireworks are given an official authorisation mark (BAM number)</li> <li>Fireworks that have not been tested or authorised are illegal</li> </ul>	<ul style="list-style-type: none"> <li>F1 fireworks may be used throughout the year by those aged 12+</li> <li>F2 fireworks can only be sold during the last 3 days of the year and used on the 31<sup>st</sup> of December and 1<sup>st</sup> of January by those aged 18+</li> <li>Each municipality is authorised to limit the hours this lasts locally; many impose tighter conditions</li> <li>Fireworks are forbidden in the vicinity of churches, hospitals, children's homes, retirement homes and wooden or thatch roofed buildings</li> <li>Offences carry a fine of up to €50,000 or three years in prison, or both</li> <li>F3 and F4 fireworks may be bought and used only by professionals with a licence</li> </ul>
<b>Belgium</b>		

- Royal Order concerning the supply of pyrotechnic articles (2015)
- Decree on Local Government
- Fireworks manufactured, imported and distributed in Belgium must meet the EU standards
- Since July 2017 the sale of both F3 and F4 fireworks to non-professionals is a criminal offence in Belgium
- The age limits for the sale of F1 and F2 fireworks are in line with the EU regulations

## Finland

- Act on the safe handling of dangerous chemicals and explosives
- Government decree on the control of handling and storage of dangerous chemicals
- Government decree on the safety requirements of manufacturing, handling and storage of explosives
- Fireworks manufactured, imported and distributed in Finland must meet the EU standards
- The storage and sale of fireworks in premises requires a decision from local rescue authorities, which must be given a month in advance
- Fireworks can only be used by those aged 18+
- All fireworks users must wear safety glasses
- Local rescue authorities must be notified about the use of fireworks at least five days before the event
- The rescue authorities may prohibit the use of fireworks, or set the user some terms and restrictions necessary to their safety
- Fireworks can be used without a notification sent to the rescue authorities between 6pm on New Year's Eve, December 31, and 2am on January 1
- Several municipalities in Finland have prohibited the use of fireworks or made them off limits in the city centre

## The Netherlands

- Vuurwerkbesluit ('Fireworks Decree')
- The Netherlands used to host several fireworks manufacturers, but in the late 1990s almost all production of fireworks was moved abroad
- The Netherlands Organisation for Applied Scientific Research (TNO) is responsible for safety testing of fireworks in the Netherlands
- Retailers are not allowed to sell more than 25 kilos of fireworks per delivery, and not allowed to store more than 500 kilo of fireworks in their showroom
- Category F1 fireworks are on sale and usable throughout the year by those aged 12+
- Category F2 and F3 fireworks are on sale the last three days of the year from licenced retailers, and only to be used from 6pm on 31st of December until 2am on 1st of January. Using fireworks outside these hours is punishable by confiscation and a fine of 100 euros
- Category F4 fireworks are for professional use only. A general business permit is required to use these which is issued by regional Environmental Agencies
- Permission is required to set off professional fireworks, which is granted by the provincial authority. The province has set requirements with regard to extinguishing agents, safety distances, packages and transport

		<ul style="list-style-type: none"> <li>• Fireworks are forbidden near shopping centres, nursing homes, animal shelters and historic buildings and monuments</li> </ul>
<b>Sweden</b>		
<ul style="list-style-type: none"> <li>• The Swedish Public Order Act</li> </ul>	<ul style="list-style-type: none"> <li>• The governing body responsible for issuing 154-Licences and testing of pyrotechnic products is MSB. This organisation tests that all pyrotechnic products conform to environmental and safety regulations</li> <li>• MSB also has the jurisdiction to oversee storage and sales of fireworks, to ensure compliance with local laws</li> </ul>	<ul style="list-style-type: none"> <li>• Most municipalities have their own rules for how and where fireworks may be used</li> <li>• Firecrackers were banned in Sweden in 2002</li> <li>• Heavier rockets were banned in Sweden in 2014</li> <li>• From June 2019, skyrockets need to be launched with 'control sticks' and anyone buying and lighting skyrockets must complete a special training course set up by the municipalities to obtain a permit; retailers may only sell skyrockets to permit holders</li> </ul>
<b>Czech Republic</b>		
<ul style="list-style-type: none"> <li>• The Act on Pyrotechnics (2015)</li> </ul>	<ul style="list-style-type: none"> <li>• The Act on Pyrotechnics incorporated the EU legislation on fireworks with regards to manufacturing, labelling and supply, and streamlined existing legislation on fireworks in the Czech Republic</li> <li>• Traders or professionals may only sell fireworks that have been certified as compliant, are marked in accordance with the requirements of the Act on Pyrotechnics, are in the original packaging and have not expired</li> <li>• If those with a trade licence do not meet the requirements of the Act they can face a fine of up to 5 000 000 CZK</li> </ul>	<ul style="list-style-type: none"> <li>• F1 fireworks are available to individuals aged 15+</li> <li>• F2 fireworks are available to those aged 18+</li> <li>• F3 fireworks are available to those aged 21+, or those aged 18+ who hold a certificate of professional competence</li> <li>• To obtain this certificate, individuals must have a secondary school diploma, be legally competent, have a clean criminal record, be medically fit, and undergo specialised training courses</li> <li>• F4 fireworks are available to professionals only</li> <li>• Firework displays must be reported to the relevant municipal authority or Regional Fire Brigade at least 2 days before</li> <li>• Firework displays must be conducted by a trader or professionally qualified person. If rules for holding a firework display are not followed, individuals can be fined up to 500 000 CZK</li> </ul>
<b>Spain</b>		
<ul style="list-style-type: none"> <li>• The Regulation on Pyrotechnic Articles and Ammunition</li> </ul>	<ul style="list-style-type: none"> <li>• The 'Regulation on Pyrotechnic Articles and Ammunition' incorporated the EU directives the Spanish legal system</li> <li>• A catalogue of available fireworks is held by the Spanish Ministry of Industry, Energy and Tourism (MINCOTUR), including data on the traceability of fireworks</li> </ul>	<ul style="list-style-type: none"> <li>• Age limits on the sale and use of fireworks are in line with the EU regulations. However, given the use of fireworks for traditional celebrations and cultural and religious festivities in Spain, some powers are granted to autonomous regions in Spain relating to public shows and the 'promotion of culture'</li> <li>• Specifically, the autonomous regions may lower the minimum age for the use of fireworks in Categories F1 and F2 for those</li> </ul>

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- MINCOTUR publishes the catalogue of fireworks online, as a public register of fireworks
  - To sell fireworks in Spain, retailers must have an authorised establishment or obtain specific authorisation from the relevant Government Delegation, having first obtained a report from the Industry and Energy Department and the Arms and Explosives Division (IAE) of the corresponding Civil Guard Command
- classified fireworks 'intended for use as part of well-established customs', to 8 and 10 years respectively
  - Users in these age ranges must be trained on the fireworks, be under supervision of an adult, and have written authorisation from a parent/guardian
  - Misuse of fireworks can lead to a fine, with the amount dependent on whether the infringement is classed as minor, serious or very serious
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