Operational Use of Firefighting Foam Policy

Executive Summary

The Metropolitan Fire Brigade (**MFB**) and the Country Fire Authority (**CFA**) have phased out the use of persistent PFAS-containing firefighting foams across their respective operations. Despite MFB's phase out of the substances from all sites and appliances, routine testing completed on 22 September 2016 at the VEMTC Training Facility (Craigieburn) identified levels of PFAS above intended thresholds for the facility. Similar testing identified residual levels of PFAS-containing firefighting foams in appliances.

To date there exists no objective occupational standards and exposure thresholds relating to the use of firefighting foams, or permissible residual levels. It is recognised that achieving the immediate removal of all traces of PFAS from appliances is not reasonably practicable. In Consultation with the Environment Protection Authority (**EPA**), Victorian WorkCover Authority (**WorkSafe**) and other external stakeholders and industry experts, MFB, and the CFA, developed this Policy.

This Policy relates to those aspects of the operations of the MFB and CFA during which a person handles, transports, stores, uses, releases, treats wastes and/or disposes of any products, compounds, water, soils, wastes or other materials associated with or contaminated by firefighting foams in the state of Victoria and its waters.

The requirements identified in this policy were determined based on the 'As Low as Reasonable Practicable' (ALARP) risk-management principle and supported by a comprehensive risk assessment, undertaken in consultation with relevant regulators, subject matter experts and firefighters. The thresholds identified in this policy aim to protect both human health and protect the environment to an extent that is reasonably practicable, including in an emergency operation.

Table 1 Residual Thresholds Limits - Foam Concentrate in Firefighting Appliances

Compounds (s)	Threshold
PFOS	9mg/l
PFOA	10mg/l

Table 2 Residual Thresholds Limits - Water in Firefighting Appliances

Compounds (s)	Threshold
PFOS	0.413 mg/l
PFOA	0.021mg/l

The overall intent of this policy is to form an overarching set of principles which will inform and underpin the development of policies and procedures of each independent agency.

1. Intent

The objective of this Operational Use of Firefighting Foam Policy (the Policy) is to set out the overarching principles relating to the health, safety and environmental requirements and expectations for the handling, transport, storage, use, release, waste treatment and disposal measures relevant to the use of firefighting foam in the Metropolitan Fire Brigade (MFB) and the Country Fire Authority (CFA). Priority is given to:

- the protection of human health;
- the minimisation of adverse impacts to the environment from persistence, bioaccumulation and any other chronic effects from toxic components.

It is recognised that the immediate removal of all traces of PFOS and PFOA (PFAS) from firefighting appliances is not reasonably practicable, but it is the policy of MFB and CFA to take steps to remove any further introduction of these substances, and actively mitigate legacy contamination issues. To assist this objective, among other things this policy sets acceptable residual threshold levels for PFOS and PFOA in firefighting appliances that both protects human health and minimises any adverse effects to the environment. The thresholds documented in this policy were developed by applying the 'As Low as Reasonable Practicable' (ALARP) risk-management principle. These thresholds were developed in consultation with an expert working group with Environment Protection Authority Victoria (EPA), WorkSafe Victoria, subject matter experts and firefighters.

2. Scope

This Policy provides an overarching set of principles to support the remediation and clean-up efforts of firefighting appliances following the initial investigation into PFAS across the MFB and CFA. Specifically this includes the handling, transport, storage, use, release, treatment of waste and/or disposal of any products, compounds, water, soils, wastes or other materials associated with or contaminated by firefighting foams, at any concentration, at any place in the state of Victoria and its waters. This policy also applies to MFB and CFA appliances provided to support other states or countries in emergency response.

3. Legislation

Summary of legislation dealing with general OHS and environmental risk management principles applicable to this policy are listed provided below:

Acts

- Occupational Health and Safety Act 2004
- Environment Protection Act 1970

Note that firefighting foam products are currently not rated as a 'dangerous good' and therefore legislation dealing with Dangerous Goods does not apply.

Regulations

- Occupational Health and Safety Regulations 2007
- Environment Protection (Industrial Waste Resource) Regulations 2009

State Environment Protection Policies (SEPPs)

- State Environment Protection Policy (Prevention and Management of Contamination of Land)
- State Environment Protection Policy (Groundwaters of Victoria)
- State Environment Protection Policy (Waters of Victoria)

- Information bulletin 1633 - Incoming water standards for aquatic ecosystem protection

4. Policy

Both the MFB and CFA no longer use PFAS-containing persistent firefighting foams however at the time of preparing this Policy, traces have been identified in a number of appliances – presumably arising as a legacy of historical use. Foams are an essential firefighting tool for protection of life and property with the prime consideration being safety and the protection of life. The consequences of foam use on the environment, human health, economic assets and amenity should be taken into account in contingency planning, as well as during the incident response with consideration of all likely downstream adverse effects. All firefighting foams pose a degree of hazard and risk to the environment when released during activities such as training, maintenance, testing, incident response, fires and waste disposal. It is currently believed that the combination of chemicals used in firefighting foams can have direct and indirect, acute and chronic impacts on biota, soils and waterways through their persistence, bioaccumulation, toxicity and biochemical oxygen demand (BOD) when they are released and degrade.

When selecting firefighting foam, the following should be considered:

- Assessing its suitability for a particular application, including composition and effectiveness
- The potential to cause adverse health and environmental effects
- Assessment of the risk and appropriate risk management measures
- Contingency planning, including the following:
    - The types and quantities of firefighting foam concentrate to be held on site
    - The potential volume of firewater that could be generated during an incident
    - The ability to manage and contain spills and firewater on site
    - The management measures to prevent release of contaminants to soils, groundwater, waterways and air
    - The facility location and proximity to environmentally sensitive areas
    - The circumstances under which an intended or unintended release might occur
    - The pathways for foam and other incident contaminants to be released to the environment
    - The potential for impacts on the local and wider environmental values
    - Onsite and offsite treatment and disposal of wastewater and contaminated materials
    - Potential remediation of contaminated soils, waterways and groundwater
    - Any training, maintenance and testing needs and requirements

The Policy also recognises that the prime consideration when choosing and procuring firefighting foam is the effectiveness of the foam for the intended application in providing adequate levels of firefighting performance, safety and property protection. The alternatives available to meet the appropriate, independently verified performance standards and approvals, must then be compared in terms of a net environmental benefit analysis, in order to select the optimal combination that also best addresses the relevant environmental protection standards and overall best practice.

All firefighting foams must be assessed for their potential to impact human health and cause environmental harm prior to use or disposal. The need for management and containment, as

well as protective measures and procedures, must be assessed in terms of the firefighting foam's properties relative to:

- Impact on human health
- Environmental persistence of the compounds in their formulation and any breakdown products
- Biopersistence, bioaccumulation, bioconcentration and biomagnification potential
- Toxicity (both acute and chronic effects)
- Biochemical oxygen demand (BOD) and
- Lack of biodegradability

Training activities are recognised as required to maintain fire protection standards and proficiency and if conducted without adequate risk controls may result in unavoidable releases of non-persistent foam to waterways and their environment. To manage this risk, training activities should be undertaken and managed to minimise the impact on human health and potential for pollution or environmental harm. At designated training grounds where fire training occurs on regular basis annually, the following principles should apply:

- Only non-persistent PFAS free firefighting foam should be used in training
- Wastewater from fire training using firefighting foam should be discharged through appropriate licensed trade waste agreements, where this is available. Where trade waste agreements are not available, wastewater from training using firefighting foam should be managed and treated with appropriate water treatment options
- Firefighting appliances should be determined to have a PFAS reading as low as reasonably practicable, prior to the commencement of the training

5. Non-Persistent Firefighting Foams

Although non-persistent (including fluorine-free) foams may not contain highly persistent organic compounds such as PFASs, the potential for causing environmental harm and the need for management, containment and protective measures and procedures must be fully assessed. Where non-persistent firefighting foam is used, site managers must take all reasonable and practical measures to adequately manage, contain, treat or properly dispose of the foam, firewater, trade wastewater, runoff from activities or after incidents on the site such that any unavoidable release to the environment is not likely to cause significant environmental harm.

The agency has the management or control of the site except during an incident or emergency, where the incident controller is in control. Where practicable, the emergency services incident controller may facilitate initial pollution control measures, such as bunding to contain runoff. The agency managing the site is responsible for ongoing prevention of releases to the environment.

Where volumes of non-persistent firefighting foams are used for vapour and spark suppression on a hydrocarbon incident and are contained onsite, the only significant contaminant is the firefighting foam itself. It may be disposed of by:

- Irrigation onto adjacent land (with permission) to soak in and degrade *in situ*
- Holding of larger quantities in onsite ponds or closed drains for 28 days or longer, according to its BOD profile to completely biodegrade

- Covering with sand or soil to prevent or limit subsequent movement to a waterway through runoff
- Soaking into soil along a roadside drainage line to degrade *in situ* (clear of any waterway)
- Pumping out and disposal to sewer or wastewater treatment plant.

The disposal of firewater that also contains significant levels of contaminants, such as hydrocarbons, chemicals or fire combustion products, in addition to containing non-persistent firefighting foam, needs to be considered on a case-by-case basis. It should not be released into the environment until regulatory permission is granted, all the risks have been assessed and appropriate risk control measures put in place.

Direct releases to land of non-persistent firefighting foam

Where 100% biodegradable firefighting foam is released to land, away from waterways and drains, such as when used by fire services for ignition prevention, fire control, extinguishment, damping-down and vegetation fires, it is expected that no adverse effects will occur from the application of small amounts of foam at low concentrations.

For the normal application of foam across a wide area or fire front away from waterways, the foam will rapidly soak into the soil and biodegrade in-situ. Significant releases of foam directly to, or within 50 metres of a waterway during firefighting should be avoided where possible. Where a volume of firewater is generated, beyond that which can readily soak into the soil or be irrigated to adjacent land with permission, control measures such as bunding or ponds should be used to hold the water for at least 28 days, to allow it to degrade until it is suitable for release and/or to evaporate.

Direct releases to waterways of non-persistent foam

When selecting a non-persistent foam type where a discharge of the foam is directly to a waterway, or to a place where contaminants may then travel to a waterway, is unavoidable as far as practicable, consideration should be given to the potential extent of impacts from the combined effects of acute toxicity and BOD in the affected waterway. Examples of such situations are marina fires, foam from a firefighting tug, other vessel, shipping berth or wharf where hydrocarbons are transferred.

Testing, certification and maintenance activities are recognised as required to maintain fire protection standards and proficiency and may result in unavoidable releases of non-persistent foam directly to waterways and their environment. These activities should be undertaken and managed to minimise the potential for pollution or environmental harm for example:

- Avoid discharging to environmentally sensitive areas (particularly from mobile plant)
- Avoid or minimise discharges to confined waterways where water turnover is limited
- Block drains and pump out wastewater to adjacent land (with permission) to soak in and degrade
- Wash down decks and hardstands with large volumes of water to dilute discharges
- Test systems in segments spread over a time period to allow for the dispersion of foam
- Schedule activities to coincide with large outgoing tidal flows to dilute and disperse foam

6. Persistent Firefighting Foams

Persistent firefighting foam is any foam that contains any persistent compounds, such as fluorinated organic compounds (refer to Definitions). If foams containing fluorotelomers of appropriate purity are to be used for firefighting (refer to Definitions), then the user must be aware of the composition of the foam in terms of:

- The presence and overall concentration of fluorinated organic compounds with a perfluorinated 6-carbon chain length and shorter including 6:2 fluorotelomers
- The presence and overall concentration of fluorinated organic compounds with a perfluorinated 7-carbon chain length and longer, including PFOS, PFOA, their precursor compounds and their higher homologues
- The presence of any other persistent, toxic or bioaccumulative compounds, e.g. siloxanes.

MFB and CFA no longer procure or permit the use of persistent PFAS foams in their respective operations. If circumstances of an emergency response require a persistent fire fighting foam to be used to protect community safety, the following requirement applies:

- Appropriate PPE should be utilised to protect firefighter safety
- Where there is any potential for spill or release of firefighting foam containing fluorotelomers, fluoropolymers, perfluorinated organics, their precursors or other persistent toxic compounds, the user must be able to demonstrate that they can, as far as reasonably practicable, contain and properly dispose of the concentrate, foam solution, produced foam, firewater, wastewater, runoff, contaminated soils and any other materials. This includes spills or releases produced during accidental spills, the testing and maintenance of fixed or mobile equipment.

Residual Thresholds Limits – Firefighting appliances used in operations

Firefighting appliances have previously used persistent firefighting foams and so it is to be assumed will have some residual fluorinated organic compounds remaining in the appliance. These residual compounds are most likely to be found in the foam concentrate and water. Acceptable residual thresholds for foam concentrate in firefighting appliances used in operational response are in Table 1. Acceptable residual thresholds for water in firefighting appliances used in operational response are in Table 2.

The thresholds have been determined based on the ALARP principle and supported by a comprehensive risk assessment[1], undertaken in consultation with relevant regulators, subject matter experts and firefighters. The thresholds are set as an interim measure to protect both human health and protect the environment to an extent that is reasonably practicable in an emergency operation. Agencies should conduct an appropriate sampling program to determine and monitor residual PFAS values.

Table 1 Residual Thresholds Limits - Foam Concentrate in Firefighting Appliances

Compounds (s)	**Threshold**
PFOS	9mg/l
PFOA	10mg/l

Table 2 Residual Thresholds Limits - Water in Firefighting Appliances

[1] Thresholds limits are supported by a risk assessment by GHD. This report should be referenced for further information on how thresholds were developed

Compounds (s)	Threshold
PFOS	0.413 mg/l
PFOA	0.021mg/l

7. Procurement of firefighting foam – Environment and Human Health Acceptability

It is the policy of MFB/CFA to procure firefighting foam free from PFAS chemicals.

In addition, when assessing the suitability of a firefighting foam product, considerations must be given to performance and operational constraints. In addition, the following potential impacts must also be considered:

- Impact on human health
- Persistence in the environment
- Biopersistence, bioconcentration, bioaccumulation and biomagnification potential
- Toxicity (both acute and chronic impacts)
- Biochemical oxygen demand and biodegradability
- Initial and lifetime costs

Environmental acceptability related tests should be conducted by an independent laboratory or organisation using Australian, USA, Canada, New Zealand and the OECD standards and methodologies. These tests must be undertaken for the combined formulation of all the ingredients, that is, the concentrate as is normally formulated, marketed and intended for final use, and not just the principal or selected ingredients in isolation. Note that assessment of toxicity must include both acute and chronic longer-term toxicity.

It is the manufacturer's and/or supplier's responsibility to undertake such testing and provide the results to the user in the SDS for the product. Any firefighting foam product intended to be used or stored on a site must have a readily available SDS. A firefighting foam product is not to be purchased until the SDS has been reviewed and accepted, prior to the material coming to site. The MFB and CFA expect suppliers to provide full product disclosure statements, including all test results that demonstrate firefighting foam is free from PFAS chemicals. The MFB and CFA will conduct an independent analysis of firefighting foam before purchase to ensure it is free from PFAS chemicals.

8. Transport and storage of firefighting foam

Where practicable, firefighting foam should be stored in a cool, bunded and roofed building to avoid rain ingress and away from hazardous substances. All foams should be stored and transported in accordance with the manufacturer's instructions, organisational policy and SDS.

9. Disposal of foam and water containing PFOS and PFOA

Foam concentrate that contains the fluorinated organic compound PFOS, PFOA, perfluorohexane sulfonate (PFHxS), their precursors or their higher homologues at greater than the limits in Table 1, or any compound that degrades or converts to those compounds, must not be on-sold, traded, exported or otherwise provided to any person other than for the purposes of disposal. Wastewater from the cleaning of such contaminants from equipment and pipework must be fully contained and removed for disposal to an approved facility or in compliance with a trade waste licence. Foam concentrate should be removed by an accredited waste provider from site and destroyed at an approved facility.

A disposal plan for waste fluorinated foam concentrate containing PFOS, PFOA, their precursors and their higher homologues (at greater levels than those in Table 1) must be prepared. This plan must include management measures to secure and prevent release of the material until arrangements are made for final disposal. Fluorinated foam concentrate and its wastes must be disposed of at an approved facility. Such foams must not be used in training, maintenance, testing or other activities that may result in their release to the environment on or off the user's site.

10. Portable extinguishers & mobile plant extinguishers – Special considerations

Non-persistent (fluorine-free) foams are available for hand-held extinguishers and mobile plant systems that meet Australian fire performance standards. MFB and CFA are committed to using these foams in their operational response.

11. Annual Review

This policy will be subject to annual review to monitor the state of knowledge regarding fluorinated organic compounds as it continues to evolve.

12. Definitions

The following definitions apply for the purposes of this Policy:

AFFF
Aqueous film forming foam

ALARP
As Low As Reasonably Practicable – such that the risks from the activity must be eliminated or controlled, having regarding to the likelihood and severity of any harm occurring, the availability of risk controls, and taking into account any grossly disproportionate costs.

Biochemical oxygen demand (BOD)
BOD as measured over periods such as 5, 10, 20 and 28 days and is expressed in milligrams of oxygen per litre (mg/L) for each period. The terms *biochemical* oxygen demand and *biological* oxygen demand are interchangeable for the purposes of this Policy. BOD is a measure of the amount of oxygen consumed, primarily by bacteria, in breaking down organic matter in a water body (algal respiration, sediment and chemical uptake can also contribute to BOD).

Bioaccumulation
A general term for the progressive increase in the amount of a substance in an organism or part of an organism that occurs because the rate of intake exceeds the organism's ability to remove the substance from the body. Intake can be directly from environmental exposure, i.e. by absorption through the skin or from the air through inhalation, or from food and water ingestion.

Bioconcentration
Process leading to a higher steady-state concentration of a substance in an organism compared to the concentration in the environmental media to which it is exposed, e.g. the net uptake, against a concentration gradient, of a contaminant directly from the environment by plants or animals (from water or soil) until an equilibrium (higher) concentration of the contaminant is reached in one or more tissues.

Biodegradability (value)
The degradability of the product or waste under environmental or biological treatment conditions, determined as the ratio of the 28-day biochemical oxygen demand (BOD_{28}) to the total chemical oxygen demand (COD) for the oxidisable organics, expressed as a percentage:

- (BOD_{28}/COD x 100)

Biodegradable
For the purposes of classifying and stating the biodegradability of a firefighting foam, all the organic compounds in its composition must degrade under normal environmental conditions within 28 days or over a similar stated period from the time of its release to water by:

- Readily biodegradable (>95% in 28 days)
- Fully biodegradable (>99% in 28 days), OR
- Readily biodegradable (>95%) within a specified number of days
- Fully biodegradable (>99%) within a specified number days

Foams that contain organic compounds that do not degrade under normal environmental conditions, or break down or transform to produce organic compounds that do not degrade under normal environmental conditions, cannot be classed as readily or fully biodegradable.

In particular, if transformation/degradation products with persistence, bioaccumulation, toxicity (PBT) properties are being generated, the substances themselves must be regarded as PBT substances. Otherwise, the biodegradability of firefighting foam that does contain persistent toxic compounds, such as any fluorinated organics, should not claim to be readily biodegradable or fully biodegradable and should state biodegradability as:

- *Non*-persistent *organic components are (specified) % are biodegradable in (specified number of) days, e*.g. “non-persistent organic components are 88% biodegradable in 28 days”

Biopersistence
Biopersistence is the persistence of a chemical compound in plant or animal tissues unaltered or altered in a way that results in a chemical with similar characteristics or effects. Biopersistence is significant if the chemical compound is toxic and persists in the plant or animal tissues for long enough to have a potentially detrimental effect (i.e. beyond that of acute toxicity) or for the chemical to be passed on to further individuals via the food chain, or across the placenta to the foetus in mammals.

Biomagnification
Also termed ecological magnification. Sequence of processes in an ecosystem by which higher concentrations are attained in organisms at higher levels in the food web (higher trophic levels); at its simplest, a process leading to a higher concentration of a substance in an organism than in its food.

Chemical oxygen demand (COD)
Chemical oxygen demand (COD), expressed as milligrams of oxygen per litre (O_2 mg/L), is a measure of the theoretical maximum amount of oxygen required to oxidise all the chemically oxidisable organics in a sample, as usually determined using acid dichromate. When BOD_{28} is subtracted from the COD, the remaining amounts represent the oxidisable organic

components that are not readily biodegradable. Fluorinated organic compounds in firefighting foam are a component of the total organic material present. However, because of their chemical stability, they do not contribute to the COD value as normally measured, and are considered non-oxidisable and non-biodegradable organics, but detectable using the standard COD method.

Contaminant/contamination

Contamination of the environment is the release into the environment (whether by act or omission) of a contaminant that is of concern or could potentially cause environmental harm.

C6 purity-compliant foam

For the purposes of the Policy, a foam product that is C6 purity compliant must not have greater than 50 mg/kg of total impurities in the concentrate for any compounds where the perfluorinated part of the carbon chain is longer than 6 carbon atoms, (e.g. PFOA, PFOA precursors, 7:3Ft, 8:2Ft, 10:2Ft, fluoropolymers, etc.) but excluding PFOS which has a separate impurity limit of 10 mg/kg.

Environmental persistence

The long-term persistence of chemicals, or their degradation products with similar characteristics or effects, in the environment under normal environmental conditions, with resistance to degradation by factors such as oxidation, hydrolysis, reduction, exposure to UV light and aerobic or anaerobic metabolic breakdown by microbes. Environmental persistence increases the exposure of organisms to the chemicals, and that is of particular concern for chemicals that bioaccumulate (as well as bioconcentrate or biomagnify), thereby increasing the risks of toxic adverse effects. An organic compound is considered environmentally persistent or very persistent under Annex XIII of REACH (EC 2011) when its half-life, including that of its degradation products with similar characteristics or effects, is greater than the value shown in the table below for each environmental element.

Criteria for identifying Persistent (P) and Very Persistent (vP) substances	
Persistent (P) degradation half-life	**Very Persistent (vP) degradation half-life**
Marine water >60 days	Marine water >60 days
Fresh or estuarine water >40 days	Fresh, or estuarine water >60 days
Marine sediment >180 days	Marine sediment >180 days
Fresh or estuarine sediment >120 days	Fresh, or estuarine sediment >180 days
Soil >120 days	Soil >180 days.

Firefighting foam

Firefighting foam refers to concentrates and their aqueous solutions that are used in the production of streams or blankets of air/gas-filled bubbles to suppress flammable vapours, increase water penetration, reduce static spark generation, control or extinguish fires, and prevent re-ignition by excluding air and cooling the fuel. For the purposes of the Policy, firefighting foams are divided into Class A foams that are used on carbonaceous combustible materials, such as wood, paper, fabric, plastics and rubber, and Class B foams that are used on flammable and combustible liquids or spills such as liquid hydrocarbon fuels and polar solvents where the fire and vapours are on the surface of the liquid.

Firewater

Any contaminated water generated where water sprays, jets, mists, deluge, monitors or foam generators have been used to extinguish a fire, dilute a contaminant, cool a container or stockpile, blanket a spill with foam, disperse or dissolve a gas or vapour release or wash down a contaminated area

Fluorinated organic compounds

All organic compounds that contain the elements fluorine and carbon, where the fluorine has replaced some or all of the hydrogen linked to carbon atoms in the straight or branched organic carbon chain, including perfluorinated, polyfluorinated or fluoropolymer compounds. This commonly refers to, but is not limited to: PFOS, PFOA, fluorotelomers, fluorosurfactants, fluoropolymers and their precursors or breakdown products. All organic fluorochemicals, or any other fluorine-carbon compounds, fall within the general classification 'organohalogens' (i.e. under Annex VIII (1) of the EU Water Framework Directive).

Fluorinated organic compounds analyses

A very diverse range of fluorinated organic compounds (FOCs/PFCs) are now known to occur in fluorinated firefighting foam and associated wastes including: poly and perfluorinated compounds, fluorotelomers, fluoropolymers and complexes of siloxanes and fluorinated compounds with branches ranging in chain length from C4 to C20. PFCs are of particular interest due to their widespread use in foams and the occurrence of transformation products with the potential for adverse effects. To assess the levels of PFCs present and their associated risk, it is not sufficient to analyse only for the current limited suite of about 20 to 28 standard fluorinated organic compounds, as it is highly likely that many compounds of concern and their precursors will remain completely undetected. A new analytical method, total oxidisable precursor assay (TOPA)[2], is now available to detect PFCs previously hidden to the standard analyses. This reveals the undetected PFCs through the treatment of samples to transform the diversity of precursors to detectable end-point perfluorinated carboxylic acids (PFCAs) that relate to the precursor's perfluorinated chain component. This information can then be used to assess one aspect of the likely risks posed by the unidentified precursor compounds according to the chain-length, which relates generally to toxicity, dispersibility and bioaccumulation.

While the functional groups of fluorinated organic compounds have an influence on their effects, for practical identification and assessment purposes, the TOPA C4-C14 method will show approximately what precursors are present, grouped according to perfluorinated chain length in the C4 to C14 range and in particular, the total amount of PFOA and longer chain PFCA precursors present. For the purposes of assessing and reporting the presence of fluorinated organic compounds in soil, water, foam solutions or foam concentrate, sample analyses shall be done for:

- The standard suite of PFCs (including key sulfonates), PLUS
- Total oxidisable precursor assay reported as the analyses for the resulting perfluorinated
- Carboxylates for C4 to C14 carbon chain length (TOPA C4-C14)
- The sum of the oxidisable precursors (TOPA C4-C14) plus perfluoroalkyl sulfonates (PFBS)

Homologue

Belonging to or consisting of a chemical series whose successive members have a regular difference in composition, especially of one methylene group.

REACH

[2] Houtz, E. & Sedlak, D. Oxidative Conversion as a means of Detecting Precursors to Perfluoroalkyl

REACH is the key chemical control regulation in the European Union. The acronym, REACH, alludes to its key components, Registration, Evaluation, Authorisation and Restriction of Chemicals manufactured in or imported into the European Union.

Residual Thresholds

PFAS containing foams are no longer in service by CFA and MFB, and are no longer contained in foam procured for firefighting or training purposes. However industry experience confirms that completely removing PFAS chemicals from foam tanks, water tanks, pipes and hoses on firefighting appliances is difficult to achieve in the medium term. Residual thresholds described in the policy are to be used as an interim measure to set values that protect human health and the environment. Cleaning processes are available to both MFB and CFA to clean appliances to achieve these values to enable the safe use of the firefighting appliances in both agencies. The ALARP principle has been applied in the developing these thresholds and is supported by a risk assessment completed by GHD. The risk assessment has thresholds for both protection of human health and environment. Achieving a level of protection to the environment that is reasonable and practical to achieve requires a lower threshold than protecting human health. Hence the thresholds levels are set at a level that achieves environmental protection, which also achieves a threshold that protects human health. The GHD risk assessment should be referenced for further information on how the residual thresholds were set.

PBT

Persistent Bioaccumulative Toxins in the environment.

PFAS

Per- and polyfluoroalkyl substances

PFOA

The fluorinated organic compound perfluoro-octanoic acid: CAS RN 335-67-1 (straight-chain isomer), IUPAC systematic name 2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-Pentadecafluoro-octanoic acid ($C_7F_{15}CO_2H$) or its carboxylate anion perfluoro-octanoate.

PFOS

The fluorinated organic compound perfluoro-octane sulphonic acid: CAS RN 1763-23-1, IUPAC systematic name 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-Heptadecafluoro-1-octanesulfonic acid or its ionised form perfluoro-octane sulphonate ($C_8F_{17}SO_3^-$).

6:2 Fluorotelomers (6:2Ft) and short-chain homologues

The polyfluorinated organic compounds containing a perfluoroalkyl tail (n=6), a dimethylene spacer (n=2) and a functional group. For example, 6:2 fluorotelomer sulphonate (6:2FtS): CAS RN 27619 97-2, IUPAC systematic name 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctane-1- sulphonate or 1H,1H,2H,2H-perfluorooctane sulfonic acid. Also other short-chain fluorotelomers homologues such as 4:2 and 5:3 fluorotelomers.

Safety data sheet (SDS)

Safety data sheet (SDS), previously referred to as a material safety data sheet (MSDS), in the form described by the Safe Work Australia Code of Practice Preparation of Safety Data Sheets for Hazardous Chemicals (2011). Information relevant to potential environmental impacts should be placed in Section 12–Ecological Information of the SDS.

Wastewater

Any contaminated water generated from fire training or foam testing activity.