Ministry for the Environment
Manatū Mō Te Taiao

*Per and poly-Fluorinated Alkyl Substances (PFAS)*

PER AND POLY-FLUORINATED ALKYL SUBSTANCES (PFAS)

# PFAS advice for councils

This fact sheet provides information to be considered when identifying, assessing and investigating land where PFAS was manufactured, used or disposed. This guidance is intended to be consistent with the PFAS National Environmental Management Plan (PNEMP) developed by the Heads of EPAs Australia and New Zealand (HEPA) and released in February 2018.

## Introduction

### What is PFAS?

PFAS is an acronym for a group of chemical compounds known as per- and poly-fluorinated alkyl substances that have been extensively manufactured and used worldwide.

PFAS compounds have been used since the 1950s to give a wide range of products some unique physical and chemical properties. These products can resist heat, stains, grease and water, and include furniture protectants, floor wax, treated fabrics and leather, paper products, non-stick cookware, food packaging, insecticides and specialised firefighting foams.

PFAS compounds are a complex family of more than 3,000 synthetic fluorinated organic chemicals, although not all are currently in use or production. PFAS include both per- and polyfluorinated chemicals. Perfluorinated chemicals, such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), are a subset of PFAS with carbon chain atoms that are totally fluorinated, while polyfluorinated chemicals have at least one carbon chain atom that is not totally fluorinated.

PFOA and PFOS are chemicals that have been used in firefighting over the last 50 years to improve the ability of fire-fighting foams to smother fire. These foams have been used for flammable liquid fires at airports and other fire training sites across New Zealand.

### Why are PFAS important?

The scientific community is rapidly recognising and evolving its understanding of PFAS in the environment. PFAS compounds in the environment are considered to be emerging contaminants of concern. Some PFAS are environmentally stable, mobile, persistent, and bioaccumulative.

PFAS are found globally in both remote and urban environments, and some PFAS compounds are present in various matrices including humans, soils, sediments, surface and groundwater, and wildlife. There is evidence there may be health effects associated with sustained exposure to some PFAS.

## PFAS industries and activities

PFAS has been used in a range of production and manufacturing industries.  Many of these may have used other hazardous substances and potentially have already been identified on regional council HAIL registers. However, not all PFAS sites clearly align with the existing HAIL categories and these sites may require additional work to identify.  Examples include the use of Class B fire-fighting foams for flammable liquid fires that occurred at a non-industrial locations (e.g vehicle fires) and where fire suppressant systems have been manufactured and tested.

It is not thought that PFAS compounds have been manufactured in New Zealand. PFAS compounds have been used to make fluoropolymer coatings and products that are oil and water repellent such as Teflon®, StainMaster® carpets, Scotchgard®, and GoreTex®. Therefore it is expected that many industries/manufacturing facilities will have used PFAS to produce goods.

Potential sources of PFAS releases to the New Zealand environment based on the manufacturing and other sectors are detailed in the table 1 below.

**Table 1: Potential sources of PFAS**

| Industry and/or activity Sector<br>(HAIL category) | Example of uses |
|---|---|
| **Fire-fighting - Events and Training**<br>(F1. Airports where there has been use of firefighting foams on a regular basis.<br>A13: Petroleum or petrochemical industries<br>F5. Port activities) | Commercial airports, Firefighting training centres, Oil terminal and depots, chemical plants and Ports , fire suppressant systems using Class B Fluorine containing foams |
| **Metal Plating & Etching**<br>(D3. Metal treatment or coating) | Corrosion prevention, mechanical wear reduction, aesthetic enhancement, surfactant, wetting agent/fume suppressant for chrome, copper, nickel and tin electroplating, and postplating cleaner. |
| **Textiles, Upholstery & Leather**<br>(A16. Skin or wool processing) | Factory or consumer-applied coatings to repel water, oil, and stains. Applications include protective clothing and outerwear, umbrellas, tents, sails, architectural materials, carpets, and upholstery. |
| **Paper Products**<br>(A15. Printing) | Surface coatings to repel grease and moisture. Uses include non-food paper packaging (for example, cardboard, carbonless forms, masking papers) and food-contact materials (for example, pizza boxes, fast food wrappers, microwave popcorn bags, baking papers, pet food bags). |
| **Wire Manufacturing**<br>(D3. Metal treatment or coating) | Coating and insulation. |
| **Industrial Surfactants, Resins, Moulds, Plastics**<br>(A2. Chemical manufacture, formulation or bulk storage<br>A17. Storage tanks or drums for fuel, chemicals or liquid waste ·<br>A13: Petroleum or petrochemical industries<br>F8. Transport depots or yards) | Manufacture of plastics and fluoropolymers, rubber, and compression mould release coatings; plumbing fluxing agents; fluoroplastic coatings, composite resins, and flame retardant for polycarbonate. |
| **Photolithography, Semiconductor Industry**<br>(A15. Printing<br>B3. Electronics commercial manufacturing, reconditioning or recycling) | Photoresists, top anti-reflective coatings, bottom anti-reflective coatings, and etchants, with other uses including surfactants, wetting agents, Photo imaging-X-ray films and photo-acid generation. |
| **Waste Disposal**<br>(G3. Landfill sites) | Landfills that received soil and material from the other PFAS activities listed. |

| | |
|---|---|
| **Waste Water Treatment Plants**<br>(G6. Waste recycling or waste or wastewater treatment) | Sewage treatment facilities that received trade waste from industries that use PFAS |
| **Bio-solids**<br>(G6. Waste recycling or waste or wastewater treatment) | The discharge of PFAS contaminated bio-solids to land as soil conditioner. |
| **Aircraft Maintenance Facilities** | Used in aviation hydraulic fluids |
| **Pesticide manufacturing or formulation**<br>(A12. Pesticide manufacture) | Pesticide manufacture, (one product – lithium salt of PFOS, used as ant bait, so not widespread use in pesticides). |

# Factors to consider when assessing PFAS sites

## PFAS properties

Originally, all PFAS were considered relatively inert and non-hazardous substances. However due to the solubility and persistence of many PFAS, environmental release mechanisms include air emission and dispersion, spills, and disposal of manufacturing wastes and wastewater. Potential impacts to air, soil, surface water, stormwater, and groundwater are present not only at release areas but have the potential to migrate to the surrounding area.

These substances are chemically very inert, resistant to high temperatures, they reduce surface tension and are water and dirt repellent and grease proof. These properties made PFAS an industrial success, but have also led to persistence, bio-accumulation and, in some cases, toxicity in the environment. Their persistence in the environment (100+ years) and in the human body (4-8 years) has made them contaminants of concern both nationally and internationally.

Chemical properties common to PFAS are that they are water soluble, have low volatility and resistant to biodegradation. PFAS do not degrade in the environment and are not removed by conventional water treatment methods, such as in-situ pump and treat, soil vapour extraction and air sparging. These properties can make PFAS a significant groundwater contaminant.

## PFAS toxicity and eco-toxicity

Currently there is no consistent evidence that environmental exposures at the low levels New Zealanders are generally exposed to will cause harmful health effects. There is no conclusive evidence that PFOS and PFOA exposure will result in future health problems. The evidence of health effects is not clear, and some effects may not be clinically significant. However, the long-term accumulation of these chemicals in the body has prompted concerns about possible health effects. Long-term the best way to avoid exposure to PFOS and PFOA is to limit their use in New Zealand.

Available data on PFAS toxicity is dominated by PFOS, PFOA and also perfluorohexane sulfonate (PFHxS) due to the widespread detection, mainly overseas, of these compounds in humans and the environment, and concern that these could biomagnify to a level whereby humans may be adversely affected. Much less data is available on the toxicology of other PFAS, and this is often inconsistent and fragmentary.

Human exposure to PFAS is mainly by ingestion of contaminated food or water. These compounds are not metabolised, bind to proteins (not to fats) and are mainly detected in blood, liver and kidneys. Elimination of PFOS, PFHxS and PFOA from the human body takes some years, whereas elimination of shorter chain PFAS is in the range of days.

The potential effects of exposure to PFOS and PFOA to human health continue to be studied. These studies involve laboratory animal studies, as well as occupationally exposed workers, residents in communities with higher exposure and studies of the general population in the USA and other countries.

In 2010, the Ministry of Health commissioned Massey University's Centre for Public Health Research to carry out a biomonitoring study to quantify the concentrations of selected persistent organic pollutants (POPs) in the blood serum of adult New Zealanders. The study was completed in 2013 and the results showed that the concentrations of PFOA in adult serum are generally similar to, or lower than, those in the USA, Canada, Germany, and Australia, while the concentrations of PFOS are considerably lower than those in USA, Canada, Germany, and Australia.

The World Health Organization (WHO) has not recommended a guideline level for PFAS compounds in drinking-water. The Ministry of Health has recommended interim guidance levels for PFOS and PFOA in drinking-water, which are the same values being proposed in Australia.

The interim guidance levels for PFOS and PFOA in drinking water were derived from effects found at certain doses in animal studies. The calculation of the guidance levels included appropriate uncertainty factors to take account of issues like differences between humans and animals. The guidance levels are based on a person weighing 70 kg drinking 2 litres of water every day over a lifetime without any significant risk to health. Although there is no consistent evidence that the effects in animals also occur in humans, the Ministry of Health recommends that an alternative drinking water source is used to protect health if the interim guidance levels are exceeded.

| Interim Guidance Levels for Drinking-Water | Units µg/L |
|---|---|
| PFOS + PFHxS | 0.07 |
| PFOA | 0.56 |

Due to the multiple global sources of PFAS and the stability and persistency of these compounds they are detected across the globe, even in remote places. Concentrations have been detected in a variety of wildlife (seals, polar bears, fish, dolphins, birds) on all continents. They also bio-accumulate in the food chain.

Ecotoxicity data were primarily identified for aquatic organisms such as algae, aquatic plants, invertebrates and fish, and birds. Ecotoxicity tests of PFAS are mostly limited to PFOS and PFOA, and the dataset is small in comparison to established pollutants, but also to many other emerging chemicals of concern.

PFOS has been categorised as moderately acutely and slightly chronically toxic to aquatic organisms. Because many PFAS and especially PFOS are persistent, longer-term exposures may occur in the environment. Acute invertebrate toxicity data show that marine invertebrates are more sensitive to short-term PFOS exposure than freshwater invertebrates.

Acute toxicity testing with aquatic species indicates that PFOA is generally less toxic than PFOS. There is about a factor of 10 difference. Some studies in aquatic organisms show the potential of PFOA to affect endocrine function. Other studies show toxicity in other different organisms such as shellfish, marine mammals, turtles and rats. PFOA also exhibits low chronic toxicities in benthic organisms.

## Environmental guidelines

The PNEMP contains the latest series of human health and environmental guidelines. The guidelines for soil investigation, freshwater and marine water are summarised below.

### Soil criteria for investigation – human health based guidance values

| Exposure scenario | PFOS/PFHxS | PFOA | Land use |
|---|---|---|---|
| Soil – Human health screening values | 0.009 mg/kg | 0.1 mg/kg | Residential with garden/ accessible soil |
| | 2 mg/kg | 20 mg/kg | Residential with minimal opportunities for soil access |
| | 1 mg/kg | 10 mg/kg | Public open space |
| | 20 mg/kg | 50 mg/kg | Industrial/ commercial |

**Aquatic ecosystems: freshwater and marine water guideline values for ecological protection**

| Exposure scenario | PFOS | PFOA | Exposure scenario |
|---|---|---|---|
| Freshwater | 0.00023 µg/L | 19 µg/L | 99% species protection – high conservation value systems |
| | 0.13 µg/L | 220 µg/L | 95% species protection – slightly to moderately disturbed systems |
| | 2 µg/L | 632 µg/L | 90% species protection – highly disturbed systems |
| | 31 µg/L | 1824 µg/L | 80% species protection – highly disturbed systems |
| Interim marine | 0.00023 µg/L | 19 µg/L | 99% species protection – high conservation value systems |
| | 0.13 µg/L | 220 µg/L | 95% species protection – slightly to moderately disturbed systems |
| | 2 µg/L | 632 µg/L | 90% species protection – highly disturbed systems |
| | 31 µg/L | 1824 µg/L | 80% species protection – highly disturbed systems |

## PFAS sampling and analysis

Because of the potential presence of PFAS in common consumer products and in equipment often used to collect groundwater samples, special handling and care must be taken when collecting PFAS samples. Sampling should be undertaken by a suitably qualified and experienced person.

Currently, in New Zealand only AsureQuality is accredited to analyse the various environmental media for PFAS with the limit of detection required for environmental assessments. It is recommended that you discuss your analysis requirements with the laboratory prior to undertaking any sampling and analysis.

## Environmental Protection Authority investigations

The Environmental Protection Authority (EPA) is investigating fire-fighting foams manufactured using PFOS or PFOA that are held or being used at airports and other locations. All hazardous substances, including fire-fighting foams, that are imported, manufactured or used in New Zealand require approval by the EPA under the Hazardous Substances and New Organisms Act 1996.

Foams manufactured using PFOS or PFOA have not been legal for use in New Zealand since 2006. The EPA's initial priority has been to identify the types of foam held, whether they have been used or not, and how and where they are stored. If any do not have an appropriate approval the EPA will check that they are safely stored. Provided these foams are safely stored, they pose no immediate risk to people or the environment.

As part of its inquiry, the EPA is visiting airports across the country. It is taking samples of fire-fighting foams and having them tested by an independent, qualified laboratory. On the basis of test results being positive for PFOS, the EPA has served a Compliance Order on one airport. This requires the airport to stop using fire-fighting foam containing PFOS when responding to emergencies as soon as practicable. In the interim, the airport may continue using the foam for emergencies, in the interests of safety. The Compliance Order also requires the airport to cease using the foam for training or testing purposes, and to submit a plan detailing steps that will be taken to ensure the foam is no longer used.

The EPA is not involved in assessing the environmental consequences arising from use of PFAS substances, nor in their remediation.

For further information and guidance we have attached the following links below

PFAS National Environmental Management Plan, HEPA January 2018

PFAS (per- and poly-fluoroalkyl substances), MfE 2018

PFAS — Per- and Polyfluoroalkyl Substances, ITRC November 2017

Environmental fate and effects of poly and perfluoroalkyl substances (PFAS) Concawe June 2016

PFOS & PFOA guidelines, CRCCARE

Health Based Guidance Values for Per- and Poly-Fluoroalkyl Substances (PFAS), Department of Health September 2017

Procedural Review of Health Reference Values Established by enHealth for PFAS, Department of Health

Managing fire-fighting foams manufactured with PFAS chemicals, EPA 2018

## Disclaimer



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