

# **Preliminary targeted assessment of PFAS in eels downstream of source sites**

For the PFAS Interagency Working Group

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ENVIRONMENT PROTECTION AUTHORITY

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### **Enquiries:**

Environment Protection Authority

GPO Box 1550

Hobart, Tasmania 7001

Telephone: (03) 6165 4599

Email: [Enquiries@epa.tas.gov.au](mailto:Enquiries@epa.tas.gov.au)

Web: [www.epa.tas.gov.au](http://www.epa.tas.gov.au)

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## Executive Summary

The EPA coordinated this eel sampling survey with input on study aims and design from the Tasmanian *Interagency Working Group for PFAS*. The physical collection of samples was completed by the Inland Fisheries Service between April and July 2021. Eels were harvested from areas downstream of three known source sites. Samples were also collected from upstream locations when there were eels present. Results were compared to relevant human health criteria for consumption of finfish.

All results were equal to or exceeded the criteria by up to two orders of magnitude. The results from Devonport Airport were the least contaminated. The results from downstream of the Cambridge Tasmania Fire Service training area and Launceston Airport were significantly elevated, exceeding the criterion by two orders of magnitude. No landowners reported that they ate the eels from their properties.

This study confirms that eels caught in areas of known per- and poly-fluoroalkyl substance (PFAS) pollution report significantly elevated levels of PFAS.

This report details the source sites that were the focus of this study but does not detail the locations of the eel samples taken where this is on private land.

## 1.0 Introduction

The *Interagency Working Group for PFAS* determined at its 1 February 2021 meeting that a preliminary assessment of PFAS concentrations in eels downstream of known source locations should be undertaken. This decision was based on the detection of elevated concentrations of PFAS in eels sampled from Barilla Rivulet, Cambridge, downstream of a known PFAS source location. The Inland Fisheries Service (IFS) agreed to collect eel samples based on a sampling plan prepared by the EPA.

The purpose of the sampling was to determine whether eels caught in the proximity of known areas of PFAS pollution report elevated levels of PFAS.

### 1.1 Previous sampling

A report entitled *Tasmania Fire Service - PFAS Management Program – Cambridge Offsite Investigations – July 2020* was provided to the EPA and detailed eel sampling which had occurred in 2018. All eels sampled from the vicinity of Barilla Rivulet, Cambridge, had elevated PFAS but the sample size was small. Results were two orders of magnitude greater than the *FSANZ Proposed Trigger Points for investigation - Fish and Seafood – Finfish (all)* (Food Standards Australia New Zealand) as detailed in the *Consolidated Report - Perfluorinated Chemicals in Food, April 2017*. The source of the PFAS was deemed to be the Tasmania Fire Service (TFS) Training Facility in Cambridge (southern Tasmania) and the sampling had been conducted as part of their off-site assessment work. TFS are managing this issue by providing management advice to landowners, for instance, to not collect eels for consumption.

Additionally, elevated PFAS in eels (and other species) was detected during Department of Health (Tasmanian Government) sampling downgradient of Launceston Airport in mid-2019. Two eels were caught at St Leonards Picnic Ground in Launceston. No eels were caught at the other

sampling locations further upstream in the North Esk River. Analysis of the two eels revealed PFAS results which were one order of magnitude higher than the *FSANZ Proposed Trigger Points for investigation - Fish and Seafood – Finfish (all)*. Other fish species were also caught and analysed which contributed to the decision to issue a Public Health advisory to avoid consuming fish from this part of the North Esk. Link to the advice: [Investigation of PFAS in North Esk River - Summary | Tasmanian Department of Health](#)<sup>1</sup>

## 1.2 Objectives and limitations of this study

This study provides a preliminary assessment of the potential for eels to accumulate elevated concentrations of PFAS and to determine if chosen human health-based trigger values are exceeded. The focus of this work was on areas around known source sites and thus most likely to contain eels with elevated concentrations. Sampling upgradient of the source site was included where possible. Although the sampling was focused on known source sites it is acknowledged that there may be other sources of PFAS at these locations.

Limitations of this study:

- Animal behaviour or exposure pathways were not considered.
- The study seeks only to confirm whether eels caught in the proximity of known PFAS pollution typically report elevated PFAS levels.
- Water sampling would not be conducted at the survey site.
- No temporal sampling was undertaken as part of this study. This sampling event provides a ‘snapshot’ only.
- This study is limited to eels (no other biota) around areas of known PFAS impacts.
- Sample numbers were limited to 20 per site. Taylor (2019) determines that sampling more than 20 individuals will provide a better approximation of mean or median when collecting biota for human health risk assessment; 30 – 50 individuals provides the best result. Therefore, in collecting fewer than optimal samples it is accepted that the results of this study are not as robust as they might otherwise be, and any proposed management actions based on these results ought to take this into account.

## 2.0 Methodology

### 2.1 Site Selection

The EPA sampling plan provided maps with general locations specified. These were determined in consultation with IFS. IFS were, however, to determine the best locations when in the field.

The locations that were sampled/assessed for eel habitat were as follows:

- a. Hobart Airport – Sinclair Creek and nearby drainage channels were visited by IFS. No samples were taken as it was not deemed to be good eel habitat due to being semi-tidal.

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<sup>1</sup> <https://www.health.tas.gov.au/publications/investigation-pfas-north-esk-river-summary>

- b. Devonport Airport – there are several dams within a kilometre of the airport. One location was on Airport land and likely down or cross gradient of the fire training ground. Two locations were likely upgradient and were farm dams up to 3 km from the fire training ground.
- c. Launceston Airport – Rose Rivulet was checked in two locations up hydraulic gradient of the airport; neither location yielded eels despite appearing to be good eel habitat. Downgradient of the Airport, a location on Rose Rivulet was sampled. Another location, a dam, was checked but did not yield eels.
- d. Cambridge, Tasmania Fire Service (TFS) Training Facility - Eel samples were taken from two locations downstream of the TFS facility, on Barilla Rivulet. Additionally, eel sampling occurred over a kilometre upstream of the TFS facility, in Barilla Rivulet.

## 2.2 Collection and processing methodology

When collecting, handling, dissecting, and storing eel samples it is important to avoid contamination with PFAS substances – the sampling plan specified details.

The aim at each site was to collect up to 20 individual eels, either short or long finned. In practice, only short-finned, *Anguilla australis*, eels were caught. As commercial harvesting by licensees is limited to eels larger than 300 mm in length, the aim was to collect eels of this size or greater. In one location, however, IFS collected some that were slightly under the approved catch size as this was what was present.

Edible portions from each eel were dissected by IFS prior to providing to Analytical Services Tasmania (AST). The minimum muscle requirement for biota sampling is 25 g for PFAS analysis. IFS reported that they provided amounts well in excess of this. Skin was left on. Where a sample was smaller than 300 mm the whole animal was bagged. Zip lock bags were used.

Samples were frozen and delivered to the lab at the completion of sampling at all locations. Sample holding times are 7 to 14 days which were significantly exceeded; AST advised that freezing would extend the acceptable holding times.

An Eel Catch Data sheet was prepared by IFS which provides locations, species, catch method and sizes caught. The sheet details the total number of eels caught even though not all were processed for analysis; this gives an indication of prevalence of eels in the location. To protect personal location data this sheet has not been included in this report however some details are provided in Table I.

## 2.3 Laboratory Analysis and QA/QC

Eels were composited in the lab with up to 5 individuals per sample. Where possible, composites were comprised of similar sized specimens. The EPA advised the laboratory on which samples to composite, following receipt of Eel Catch Data sheet from IFS. Individual eels were analysed where numbers collected at a location were less than 5.

Analyses were conducted for an extended suite of 34 PFAS compounds, for which standard analytical methodologies have been developed. The suite includes those PFAS listed, and under consideration for listing, under the Stockholm Convention. Refer Appendix A for the list of parameters analysed.

The AST information sheet provides further details on the parameters and the reporting limits at [PFAS analysis at AST](#)<sup>2</sup>.

AST prepared duplicates for the secondary lab – National Measurement Institute, Sydney (NMI). Composite samples were split for secondary lab analysis at a rate of one per 10 composite samples. Choice of duplicate samples was based on achieving a mix of likely higher and lower concentrations. Duplicate analyses provide data on analytical precision and reproducibility of results.

## 2.4 Basis of Assessment - Criteria

The results will be compared to the *FSANZ Proposed Trigger Points for investigation - Fish and Seafood – Finfish (all)* as contained in the *Consolidated Report – Perfluorinated Chemicals in Food, April 2017* (FSANZ 2017). See Table I for details. Trigger points are explained in the report as follows:

“Trigger points are the maximum concentration level of these chemicals that could be present in individual foods or food groups so even high consumers of these foods would not have dietary exposures exceeding the relevant TDI”. Page 7

**Table I Proposed trigger points for investigation (From: FSANZ 2017 report)**

Food	Food classification	Proposed trigger points for investigation (µg/kg)		Derivation
		PFOS, PFOS+ PFHxS combined	PFOA	
Fish and Seafood	Crustaceans <sup>#</sup>	65	520	Children 2-6 years, median consumption
	Finfish (all)	5.2	41	Children 2-6 years, P90 consumption
	Fish liver <sup>#</sup>	280	2240	Population 2+ years, median consumption assumed to be 5 g (weight of one liver)*
Animal Products	Meat mammalian	3.5	28	Children 2-6 years, P90 consumption
	Milk	0.4 or LOD if higher	2.8	Children 2-6 years, P90 consumption
	Honey	33	264	Children 2-6 years, P90 consumption
	Offal mammalian <sup>#</sup>	96	765	Population 2+ years, median consumption
	Poultry eggs	11	85	Children 2-6 years, P90 consumption
Fruits and vegetables	Fruit (all)	0.6 or LOD if higher	5.1	Children 2-6 years, P90 consumption
	Vegetables (all)	1.1 or LOD if higher	8.8	Children 2-6 years, P90 consumption

Pale blue box shading added by EPA to highlight the relevant criteria.

Table footnotes not repeated here as do not relate to the Finfish (all) criteria

## 3.0 Results

### 3.1 Data Quality assessment

Field quality control samples e.g. field blanks, equipment blanks and trip blanks were not collected for this project.

<sup>2</sup> [https://analyticalservices.tas.gov.au/Documents/PFAS\\_analysis\\_at\\_AST.pdf](https://analyticalservices.tas.gov.au/Documents/PFAS_analysis_at_AST.pdf)

The laboratories used for this assessment are NATA accredited for the PFAS analyses conducted and as such implement internal QA/QC procedures during sample analysis. No quality issues were notified; however, it is acknowledged that sample holding times were exceeded. As the samples were frozen this is considered acceptable.

Split samples were prepared by AST for analysis at a secondary laboratory (NMI); the purpose being to indicate repeatability of results. This was conducted for five samples. A table showing this comparison for two parameters is provided in Appendix B. The relative percentage differences (RPD) between the primary and secondary laboratory are calculated and provided in this table. A nominal acceptance criterion is 50% RPD for organics. Of the ten calculations, three exceeded the nominal acceptance criterion.

### 3.2 Analytical results

Laboratory results sheets are not provided in this report. Table 2 provides the average and max/min results for each location for PFOS+PFHxS. Figure 1 depicts the average of the composites for each location. The focus of the below discussion is on PFOS+PFHxS as these are the relevant human health criteria available, although some other PFAS's were identified as provided in Tables 3, 4 and 5. There is a FSANZ criterion for PFOA but this was not detected in any sample.

For brevity, Tables 3, 4 and 5 only include those parameters detected above the Limit of Reporting (LOR). Those parameters not listed in a given table are below the LOR for all samples included in that Table.

**Table 2. Location/eel catch data and PFOS+PFHxS (ug/kg) results summarized**

Location	Eel numbers collected for analysis	Number of Composites of 4 - 5 individuals	Concentration - average of PFOS+ PFHxS ug/kg	Min/Max concentration of PFOS+ PFHxS ug/kg
<b>FSANZ Proposed Trigger Points for investigation for fish and seafood - finfish</b>			<b>5.2</b>	
Potential source site assessed: TasFire Service Cambridge Facility				
Barilla Rivulet - ~1 km upstream of TFS facility, Cambridge	19	4	35	30/ 42
Barilla Rivulet, Cambridge	20	4	301	238/ 351
Barilla Rivulet, Cambridge	20	4	199	150/ 286
Potential source site assessed: Devonport Airport				
Farm Dam, Port Sorell	8	2	12	11/ 13
Farm Dam, Port Sorell	9	2	5	4/ 5
Devonport airport marshland	4	No compositing	11	8/ 15
Potential source site assessed: Launceston Airport				
Rose Rivulet, Relbia	15	3	213	175/ 236



### 3.2.1 Devonport Airport

Eel samples at Devonport Airport gave detects for PFOS and PFHxS. The sample location on Airport land, down/cross gradient of the fire training ground, reported around double the FSANZ criterion for PFOS+PFHxS in eels. The two other locations sampled in the vicinity of the airport were further from the coast. These locations gave detects for PFOS; samples were from farm dams up to 3 km from the fire training ground. The closest dam to the airport gave results that were equal to the criterion and the farthest about double. Therefore, there are no clear trends in relation to proximity to the airport. See Table 3 for results for those PFAS detected and key parameters highlighted.

**Table 3 Devonport Airport and vicinity - PFAS in eel results (ug/kg)**

Parameters	Airport - individual sample IDs				Off-site - Composite IDs			
					Location 1		Location 2	
	1	2	3	4	4	5	6	7
PFHxS	0.5	1.1	-	-	-	-	-	-
PFOS	11	14	7.7	11	13	11	5.2	3.9
PFDA	-	-	-	-	0.5	0.5	-	1.6

- means that sample was below the Limit of Reporting

### 3.2.2 Launceston Airport

Sample collection at several locations was attempted but eels were only captured in one area, in an instream dam on Rose Rivulet. This is downgradient of the Airport. PFHxS was detected in these eels as was PFOS. The results exceed the criterion (PFOS + PFHxS) by two orders of magnitude. See Table 4 for results with key parameters highlighted.

**Table 4 Launceston Airport - downgradient - PFAS in eel results (ug/kg)**

Parameters	Downstream Composite IDs – one location		
	1	2	3
PFHxS	16	15	18
PFOS	220	160	210
10:2 FTS	2.6	5.4	4.3
PFDA	0.6	-	-
PFDS	1.8	1.1	1.1
PFHpS	2.9	2.1	2.5
PFPeS	0.7	0.7	0.8

- means that sample was below the Limit of Reporting

### 3.2.3 Cambridge Fire Training Facility

Eels downstream the Cambridge Fire Training Facility exceed FSANZ criterion (PFOS+PFHxS) by two orders of magnitude in every sample. The two locations assessed were in close proximity to each other. PFOA was ND in all samples in spite of this being identified on the source site in previous environmental sampling.

The upstream composites from Barilla Rivulet, over a kilometre upstream of the Cambridge Fire Training Facility, also exceed the criterion but by one order of magnitude. Table 5 provides results with key parameters highlighted.

**Table 5 Cambridge Fire Training Ground – upstream and downstream – PFAS in eel results (ug/kg)**

Parameters	Downstream – Composite IDs								Upstream - Composite IDs			
	Location 1				Location 2							
	8	9	10	11	12	13	14	15	16	17	18	19
PFHxS	3.9	6.4	6.7	9.4	22	18	14	11	1.9	0.7	1.1	0.8
PFOS	200	280	150	140	250	220	330	340	28	41	36	30
PFDA	1.4	0.8	2.0	0.7	3.5	3.2	3.3	4.6	1.4	1.2	0.7	-
PFDS	1.5	1.3		1.2	1.7	2.6	5.3	3.9	-	-	-	-
PFHpS	1.0	1.1	1.0	1.1	2.0	1.8	1.8	1.9	-	-	-	-
PFNA	5.2	7.4	4.4	9.5	1.2	3.6	3.2	4.1	-	0.6	0.5	-
PFTTrDA	-	-	-	-	-	-	5.2	7.5	-	-	-	-
PFUnDA	23	35	14	15	25	33	47	63	-	-	-	-
10:2 FTS	-	-	-	-	4.5	4.5	5.2	5.3	-	-	-	-
6:2 FTS	-	-	-	-	18	8.1	10	5.0	-	-	-	-
8:2 FTS	-	-	-	-	11	6.1	8.1	7.1	-	-	-	-

- means that sample was below the Limit of Reporting

### 3.2.4 Other PFAS's

Generally, PFOS and PFHxS were the most encountered PFAS's. However, as provided in Tables 3, 4 and 5, other PFAS's were identified. The fluorotelomers (FTS) were identified at Cambridge and Launceston and are indicative of the use of newer generations of foams. None of these were identified at Devonport which ceased fire fighting training over 20 years ago.

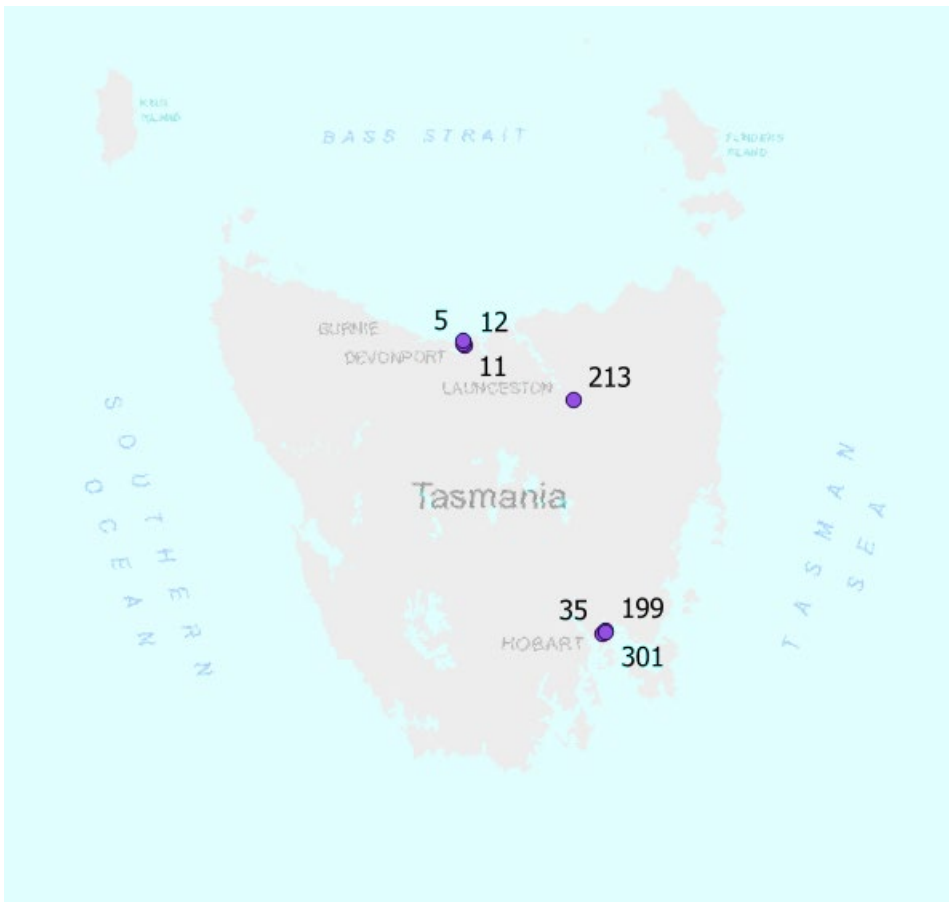
## 4.0 Conclusions

All PFOS+PFHxS results were equal to or exceeded the FSANZ proposed trigger points for investigation by up to two orders of magnitude. The results from Devonport Airport were the least elevated. The results from downstream of the Cambridge TFS training area and Launceston Airport were significantly elevated, exceeding the proposed trigger points by two orders of magnitude.

The three locations at Devonport showed no clear decreasing trends with distance from the fire training ground. The three locations in Cambridge indicated lower concentrations upstream of the TFS facility compared to downstream. No assessment of trends can be made for Launceston Airport as eels were only located in one area, in spite of several locations being checked.

This study confirms that eels caught in areas of known PFAS pollution report significantly elevated levels of PFAS as compared to the FSANZ proposed trigger points for consumption of finfish (PFOS+PFHxS). No landowners reported that they ate the eels from their properties.

Figure 1 – Averaged PFOS+PFHxS results as per Table 2 – concentrations in eels ug/kg



## Appendix A: List of PFAS compounds monitored

PFAS groups and chemical names	PFAS acronym
Perfluorobutanoic acid	PFBA
Perfluoropentanoic acid	PFPeA
Perfluorohexanoic acid	PFHxA
Perfluoroheptanoic acid	PFHpA
Perfluorooctanoic acid	PFOA
Perfluorononanoic acid	PFNA
Perfluorodecanoic acid	PFDA
Perfluoroundecanoic acid	PFUnDA
Perfluorododecanoic acid	PFDoDA
Perfluorotridecanoic acid	PFTTrDA
Perfluorotetradecanoic acid	PFTeDA
Perfluorohexadecanoic acid	PFHxDA
Perfluorooctadecanoic acid	PFODA
Perfluorobutanesulfonic acid	PFBS
Perfluoropentanesulfonic acid	PFPeS
Perfluorohexanesulfonic acid	PFHxS
Perfluoroheptanesulfonic acid	PFHpS
Perfluorooctanesulfonic acid	PFOS
Perfluorodecanesulfonic acid	PFDS
4:2 Fluorotelomer sulfonic acid	4:2 FTS
1H, 1H, 2H, 2H-perfluorooctanesulfonic acid	6:2 FTS
1H, 1H, 2H, 2H-perfluorodecanesulfonic acid	8:2 FTS
1H, 1H, 2H, 2H-perfluorododecanesulfonic acid	10:2 FTS
6:2 Fluorotelomer acrylate	6:2 FTA
8:2 Fluorotelomer acrylate	8:2 FTA
10:2 Fluorotelomer acrylate	10:2 FTA
N-ethylperfluoro-1-octane sulfonamide	N-EtFOSA
N-ethyl-perfluorooctanesulfonamidoacetic acid	N-EtFOSAA
N-methylperfluoro-1-octane sulfonamide	N-MeFOSA
N-methyl-perfluorooctanesulfonamidoacetic acid	N-MeFOSAA
Perfluorooctane sulfonamide	FOSA
Perfluorooctane sulphonamidoacetic acid	FOSAA

## Appendix B: Intra-laboratory duplicate results – Relative Percent differences (ug/kg)

Composite ID	PFHxS	PFOS
Launceston Composite 1 AST	16	220
Launceston Composite 1 NMI	19	460
RPD	17%	71%
Devonport Airport Sample 3 AST	0.5	7.7
Devonport Airport Sample 3 NMI	ND* (assume 0.25)	8
RPD	66%	3.8 %
Cambridge Composite 9 AST	6.4	280
Cambridge Composite 9 NMI	6.8	440
RPD	6%	44%
Cambridge Composite 15 AST	11	340
Cambridge Composite 15 NMI	14	670
RPD	24%	65%
Cambridge Composite 18 AST	1.1	36
Cambridge Composite 18 NMI	1.3	27
RPD	17%	29%

\*Result was ND – assume half the Detection limit (which is 0.5 for biota) for comparison purposes

## References

Food Standards Australia New Zealand, (FSANZ) Consolidated Report - Perfluorinated Chemicals in Food, April 2017. Published by Department of Health [Perfluorinated chemicals in food \(health.gov.au\)](https://www.health.gov.au)

Western Australian Department of Environment Regulation. 2016. "Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Contaminated Sites Guidelines," no. January: 34.

Taylor 2019, in Mendeley. Survey design for quantifying perfluoroalkyl acid concentrations in fish, prawns and crabs to assess human health risks

Guideline for sampling and analysis of seafood suitable for human health risk assessments of PFAS contamination ([www.qld.gov.au](http://www.qld.gov.au))



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