

# The Changing Nature of Fire-Fighting Foams

Understanding the risk posed by PFAS



GUIDANCE  
BOOKLET

## Introduction

Fires present risk to life and damage to property and the control of fires is typically achieved through the use of an extinguishing agent to remove heat or oxygen, or both, from the fire triangle: fuel, heat, oxygen. Water is the most commonly used agent, but other materials which “smother” the fire are also employed (e.g. inerting gases or the application of foam).

Foam, often referred to as “AFFF” (Aqueous Film-Forming Foam), is used where water alone or inerting gases are unsuitable and has been favoured for use with Class B flammable liquid fires.

AFFF forms a stable barrier on top of the fire, restricting the vaporisation of flammable materials and access to oxygen in the air. In order to prevent the foam breaking down, additives are introduced to change its behaviour, so that:

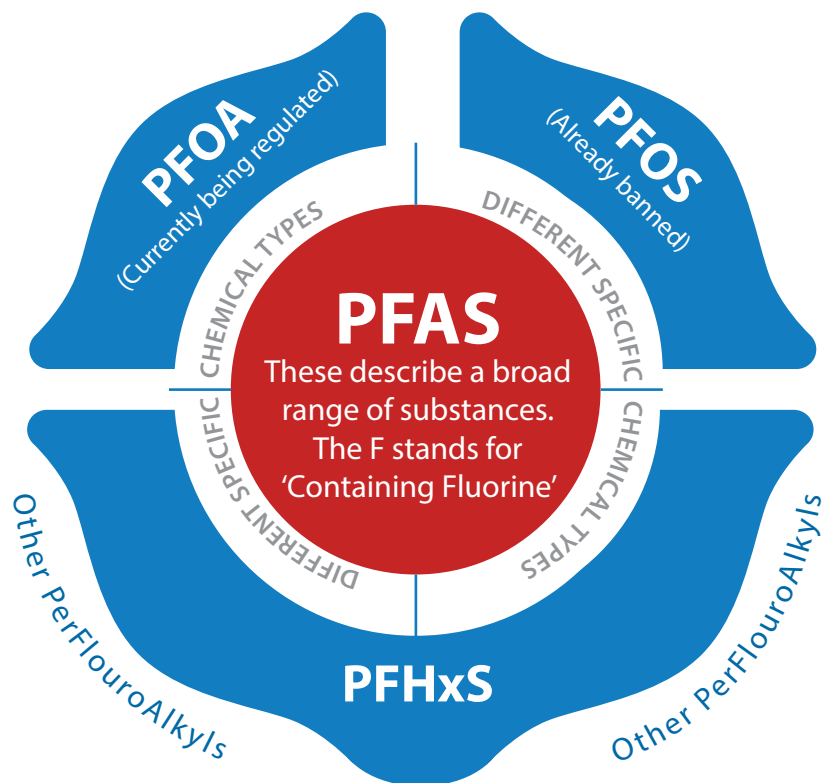
- the bubbles in the foam can be stretched without breaking,
- the foam can resist breakdown under fire conditions,
- the foam is prevented from dissolving in particular chemicals,
- the fuel being contained doesn't get into the foam bubbles.

**As well as the immediate, local damage, longer range impacts can arise from the plume emitted to the air and the run-off of liquids involved in the fire and of the extinguishing agent itself. A comprehensive risk assessment of your fire hazard management plan will consider the longer-term impacts as well as the immediate aspects of fighting a fire.**

## What are AFFF additives?

The additives in foam are surface-active agents, or “surfactants”. Many of those used for AFFF are substances called “PFAS”, Per- and PolyFluoroAlkylated Substances. These chemicals consist of a range of different fluorine containing molecules (often called organofluorine compounds), with the “F” in the PFAS abbreviation referring to fluorine. Thousands of these substances have been developed since the 1950's and are used for a multitude of functions such as stain-resistant or waterproofing agents, in upholstery and carpets, non-stick coatings, as additives in lubricating oil and as additives in AFFF.

AFFF has commonly contained PFAS, in particular in the past “PFOS” (PerFluoroOctane Sulphonic acid) and latterly “PFOA” (PerFluoroOctanoic Acid). Variations on these and other PFAS may be used in AFFF. While still used extensively, due to their serious environmental impact, alternatives to PFAS have been developed, tested and marketed in recent years.



### What's the problem with PFAS?

Many PFAS (e.g. PFOS and PFOA) are proven to have harmful impacts on the environment and human health, others are suspected of posing risks and nothing is known about many others - though it is presumed that their behaviour is similar. One of the main concerns regarding PFAS is that they are "persistent", meaning they break down very slowly, if at all, in the environment. Many PFAS dissolve in water, meaning they can be transferred by surface water, i.e. streams and rivers, and groundwater, and can end up in drinking water supplies. As they are not broken down by wastewater treatment plants, discharge to sewer is not an effective treatment method, with them ultimately accumulating in our natural environment. They are both bioavailable and bioaccumulative, meaning that living organisms (including humans) can absorb them and once absorbed, they can increase in concentration in the body. It can take days or, for some PFAS, years before they are excreted from the body and they are known to interfere with the hormonal system, affect the immune system, impact the reproductive system, and are possibly carcinogenic. The more they are studied, the more negative impacts are discovered.

### Are these additives biodegradable?

The longer chain molecules in some PFAS may degrade and break-down into smaller molecules, but then the degradation slows greatly or, for practical purposes, stops. The carbon to fluorine bonds in the molecule are highly stable and the smaller molecules may be more harmful than the bigger molecules from which they originated. Consequently, PFAS are described as "persistent", and often called "forever chemicals" for good reason.

### What is being done about this?

Some of these substances have been classified as "POPs", Persistent Organic Pollutants, and these are now regulated to avoid or minimise their use. In May 2009, the international Stockholm Convention on POPs severely restricted the use of PFOS and related chemicals and extended these restrictions to PFOA and its related substances in May 2019. The EU implements the Convention through Regulation (EU) 2019/1021, known as the POPs Regulation, which applies to PFOS and its family, and was extended to PFOA and its family by Regulation (EU) 2020/784. The EPA is responsible for implementing these regulations.

The 2020 EU Chemicals Strategy for Sustainability: Towards a Non-Toxic Environment proposes the banning of PFAS except for essential uses where no alternatives exist. Considering that there are thousands of PFAS in use, individual regulation is seen not to be practicable, and a collective approach is being drafted under the EU REACH Regulation to eliminate all non-essential uses of PFAS and PFAS-containing AFFF. **See the Appendix for more details on the relevant regulations.**

### Are fire-fighting foams being banned?

Not at all. However, restrictions and obligations are already in place on the storage and use of particular AFFFs containing PFOS and PFOA and their related substances and these requirements are likely to extend to other AFFFs containing other PFAS in the near future. The good news is that alternative AFFFs are available that do not contain PFAS, described as "fluorine-free".

If you use AFFF, the key messages for you are:

- Determine whether any of your stocks of AFFF concentrates contain PFOS, PFOA or other PFAS,
- follow the current restrictions on AFFFs containing PFOA,
- limit and carefully control the use of AFFFs that contain any other PFAS,
- prepare for the future by conducting a risk assessment and
- purchase suitable replacement foams that are free of PFAS.

### What are the potential costs associated with using AFFF containing PFAS?

AFFF may be used for training or system testing, as well as in fighting Class B fires. In the case of fire, damage restoration and business interruption are obvious costs. However, in all cases, the costs can extend far beyond the immediate and obvious costs where PFAS clean-up is required. Not only are there collection and disposal costs, remediation of contaminated water and soil is difficult and therefore expensive. Since the PFAS are transported by water, the extent of impact can reach outside the original site if runoff water is not successfully collected. It may enter the general environment and, in some cases, contaminate groundwater used for human consumption, with further serious reputational risk, adding to the technical expenses.

**Remediation costs have been reported to range from half a million Euro to €100 million, depending on the site and the quantity of PFAS released. Sites that are contaminated with PFAS can pollute the environment for decades after use of the AFFF containing PFAS has ceased.**





## What does a user need to do?

### I have only a few AFFF extinguishers, does this legislation apply to me?

Yes - the Regulations apply to you.

More details of the requirements and the timing of implementing of the Regulations are detailed in the text.

#### 1 Identify and inventory your AFFF stocks

First you need to identify and determine how much AFFF containing PFOA you currently have. This refers to both foam concentrate and hand-held extinguishers. While you will readily identify your foam extinguishing agents, you may not know the detailed composition of what they contain and if the Regulation applies to them. In order to do this, check the labelling and Safety Data Sheets (SDS) to see are the contents “fluoro free”, or if they mention “fluor” anywhere.

The manufacturer’s normal Safety Data Sheet (SDS) or standard information may not readily provide the answers – you may need to consult your supplier. It is quite possible that PFOA is not an intended ingredient, but is a by-product of the manufacturing process. You may need to get proof that any analytical method used has been confirmed to detect the relevant PFAS in a fire-fighting agent. Ensure you get these answers in writing. If you cannot get a satisfactory response, you should manage the AFFF on the basis it contains restricted substances and avoid purchasing further stocks of the particular foam.

When consulting with your supplier, you should make sure to have the following information available for them:

- The exact name of product – many foams are variations of the same product and share a common name. The precise name can be found on the SDS.
- Batch or lot number, if known.
- Date of manufacture, if known, or date of purchase.
- The container size may also be relevant.

Then, you need to ask several questions:

#### Does my AFFF contain PFOS (PerFluoroOctane Sulphonic acid), its salts or PFOS related compounds?

AFFF containing PFOS is already banned for some time. There are no exemptions for PFOS and related substances in Ireland. You must not use AFFF containing PFOS. If you discover you have AFFF containing PFOS, you must now dispose of it in an environmentally sound manner as soon as possible. See below for guidance on this.

#### Does my AFFF contain PFOA (PerFluoroOctanoic Acid), its salts or PFOA related compounds?

If yes, then specific obligations are now imposed on you:

- Regardless of quantity, if you intend to continue to use these materials for testing or fire-fighting (training is prohibited), you must notify the EPA straight away via email to [pops@epa.ie](mailto:pops@epa.ie). This “use”derogation will be further restricted in January 2023 and automatically lapse on 4th July 2025. See the next sections for further requirements.
- By the 4th July 2021, if you have in excess of a total of 50 kg of AFFF containing PFOA at a given site, its salts or PFOA related compounds (includes both hand-held extinguishers and foam concentrate) at a given site, you must annually notify the EPA. This notification will likely include reporting on the types and quantities of the relevant AFFF held in stock. Check with EPA prior to the date for details of the reporting requirements.

Also, it is important to note that as the restrictions apply to AFFF that contain and “may contain” PFOA and related substances, you will need proof your AFFF do not contain these substances where there is reasonable doubt as to the chemical composition of the AFFF used.

#### Is the AFFF fluorine-free or does it contain C6 fluorsurfactants (PFHxA and PFHxS), or any other PFAS?

Be aware that other PFAS (e.g. C6 fluorsurfactants PFHxA and PFHxS) are being scrutinised with a view to their restriction. While you do not have to report these AFFFs, expect their use to be limited in the near future and similar reporting requirements to be required as for those containing PFOA-related chemicals. Stop using them for training if possible. At the very least, consider their proper management now, and plan to replace them. Until you replace them, prevent their release to soil or water by proper containment and ensure, where practical, any run off water is contained and disposed of appropriately.

If you have fluorine-free AFFF, you are ahead of the current legal requirements! Still, be cautious when disposing of the foam. It will contain surfactants that may impact the environment.

## 2 Prepare a management plan for the storage and use of your existing stocks of AFFF containing PFAS

The next thing to do is develop a management plan for the storage and use, where allowed, of your existing stocks. This should contain information on the following:

### a. Storage of all AFFF containing PFAS

Carelessly managed stockpiles of any POPs, including many PFAS, can contaminate the soil or groundwater. Where you have stock of foam concentrate containing PFAS, you must store it in a safe and environmentally sound manner in order to protect human health and the environment. Spills must be avoided and, if they occur, the spill must be contained and captured for proper disposal. This may require you to have some form of containment, including drip-trays/bunds around the foam concentrate containers.

### b. Use of AFFF containing PFOA

The limited activities below are permitted only as a derogation under Regulation (EU) 2020/784 for the specified time period and only if you notify the EPA.

#### i. Training of personnel

AFFF containing PFOA may not be used for training any longer.

#### ii. Testing of equipment and systems

AFFF containing PFOA and PFOA-related chemicals installed in systems prior to 4th July 2020 may be used for testing of equipment and systems, only if all releases are contained. If you intend to follow this approach, you must notify the EPA and may not use these materials after 4th July 2025. This applies to hand-held extinguishers as well as concentrate.

#### iii. Fire-fighting

No stocks of concentrate or hand held extinguishers containing PFOA and related substances, purchased since 4th July 2020, can be used. AFFF containing PFOA that has been in stock before 4th July 2020 may be used for class B fires, and, as of 1st January 2023, only if all releases can be contained. If you intend to continue using AFFF containing PFOA and related substances, you must notify the EPA at [pops@epa.ie](mailto:pops@epa.ie) and cease this use on or before the 4th July 2025.



## What does a user need to do?

### 3 Decontamination of equipment and systems

Equipment and systems that have used AFFF containing PFOA and related substances are likely to be contaminated. When you replace the AFFF, even with fluorine-free products, this contamination will be subsequently discharged unless the PFOA or other PFAS residues have been rigorously removed. Decontamination of equipment is a specialised task. The flushings from this will contain PFAS and must be handled accordingly and not flushed to drain. Effective and economic cleaning of systems requires careful planning.

### 4 Disposal of AFFF containing PFAS

Waste AFFF containing PFAS may arise as unused concentrate, hand held extinguishers, post-discharge foam or flushings from decontaminating equipment. You are obliged to dispose of these wastes in "an environmentally sound manner". This involves:

- ensuring that waste containing PFAS does not contaminate any other waste,
- ensuring that waste containing PFAS is not discharged to any waterways, drains or waste water treatment plant or allowed to drain to soil,
- using a licensed/permitted waste management operator to collect the waste and dispose of it appropriately,
- ensuring best practice is followed to destroy the PFAS, without any of it entering the environment - this will likely mean high-temperature incineration,
- retaining a record of your disposal of the AFFF, its treatment and final destruction. Your selected waste management operator must provide this documentation.

### 5 Look back at your past practices

If you have used AFFF containing PFAS in the past, for training or for fighting an actual fire, it is possible you have contaminated soil which presents an on-going risk to human health and the environment, due to the mobility of PFAS in water. You should identify potentially contaminated areas, undertake a risk assessment and contact the EPA. For more information on this the EPA has published Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites. This presents an approach that may be used for all sites.

### 6 Consider replacing your AFFF

After the 2025 deadline you will have to use alternatives to AFFF containing PFOA and related substances but, remember, other PFAS-containing AFFF may be scheduled for phase-out by then. Already numerous AFFF substitutes, free from PFAS, are available and in commercial use. Fluorine-free products are better for human health and the environment.

When purchasing new foam concentrate, there may be changes in operating practice or storage life with fluorine-free alternatives so ensure you are familiar with these. You must also consider the need to decontaminate fixed installations and equipment that have already been in contact with AFFF containing PFOA and related substances, or else you will continue to emit PFAS from the historic residue.



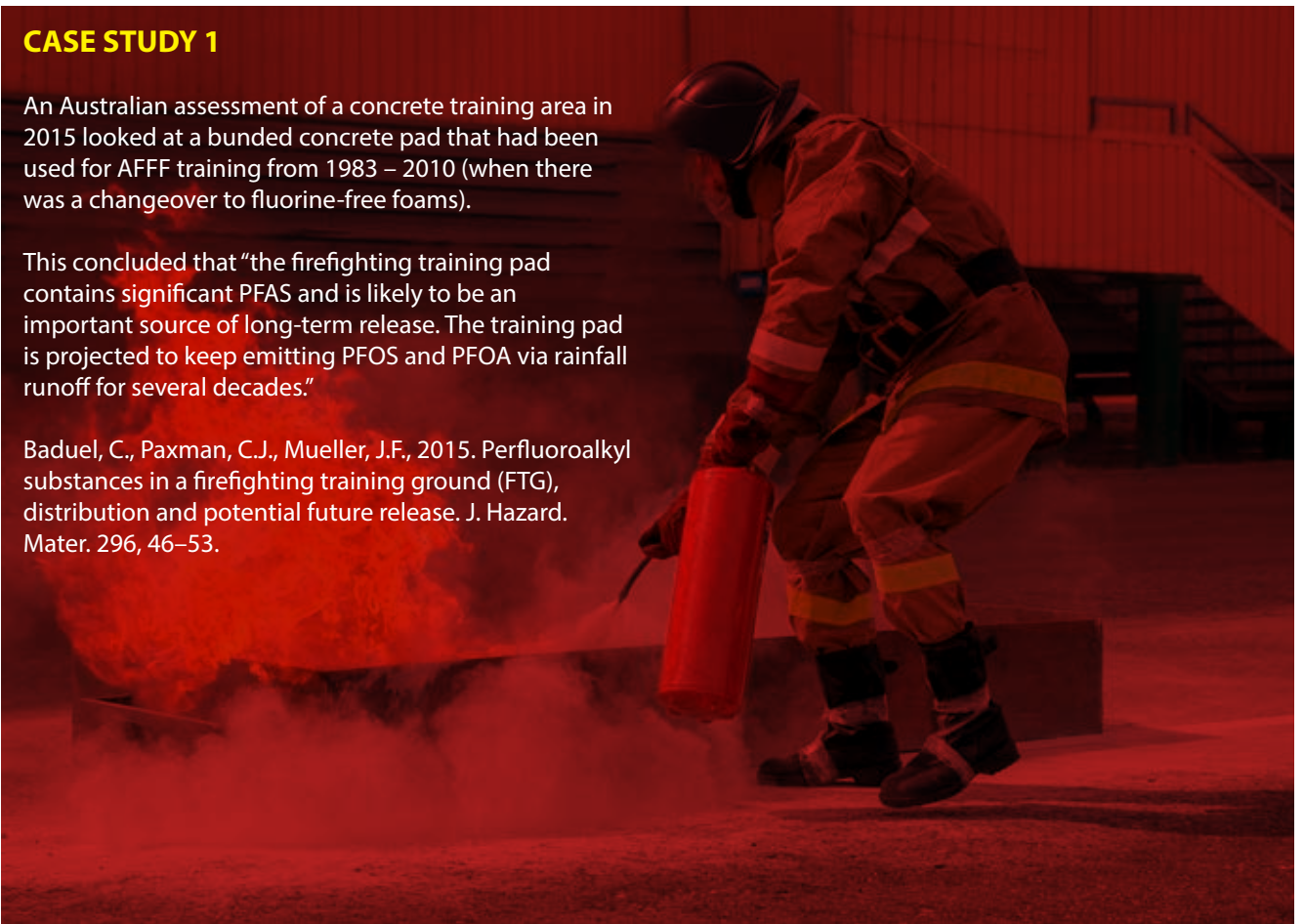


## CASE STUDY 1

An Australian assessment of a concrete training area in 2015 looked at a banded concrete pad that had been used for AFFF training from 1983 – 2010 (when there was a changeover to fluorine-free foams).

This concluded that “the firefighting training pad contains significant PFAS and is likely to be an important source of long-term release. The training pad is projected to keep emitting PFOS and PFOA via rainfall runoff for several decades.”

Baduel, C., Paxman, C.J., Mueller, J.F., 2015. Perfluoroalkyl substances in a firefighting training ground (FTG), distribution and potential future release. *J. Hazard. Mater.* 296, 46–53.



## CASE STUDY 2

Many major airports have replaced their AFFF containing PFAS with fluorine-free foam. As a consequence, post-incident or post-training clean-up has been easy and without risk to human health or the environment.

Ross, I., Is the burst of the AFFF bubble a precursor to long term environmental liabilities? *International Airport Review*, 29 July 2019,

[www.internationalairportreview.com/article/98795/fire-fighting-foam-chemicals-water/](http://www.internationalairportreview.com/article/98795/fire-fighting-foam-chemicals-water/)





### **What does a supplier need to do?**

Prepare to answer the questions on the AFFF composition that users will ask.

Users are going to ask detailed questions about the composition of your products, so you need to have the answers ready based on what is presented here. Note that PFOA and related compounds may be present in very low concentrations as unintended by-products of the manufacturing process for foams, so you will need a quantified composition.

### **What about my existing stocks?**

The same requirements apply to you as apply to users, particularly storage and disposal. Under no circumstances should extinguishers be discharged in order to dispose of their contents. See above for the requirements relating to inventory management and disposal of obsolete stock.

### **What are the trends in AFFF containing PFAS?**

PFOS was banned, PFOA and its related substances are restricted, other PFAS are under scrutiny and likely to be banned. You need to know the detailed composition of your stocks and consider offering fluorine-free materials.



### **What does a waste contractor need to do?**

If you receive waste foam concentrate, or collected foam effluent after a fire, or contaminated material from flushing systems, or contaminated soil or concrete, you must handle this material in an environmentally sound manner. Record the treatment and final destruction of the material, likely via high-temperature incineration and provide these records to the waste originator. Do not mix/blend this waste with other wastes. Do not dilute it and do not flush it to any waterways, drains or waste water treatment plant or allow it to drain to soil.





### **What happens if I ignore these requirements?**

You may be found guilty of an offence under S.I. No. 146/2020 – European Union (Persistent Organic Pollutants) Regulations 2020. On conviction on indictment, you may be fined up to €100,000.

This is because you may be posing a risk to human health and to the environment as PFAS are:

- Persistent: they do not biodegrade to safe substances;
- Mobile: because they are very soluble in water, they can be transported long distances by groundwater and contaminate drinking water and water for plants and animals;
- Bioaccumulative: humans can consume them at a faster rate than the body can process them, their concentration builds up in the body;
- Toxic: multiple impacts on human health have been identified, ranging through cancers, thyroid disease, and the list goes on;
- Very difficult to clean up: because low concentrations must be achieved and because they are water soluble, large volumes of material must be treated.



### **How do I avail of a “derogation” to continue using AFFF containing PFOA until 2025?**

The EPA is the Competent Authority under the relevant Irish Statute. Ireland has a derogation to allow use of AFFF containing PFOA and related substances in limited circumstances. Users with AFFF containing PFOA must email [pops@epa.ie](mailto:pops@epa.ie), providing the Safety Data Sheet (SDS) or other confirmation that the foam they have contains PFOA, explaining they intend to use the material for testing or fire-fighting for the limited time period with the associated restrictions.

#### **Further information?**

The EPA hosts a website at [www.pops.ie](http://www.pops.ie). This contains very useful information on POPs, PFAS, the known PFAS composition of particular brands of AFFF, whether fluorine-free or not, and any updates on restrictions. You may also email [pops@epa.ie](mailto:pops@epa.ie)

## Appendix: Summary of legal and regulatory framework

**Regulation (EU) 2020/784 of 8 April 2020 amending Annex I to Regulation (EU) 2019/1021 of the European Parliament and of the Council as regards the listing of perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds. This is the relevant, specific, regulation for PFOA and its family of compounds.**

It links to Regulation (EU) 2019/1021 (the EU POPs Regulation). It specifies the allowable derogations and removes derogations that were included for PFOA in the REACH Regulation. It applied from 4th July 2020, with a schedule of time-limited allowable derogations relating to AFFF, with a closing deadline of 4th July 2025. It provides the detailed scope of the chemical identity of PFOA, its salts and PFOA related compounds. It also provides the threshold for PFOA contamination in other substances which will require the application of the Regulation.

### **POPs Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants**

This Regulation implements the Stockholm Convention and the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants, and, applying the precautionary principle, goes beyond them in requiring further measures to protect human health and the environment. It integrates with other international Conventions and the EU's assessment and authorisation schemes. It provides the general legal framework which the PFOA Regulation applies specifically. It prohibits or restricts the manufacture, placing on the market and use of specific POPs. It specifies requirements, including record-keeping, for stockpiles and the disposal of materials as waste, or waste contaminated by specific POPs.

### **S.I. No. 146/2020 – European Union (Persistent Organic Pollutants) Regulations 2020**

These are the Irish Regulations which give effect to Regulation (EU) 2019/1021. They define the Environmental Protection Agency to be the Competent Authority responsible for the administrative tasks and enforcement of the EU Regulation and identify the public authorities with responsibilities for particular areas. The Regulations identify the obligations on persons and specify offences. Penalties for committing an offence are: on summary conviction – a Class A fine; on conviction on indictment – a fine not exceeding €100,000.

### **Stockholm Convention on persistent organic pollutants**

This is a global treaty which entered into force in 2004, requiring Parties to reduce or, where feasible, eliminate the release of POPs into the environment. The European Union ratified the Convention in 2004 and enacted a Regulation that was directly applicable in all Member States, including Ireland. This Regulation from 2004 has been replaced by Regulation (EU) 2019/1021. It is important to realise that EU Regulations may go beyond the requirements of the Stockholm Convention and it is the Regulation which has legal standing.

Ireland became a Party to the Stockholm Convention in 2010. This requires Ireland to develop and periodically review a National Implementation Plan on POPs, addressing its obligations under the Convention. The Plan was last updated in 2018.

### **Appendix: Sources of other information**

EPA, 2013. Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites. EPA, Ireland

Persistent Organic Pollutants Review Committee. 2017, Risk management evaluation on pentadecafluorooctanoic acid (PFOA, perfluorooctanoic acid), its salts and PFOA-related compounds, UNEP/POPS/POPRC.13/7/Add., Stockholm Convention.

Persistent Organic Pollutants Review Committee. 2018, Addendum to the risk management evaluation on perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds, UNEP/POPS/POPRC.14/6/Add., Stockholm Convention.

State of Queensland, Australia. Firefighting foam management policy:  
<https://www.qld.gov.au/environment/pollution/management/disasters/investigation-pfas/firefighting-foam>

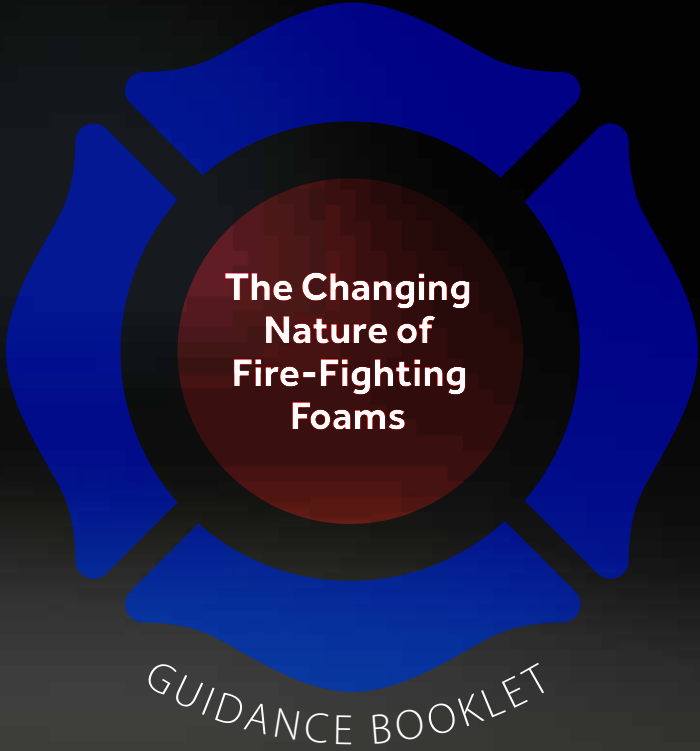
Wood, Ramboll, COWI, 2020. The use of PFAS and fluorine-free alternatives in fire-fighting foams (No. Contracts 07.0203/2018/791749/ENV.B.2 and ECHA/2018/561). DG Environment ECHA.

**With regard to AFFF that contains or may contain PFOA and PFOA-related substances, the key dates and restrictions are as follows:**

On or after this date	Purchase of this material	Inventory of this material	Training	Testing	Use
4th July 2020	Prohibited	Identify and inventory your AFFF stocks and assess if they contain PFAS. Then, prepare a management plan for the storage and use of your existing stocks of AFFF containing PFAS	Prohibited	Existing installation in systems and equipment may be tested, <b>ONLY</b> if releases are contained and properly disposed, <b>AND</b> notify EPA if you intend to continue to test with this AFFF.	Existing stock may continue to be used for class B fires, and, as of 1st January 2023, <b>only</b> if all releases can be contained.
4th July 2021		If your total inventory of concentrate and hand-held extinguishers exceeds 50 kg, you must henceforth annually notify the EPA.			
1st Jan 2023					Henceforth, use is allowed <b>ONLY</b> if releases are contained and properly disposed, <b>AND</b> notify EPA if you intend to continue to use this AFFF.
4th July 2025	Total prohibition on purchase, training, testing and application of this AFFF. Any remaining inventory shall be properly managed as waste.				
EPA contact	Contact EPA via email at <a href="mailto:pops@epa.ie">pops@epa.ie</a>				







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