

# **COMPARISON OF TINDAL FOOD SAMPLES WITH PFAS TRIGGER LEVELS**

**Additional Analysis of foods from the Katherine River and Human  
Health Risk Assessment Zones 1, 2 and 3**

**Prepared for Northern Territory Department of Health**

**By**

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## 1. Background

At the request of Northern Territory Department of Health an additional report has been prepared providing refined analyses of per- and poly-fluoroalkylated substances (PFAS) in foods from a more restricted sampling area than reported in the FSANZ report *Comparison of Tindal food samples with PFAS trigger levels* (the main report). Background, data preparation and analysis methods are as reported in the main report.

Sampling conducted as part of the Department of Defence Human Health Risk Assessment (HHRA) included sampling from sites other than the Katherine River for aquatic biota and from a range of zones inside and outside of the identified PFAS investigation area for other foods (animal products, fruits and vegetables).

This report provides the analyses of perfluorooctane sulfohate + perfluorohexane sulfonate (PFOS+PFHxS) combined conducted for aquatic biota sampled from the Katherine River only, and excluded results of sampling from the Tindal Creek, Tindal Aquaponics, Daly River and Fergusson River. Additional analysis of animal products, fruits and vegetables were conducted for those foods sampled in the HHRA residential water use investigation zones 1, 2 and 3 only and excluded samples from all other investigation zones. Mean and median PFOS+PFHxS concentrations for aquatic biota and other foods in this report have been compared to mean and median concentrations as reported in the main report, which includes analysis of samples from 'all areas' including the Katherine River and investigation zones 1, 2 and 3.

Analysis of aquatic biota, animal products, fruit and vegetables from all areas, including the Katherine River and investigation zones 1, 2 and 3 in the main report found a high proportion of samples with no detected concentrations of perfluorooctanoic acid (PFOA) and that any detections of PFOA in the range of food matrices analysed were below the relevant trigger levels. Consequently, conclusions relating to PFOA as reported in the main report are applicable to this refined analysis of aquatic biota from the Katherine River only, and animal products, fruit and vegetables from investigation zones 1, 2 and 3. No further analysis of PFOA has been included in this report.

## 2. Analytical data

### 2.1. Aquatic biota

A total of 236 samples that included fish flesh (37 diadromous, 138 freshwater), fish liver (9 diadromous, 16 freshwater) and crustacea (36 cherabin) were included in the analysis of aquatic biota from the Katherine River only. One hundred and fifty-eight samples were taken from sites other than the Katherine River and were therefore excluded from this analysis. Freshwater crab (16 samples) were the only aquatic species not sampled from the Katherine River, and are not included in this analysis.

Tarpon, Archerfish, Blue Catfish (flesh and liver), Butler's Grunter (flesh and liver), Catfish and Mullet (flesh and liver) were only sampled in the Katherine River. Analysis of these species have been included in this report however, these results are the same as the analysis of data from all areas as reported in the main report.

Aquatic species sampled from other locations in addition to the Katherine River included Cherabin, Barramundi (flesh and liver), Barred Grunter, Black Catfish, Bony Bream (flesh and liver), Ord River Mullet (flesh and liver), Sleepy Cod (flesh and liver) and Sooty Grunter (flesh and liver).

Median concentrations of PFOS+PFHxS combined for fish flesh and liver were higher for samples from the Katherine River only when compared to median concentration values from sampling from all areas including the Katherine River except for cherabin (equivalent at 54.2 µg/kg) and bony bream flesh (12.3 µg/kg compared with 12.8 µg/kg, respectively). Overall across all species sampled in all areas, median concentrations were lowest for samples caught outside of the Katherine River, higher for samples from all areas and highest for samples from the Katherine River only.

## 2.2. Animal products

PFAS analytical data were available for poultry eggs (chicken, duck, turkey), poultry meat (chicken, duck) and for serum from cattle, sheep, pigs, goats and chickens. Of the range of animal products tested in the Tindal-Katherine area only chicken eggs (19<sup>1</sup> of the 67 samples) were sampled outside of investigation zones 1, 2 and 3.

## 2.3. Fruit

Limited analytical data (60 data points) from all areas including investigation zones 1, 2 and 3 were available for 14 fruit species. Of the 60 data points, two species of fruit had some samples taken outside of investigation zones 1, 2 and 3 (banana, 1 of 5 samples; and mango, 3 of 24 samples). All samples from outside investigation zones 1, 2, and 3 had PFOS+PFHxS concentrations at <LOR.

## 2.4. Vegetables

Twenty vegetable species (58 data points) were sampled from all sites in the Tindal-Katherine area. The majority of vegetables samples (50/58) were sampled inside investigation zones 1, 2, and 3. Six types of vegetables were sampled outside of investigation zones 1, 2 and 3: three of 7 spinach samples and one each of capsicum (1 sample only), eggplant (5 samples in total), tomato (11 samples in total), beetroot (1 sample only) and sweet potato (7 samples in total). Beetroot was the only vegetable sampled outside of investigation zones 1, 2 and 3 with a detected level of PFOS+PFHxS (upper bound concentration of 0.8 µg/kg).

## 2.5. Summary of analytical data

Summary analytical data for aquatic biota from the Katherine River only are provided in Table 1, with a comparison of mean and median concentrations for aquatic biota from all areas (including Katherine River) provided in Table 4.

Similarly, summary data for animal products and fruit and vegetables from investigation zones 1, 2 and 3 are provided in Tables 2 and 3, with a comparison of mean and median concentrations for foods from all areas (including zones 1, 2 and 3) in tables 5 and 6.

**Table 1 PFAS concentration data (µg/kg) for aquatic biota sampled in the Katherine River only**

Matrix	Chemical	Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
<b>Fish flesh*</b>	PFHxS	175	135	<LOR	4.1	0.5	0.3
	PFOA	179	179	<LOR	<LOR	0.5	0.5
	PFOS	179	3	<LOR	380	55.5	31.0
	PFOS+PFHxS	175	3	<LOR	380.5	56.5	32.3
<b>Fish Liver*</b>	PFHxS	25	9	<LOR	6	1.1	0.4
	PFOA	25	23	<LOR	0.7	0.5	0.5
	PFOS	25	0	3.4	1400	269.2	170.0
	PFOS+PFHxS	25	0	3.4	1406	270.3	171.3
<b>Crustaceans*</b>	PFHxS	36	8	<LOR	3.2	1.7	1.2
	PFOA	36	36	<LOR	<LOR	0.5	0.5
	PFOS	36	0	0.7	87	47.4	53.0
	PFOS+PFHxS	36	0	0.7	90.2	49.2	54.2

\*All species combined.

\*\* Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (LOR of 0.3 µg/kg for PFOS and PFHxS, 0.5 µg/kg for PFOA unless otherwise reported).

<sup>1</sup> Two chicken egg samples were identified as coming from 'zone4/zone 1' and were included in the analysis of data from zones 1, 2 and 3.

**Table 2 PFAS concentration data ( $\mu\text{g}/\text{kg}$ ) for animal products sampled in investigation zones 1, 2 and 3 only**

Matrix	Chemical	Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
<b>Meat mammalian*</b>	PFHxS	31	2	<LOR	1.8	0.6	0.5
	PFOA	31	21	<LOR	0.4	0.7	1.0
	PFOS	31	0	0.3	10.8	2.7	1.8
	PFOS+PFHxS	31	0	0.3	11.5	3.3	2.5
<b>Poultry eggs*</b>	PFHxS	56	18	<LOR	9.1	2.1	1.1
	PFOA	56	56	<LOR	<LOR	0.5	0.5
	PFOS	56	8	<LOR	100.0	15.7	8.9
	PFOS+PFHxS	56	8	<LOR	106.9	17.8	10.5
<b>Poultry meat*</b>	PFHxS	29	6	<LOR	1.2	0.5	0.4
	PFOA	29	29	<LOR	<LOR	1.0	1.0
	PFOS	29	6	<LOR	5.0	1.2	1.0
	PFOS+PFHxS	29	6	<LOR	6.2	1.8	1.8

\* All species combined.

\*\*Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (LOR of 0.3  $\mu\text{g}/\text{kg}$  for PFOS and PFHxS, 0.5  $\mu\text{g}/\text{kg}$  for PFOA, except for all serum conversion measures where the LOR is 1.0  $\mu\text{g}/\text{kg}$  for all PFAS congeners).

**Table 3 PFAS concentration data ( $\mu\text{g}/\text{kg}$ ) for fruit and vegetables sampled in investigation zones 1, 2 and 3 only**

Matrix	Chemical	Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
<b>Berry fruit*</b>	PFHxS	3	3	<LOR	<LOR	0.3	0.3
	PFOA	3	3	<LOR	<LOR	0.3	0.3
	PFOS	3	3	<LOR	<LOR	0.5	0.5
	PFOS+PFHxS	3	3	<LOR	<LOR	0.8	0.8
<b>Citrus fruit*</b>	PFHxS	11	11	<LOR	<LOR	0.3	0.3
	PFOA	11	11	<LOR	<LOR	0.3	0.3
	PFOS	11	11	<LOR	<LOR	0.5	0.5
	PFOS+PFHxS	11	11	<LOR	<LOR	0.8	0.8
<b>Cucurbits*</b>	PFHxS	2	2	<LOR	<LOR	0.3	0.3
	PFOA	2	2	<LOR	<LOR	0.5	0.5
	PFOS	2	0	0.4	0.5	0.5	0.5
	PFOS+PFHxS	2	0	0.7	0.8	0.8	0.8
<b>Fruiting vegetables curcurbits*</b>	PFHxS	2	2	<LOR	<LOR	0.3	0.3
	PFOA	2	2	<LOR	<LOR	0.3	0.3
	PFOS	2	2	<LOR	<LOR	0.5	0.5
	PFOS+PFHxS	2	2	<LOR	<LOR	0.8	0.8
<b>Herbs*</b>	PFHxS	5	5	<LOR	<LOR	0.3	0.3
	PFOA	5	5	<LOR	<LOR	0.5	0.5
	PFOS	5	3	<LOR	0.9	0.5	0.3
	PFOS+PFHxS	5	3	<LOR	0.9	0.8	0.6
<b>Leafy vegetables*</b>	PFHxS	4	1	<LOR	1.4	1.0	1.1
	PFOA	4	4	<LOR	<LOR	0.5	0.5
	PFOS	4	1	<LOR	1.3	0.8	0.8
	PFOS+PFHxS	4	1	<LOR	2.7	1.8	1.9
<b>Legume vegetables*</b>	PFHxS	7	7	<LOR	<LOR	0.3	0.3
	PFOA	7	7	<LOR	<LOR	0.5	0.5
	PFOS	7	7	<LOR	<LOR	0.4	0.3
	PFOS+PFHxS	7	7	<LOR	<LOR	0.7	0.6
<b>Other fruiting vegetables*</b>	PFHxS	16	16	<LOR	<LOR	0.3	0.3
	PFOA	16	15	<LOR	0.4	0.4	0.3
	PFOS	16	16	<LOR	<LOR	0.4	0.5
	PFOS+PFHxS	16	16	<LOR	<LOR	0.7	0.8
<b>Root and tuber vegetables*</b>	PFHxS	16	12	<LOR	1.8	0.4	0.3
	PFOA	16	16	<LOR	<LOR	0.5	0.5
	PFOS	16	9	<LOR	5.7	0.8	0.3
	PFOS+PFHxS	16	8	<LOR	7.5	1.3	0.6
<b>Tree nut*</b>	PFHxS	2	2	<LOR	<LOR	0.3	0.3
	PFOA	2	2	<LOR	<LOR	0.3	0.3
	PFOS	2	2	<LOR	<LOR	0.5	0.5
	PFOS+PFHxS	2	2	<LOR	<LOR	0.8	0.8
<b>Tropical fruit*</b>	PFHxS	2	2	<LOR	<LOR	0.3	0.3

Matrix	Chemical	Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
	PFOA	2	2	<LOR	<LOR	0.3	0.3
	PFOS	2	2	<LOR	<LOR	0.5	0.5
	PFOS+PFHxS	2	2	<LOR	<LOR	0.8	0.8
<b>Tropical fruit inedible peel*</b>	PFHxS	36	36	<LOR	<LOR	0.3	0.3
	PFOA	36	32	<LOR	1.7	0.4	0.3
	PFOS	36	32	<LOR	1.7	0.5	0.5
	PFOS+PFHxS	36	32	<LOR	1.7	0.8	0.8

\* All species combined.

\*\*Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (LOR of 0.3 µg/kg for PFOS and PFHxS, 0.5 µg/kg for PFOA, except for all serum conversion measures where the LOR is 1.0 µg/kg for all PFAS congeners).

### 3. Comparison with trigger levels

#### 3.1. PFOA

As described in the main report, the majority of PFOA analyses for aquatic species, animal products, fruit and vegetable for samples from all areas (including the Katherine River and investigation zones 1, 2 and 3) were reported to be <LOR. Where there were detections of PFOA, all concentrations were below relevant trigger levels.

#### 3.2. PFOS+PFHxS combined

##### *Aquatic biota*

Summary PFOS+PFHxS concentration data for aquatic species sampled only from the Katherine River, including a comparison with mean and median concentrations for species sampled from all areas (including the Katherine River), as reported in the main report, are provided in Table 4.

For fish flesh from all species sampled in the Katherine River only, 158 of the 175 samples (90%) had concentrations that exceeded the PFOS+PFHxS trigger level of 5.2 µg/kg, a higher proportion compared to fish flesh sampled from all areas (82%). Median concentrations for fish flesh for each species sourced from the Katherine River only were higher than for median concentrations for samples sourced from all areas (except for Bony Bream), all exceeding the PFOS+PFHxS trigger level of 5.2 µg/kg.

The median PFOS+PFHxS concentration for all fish flesh combined for samples sourced from the Katherine River only was 32.3 µg/kg, compared with a median of 17.3 µg/kg for fish flesh from all areas including the Katherine River, and higher than the trigger level of 5.2 µg/kg. This indicates that, overall, consumption of a range of these fish species from the Katherine River over time may present a public health and safety concern if these species are consumed on a regular basis.

Similarly for fish liver, a higher proportion (28%) of samples from the Katherine River only had PFOS+PFHxS concentrations greater than the trigger level of 280 µg/kg, compared to fish livers sourced from all areas (18%). Median concentrations for fish liver were lower than the PFOS+PFHxS trigger level of 280 µg/kg for all of the species from the Katherine River only analysed except for liver from Ord River Mullet (two samples, mean/median concentration 506.4 µg/kg compared to a median concentration of 195.6 µg/kg for Ord River Mullet liver from all areas). Note that Archerfish, Blue Catfish, Butler's Grunter, Catfish and Mullet liver samples were only sourced from the Katherine River and concentrations are therefore the same as for all areas.

The median PFOS+PFHxS concentration for all fish liver combined for samples sourced from the Katherine River only was 171.3 µg/kg, which was lower than the trigger level of 280 µg/kg but higher than the median concentration for fish liver from all areas of 98.8 µg/kg.

For crustacea, Cherabin were sampled in all areas including the Katherine River while Freshwater Crab was sampled elsewhere but not sampled in the Katherine River. For Cherabin sourced only in the Katherine River, 15 of the 36 samples (42%) exceeded the crustacea and mollusc trigger level of 65 µg/kg, a higher proportion compared to Cherabin from all areas (15/39 samples, 38%). The median concentration of PFOS+PFHxS for Cherabin sourced only from the Katherine River was 54.2 µg/kg, the same as for Cherabin sourced from all areas, and is lower than the trigger level of 65 µg/kg.

For the majority of fish species sampled from the Katherine River when considered individually the number of data points was < 25 so results need to be considered in light of these small sample numbers.

#### *Animal products*

Summary PFOS+PFHxS concentration data for animal products (mammalian meat, poultry meat and poultry eggs) sourced from investigation zones 1, 2 and 3 only, including a comparison with mean and median concentrations for products sampled from all areas, as reported in the main report, are provided in Table 5.

Chicken eggs were the only product sourced both within and outside of investigation zones 1, 2 and 3. Twenty one of the 48 eggs (44%) sourced within zone 1, 2 and 3 had concentrations greater than the trigger level of 11 µg/kg for poultry eggs, compared with 31% (21/67 samples) for eggs sourced from all areas. All eggs with PFOS+PFHxS concentrations greater than the trigger level came from zones 1, 2 and 3. For eggs sourced from within zones 1, 2 and 3 the median PFOS+PFHxS concentration was 9.2 µg/kg, higher than the median concentration for eggs sourced from all areas (3.8 µg/kg) but still less than the trigger level of 11 µg/kg for poultry eggs.

#### *Fruit and vegetables*

Summary PFOS+PFHxS concentration data for fruits and vegetables sourced from investigation zones 1, 2 and 3 only, including a comparison with mean and median concentrations for species sampled from all areas, as reported in the main report, are provided in Table 6.

Given the very limited sampling that took place outside of investigation zones 1, 2 and 3 and the high proportion of non-detects, the upper bound median concentrations for almost all fruits and vegetables sourced from within zones 1, 2 and 3 only were equivalent to fruit and vegetables sourced from all areas, including zones 1, 2 and 3. Median concentrations were at or about the limit of detection for all fruit and vegetables assessed with the exception of sweet potato and spinach, for which median concentrations were higher for those sampled in zones 1,2 and 3 compared to samples from all areas; sweet potato (median concentration of 0.7 µg/kg compared to 0.6 µg/kg for sweet potato from all areas), and spinach (median concentration 1.9 µg/kg for the four samples sourced within zones 1, 2 and 3, compared to a median concentration of 0.6 µg/kg for the seven samples sourced from all areas).

#### **4. Serves of food to reach the health based guidance value for PFOS**

Tables 7 and 8 provide an indication of the approximate number of serves of foods sampled from the Katherine River or investigation zones 1, 2 and 3 that can be consumed with median PFOS+PFHxS combined concentrations before reaching the Tolerable Daily Intake (TDI) for PFOS of 0.02 µg/kg bw, on a food by food basis. This information is provided for the whole population aged 2+ years (Table 7) and children aged 2-6 years (Table 8). All fish and crustacea are included, except for freshwater crab which was not sampled in the Katherine River. For foods from investigation zones 1, 2 and 3 only, only those foods where the median concentrations were different to median concentrations for samples from all areas are reported (chicken eggs, spinach and sweet potato).

For all tables, the grams per day, number of serves per day, week or month have been rounded down, to be conservative. For foods where there were no detects in any of the samples, the grams per day, number of serves per day and week are based on an upper bound median where non-detect results for PFOS and PFHxS were both assigned the reported LOR. This gives a conservative estimate of the amount of food that can be consumed, as actual levels of these PFAS chemicals are likely to be < LOR.



## 5. Conclusion

On the basis of the limited data provided, it is concluded that overall, exposure to PFAS from consumption over time of foods sourced or grown in investigation zones 1, 2 and 3, including mammalian meat, poultry eggs, poultry meat, fruit and vegetables is unlikely to present a public health and safety concern. This was also the case for fish liver and Cherabin sourced from the Katherine River only.

For aquatic biota sourced from the Katherine River only, the median PFOS+PFHxS concentrations were higher for all species (except Bony Bream) compared to median concentrations for aquatic biota sourced from all areas, including the Katherine River, with a greater proportion of individual samples exceeding trigger levels. Reported median concentrations of PFOS+PFHxS for fish flesh from the Katherine River only exceeded the trigger level for fish flesh for all species sampled. This reflects the findings in the main report, for fish flesh sampled from all areas. For the population aged two years and above, two to five serves of some species (Barramundi, Blue Catfish, Bony Bream, Sleepy Cod, Sooty Grunter) could be consumed each week before reaching the TDI for PFOS. Two species (Archerfish, Catfish) should only be consumed once a week, and a greater number of species (Tarpon, Barred Grunter, Butler's Grunter, Black Catfish, Mullet, Ord River Mullet) should only be consumed on a monthly basis because of high reported levels of PFOS+PFHxS combined.

Given the exceedance of the trigger level for PFOS+PFHxS for median fish flesh concentrations from the Katherine River, the high proportion of individual samples exceeding the trigger level and the low numbers of fish sampled, further monitoring may be required for all fish species caught in the Katherine River (fish flesh and liver). Regular consumption of Tarpon, Barred Grunter, Butler's Grunter, Black Catfish, Mullet, Ord River Mullet, Archerfish and Catfish alone should be avoided, rather a range of species should be consumed over time where possible.

While this report details that it is safe to consume up to five serves of some types of fish from the Katherine River per week, FSANZ nonetheless recommends that due to health concerns regarding naturally occurring mercury levels in fish, that people limit their consumption of fish in accordance with national fish consumption advice produced by FSANZ, which can be downloaded at:

<http://www.foodstandards.gov.au/consumer/chemicals/mercury/documents/mif%20brochure.pdf>

**Table 4 Summary concentration data ( $\mu\text{g}/\text{kg}$ ) of PFOS+PFHxS for aquatic biota sampled from the Katherine River only, with a comparison to mean and median concentrations for aquatic biota sampled from all areas (including the Katherine River)**

Commodity class	Species	Count	Count of <LOR	Katherine River only				All areas	
				Minimum	Max	Mean**	Median**	Mean**	Median**
<b>Crustacea<sup>^</sup></b>	<b>Total</b>	<b>36</b>	<b>0</b>	<b>0.7</b>	<b>90.2</b>	<b>49.2</b>	<b>54.2</b>	<b>46.2</b>	<b>49.9</b>
	Cherabin	36	0	0.7	90.2	49.2	54.2	47.4	54.2
<b>Diadromous fish</b>	<b>Total</b>	<b>37</b>	<b>3</b>	<b>&lt;LOR</b>	<b>271</b>	<b>31.9</b>	<b>19.3</b>	<b>20.9</b>	<b>11.3</b>
	Barramundi	35	3	<LOR	62	22.8	18.3	15.6	9.9
	Tarpon#~	2	0	110.5	271	190.8	190.8	190.8	190.8
<b>Diadromous fish liver</b>	<b>Total</b>	<b>9</b>	<b>0</b>	<b>3.4</b>	<b>820.4</b>	<b>228.1</b>	<b>150.9</b>	<b>156.7</b>	<b>100.3</b>
	Barramundi liver#	9	0	3.4	820.4	228.1	150.9	156.7	100.3
<b>Freshwater fish</b>	<b>Total</b>	<b>138</b>	<b>0</b>	<b>0.3</b>	<b>380.5</b>	<b>63.1</b>	<b>37.3</b>	<b>43.4</b>	<b>19.3</b>
	Archerfish#~	2	0	19	81.9	50.6	50.6	50.6	50.6
	Barred Grunter#	4	0	9.7	161	81.2	77.0	48.7	23.8
	Black Catfish	19	0	5.2	204.1	92.2	87.2	56.0	26.5
	Blue Catfish#~	6	0	6.2	35.3	16.4	12.3	16.4	12.3
	Bony Bream	33	0	1.8	150.3	44.8	12.3	33.6	12.8
	Butler's Grunter#~	6	0	49	160	99.5	100.3	99.5	100.3
	Catfish#~	1	0	34	34	34.3		34.3	
	Mullet~	10	0	48	351.2	117.4	89.8	117.4	89.8
	Ord River Mullet	10	0	18	380.5	184.8	150.5	69.0	18.3
	Sleepy Cod	25	0	6.9	88	27.4	18.3	20.2	11.8
	Sooty Grunter	22	0	0.3	78.0	28.0	22.8	20.3	14.3
<b>Freshwater fish liver</b>	<b>Total</b>	<b>16</b>	<b>0</b>	<b>48</b>	<b>1406</b>	<b>294.0</b>	<b>196.2</b>	<b>205.7</b>	<b>97.3</b>
	Blue Catfish liver#~	1	0	212.0	212.0	212.0		212.0	
	Bony Bream liver#	2	0	89.3	443.8	266.6	266.6	181.8	89.3
	Butler's Grunter liver#~	1	0	300.6	300.6	300.6		300.6	
	Mullet liver#~	2	0	77.4	1406	741.7	741.7	741.7	741.7
	Ord River Mullet liver#	2	0	230.9	781.8	506.4	506.4	270.0	195.6
	Sleepy cod liver#	6	0	48	260.4	120.2	90.3	80.0	50.3

Commodity class	Species	Count	Count of <LOR	Katherine River only				All areas	
				Minimum	Max	Mean**	Median**	Mean**	Median**
	Sooty Grunter liver <sup>#</sup>	2	0	130.3	310.4	220.4	220.4	148.1	115.3

<sup>^</sup> Freshwater crab was not sampled from the Katherine River (median PFOS+PFHxS combined concentration for freshwater crab was 43.5 µg/kg).

<sup>~</sup> Species sampled only in the Katherine River. Analysis for these species the same as for the main report including sampling from all areas.

<sup>\*\*</sup> Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (LOR of 0.3 µg/kg for PFOS and PFHxS, 0.5 µg/kg for PFOA unless otherwise reported).

<sup>#</sup> Limited data (<10 data points).

**Table 5 Summary concentration data (µg/kg) of PFOS+PFHxS for animal products sampled from investigation zones 1, 2 and 3 only, with a comparison to mean and median concentrations for animal products sampled from all areas (including the Katherine River)**

Commodity class	Species	Count	Count of <LOR	Investigation zones 1, 2 and 3 only				All areas	
				Minimum	Maximum	Mean**	Median**	Mean**	Median**
<b>Meat mammalian</b>	Cattle meat	14	0	0.8	8.9	3.6	2.9	3.6	2.9
	Goat meat <sup>#</sup>	9	0	0.3	11.5	4.6	4.6	4.6	4.6
	Pig meat <sup>#</sup>	5	0	0.5	1.9	1.1	1.2	1.1	1.2
	Sheep meat <sup>#</sup>	3	0	0.3	1.2	1.2	1.2	1.2	1.2
<b>Poultry eggs</b>	Chicken egg <sup>*</sup>	48	7	<LOR	55.6	12.2	9.2	9.3	3.8
	Duck egg <sup>#</sup>	7	1	<LOR	106.9	51.9	48.1	51.9	48.1
	Turkey egg <sup>#</sup>	1	0	46.1	46.1	46.1	46.1	46.1	46.1
<b>Poultry meat</b>	Chicken meat	26	6	<LOR	1.8	1.3	1.1	1.3	1.1
	Duck meat <sup>#</sup>	3	0	6.2	6.2	6.2	6.2	6.2	6.2

<sup>\*</sup> For one animal product, chicken eggs, sampling occurred across all areas. For all other animal products all sampling was within zones 1, 2 and 3.

<sup>\*\*</sup> Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (LOR of 0.3 µg/kg for PFOS and PFHxS, 0.5 µg/kg for PFOA unless otherwise reported).

<sup>#</sup> Limited data (<10 data points).

**Table 6** Summary concentration data ( $\mu\text{g}/\text{kg}$ ) of PFOS+PFHxS for fruit and vegetables sampled from investigation zones 1, 2 and 3 only, with a comparison to mean and median concentrations for fruit and vegetables sampled from all areas (including zones 1, 2 and 3)

Commodity class	Species*	Count	Investigation zones 1, 2 and 3 only				All areas			
			Count of <LOR	Minimum	Maximum	Mean**	Median**	Mean**	Median**	
<b>Berry fruit</b>	Mulberry	3	3	<LOR	<LOR	0.8	0.8	0.8	0.8	
<b>Citrus fruit</b>	Grapefruit	2	2	<LOR	<LOR	0.8	0.8	0.8	0.8	
	Lemon	4	4	<LOR	<LOR	0.8	0.8	0.8	0.8	
	Lime	5	5	<LOR	<LOR	0.8	0.8	0.8	0.8	
<b>Cucurbits</b>	Pumpkin	2	0	0.4	0.5	0.8	0.8	0.8	0.8	
<b>Fruiting vegetables cucurbits</b>	Melon	1	1	<LOR	<LOR	0.8		0.8		
	Watermelon	1	1	<LOR	<LOR	0.8		0.8		
<b>Herbs</b>	Basil	1	0	0.9	0.9	0.9		0.9		
	Chilli	2	2	<LOR	<LOR	0.6	0.6	0.6	0.6	
	Chives	1	0	1.2	1.2	1.2		1.2		
	Lemongrass	1	1	<LOR	<LOR	0.6		0.6		
<b>Leafy vegetables</b>	Spinach	4	1	<LOR	2.7	1.8	1.9	1.3	0.6	
<b>Legume vegetables</b>	Drumstick (Moringa)	1	1	<LOR	<LOR	0.6		0.6	0.6	
	Drumstick leaves	1	1	<LOR	<LOR	0.6		0.6	0.6	
	Green bean	5	5	<LOR	<LOR	0.7	0.6	0.7	0.6	
<b>Other fruiting vegetables</b>	Corn	1	1	<LOR	<LOR	0.6		0.6		
	Eggplant	4	4	<LOR	<LOR	0.6	0.6	0.6	0.6	
	Okra	1	1	<LOR	<LOR	0.6		0.6		
	Tomato	10	10	<LOR	<LOR	0.8	0.8	0.8	0.8	
<b>Root and tuber vegetables</b>	Carrot	2	1	<LOR	0.7	0.7	0.7	0.7	0.7	
	Cassava	2	1	<LOR	0.6	0.6	0.6	0.6	0.6	
	Radish	1	1	<LOR	<LOR	0.6		0.6		
	Sweet potato	6	3	<LOR	0.7	0.7	0.7	0.7	0.6	
	Taro	5	2	<LOR	7.5	2.6	1.0	2.6	1.0	
<b>Tree nut</b>	Coconut	2	2	<LOR	<LOR	0.8	0.8	0.8	0.8	
<b>Tropical fruit</b>	Dragon fruit	1	1	<LOR	<LOR	0.8		0.8		

Commodity class	Species*	Count	Count of <LOR	Investigation zones 1, 2 and 3 only				All areas	
				Minimum	Maximum	Mean**	Median**	Mean**	Median**
	Starfruit	1	1	<LOR	<LOR	0.8		0.8	
<b>Tropical fruit inedible peel</b>	Banana	4	4	<LOR	<LOR	0.8	0.8	0.8	0.8
	Black sapote	1	1	<LOR	<LOR	0.8		0.8	
	Custard apple	1	1	<LOR	<LOR	0.8		0.8	
	Jackfruit	1	1	<LOR	<LOR	0.8		0.8	
	Longan	1	1	<LOR	<LOR	0.8		0.8	
	Mango	21	17	<LOR	1.7	0.9	0.8	0.9	0.8
	Papaya	7	7	<LOR	<LOR	0.8	0.8	0.8	0.8

\*Two types of fruit, banana and mango, and four types of vegetables, spinach, eggplant, tomato and sweet potato were sampled across all zones. Two vegetables, capsicum (one sample at <LOR) and beetroot and leaves (upper bound concentration of 0.8 µg/kg) were sampled outside of investigation zones 1, 2 and 3 only and therefore do not appear in this table.

\*\* Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (LOR of 0.3 µg/kg for PFOS and PFHxS, 0.5 µg/kg for PFOA unless otherwise reported).

**Table 7 Amount of fish and fish livers and other foods sourced from the Katherine River and investigation zones 1, 2 and 3 only, at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI\* for the population aged 2+ years (expressed as grams/day, serves/day^ and frequency of consumption)**

Commodity class	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption** (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)
Fish flesh	<b>All species</b>	<b>43</b>	<b>Approx 1/4 fillet (1 fillet/cutlet = 150 g)</b>	<b>About 2 serves of a range of fish per week (1 serve = 150 g)</b>	143	56
	Barramundi	76	Approx ½ fillet	About 3 serves of Barramundi per week		
	Tarpon#~	7	Approx 1/25 fillet	About 1 serve of Tarpon <b>per month</b>		
	Archerfish#~	27	Approx 1/8 fillet	About 1 serve Archerfish per week		
	Barred Grunter#	18	Approx 1/10 fillet	About 3 serves of Barred Grunter <b>per month</b>		
	Black Catfish	16	Approx 1/10 fillet	About 3 serves of Black catfish <b>per month</b>		
	Blue Catfish#~	113	Approx 3/4 fillet	About 5 serves of Blue Catfish per week		
	Bony Bream	113	Approx 3/4 fillet	About 5 serves Bony Bream per week		
	Butler's Grunter#~	13	Approx 1/20 fillet	About 2 serves Butler's Grunter <b>per month</b>		
	Catfish#~	40	Approx 1/4 fillet	About 1 serve Catfish per week		
	Mullet~	15	Approx 1/10 fillet	About 3 serves Mullet <b>per month</b>		
	Ord River Mullet	9	Approx 1/25 fillet	About 1 serves Ord River Mullet <b>per month</b>		
	Sleepy Cod	76	Approx ½ fillet	About 3 serves Sleepy Cod per week		
	Sooty Grunter	61	Approx 2/5 fillet	About 2 serves of Sooty Grunter per week		
Fish liver	<b>All species</b>	<b>8.2</b>	<b>Approx 1½ livers (1 liver = 5g)</b>	<b>About 11 serves fish liver from a range of species per week (1 serve = 5 g)</b>	63	21
	Barramundi#	9.3	Approx 1½ livers	About 12 serves Barramundi liver per week		
	Blue Catfish#~	6.6	Approx 1 liver	About 9 serves Blue Catfish liver per week		
	Bony Bream#	5.3	Approx 1 liver	About 7 serves Bony Bream liver per week		
	Butler's Grunter#~	4.7	< 1 liver	About 6 serves Butler's Grunter liver per week		
	Mullet#~	1.9	Approx 1/3 liver	About 2 serves Mullet liver per week		
	Ord River Mullet#	2.8	Approx ½ liver	About 3 serves Ord River Mullet liver per week		
	Sleepy Cod#	15.5	Approx 3 livers	About 21 serves Sleepy Cod liver per week		
	Sooty Grunter#	6.4	Approx 1 liver	About 8 serves of Sooty Grunter liver per week		
Crustacea	Cherabin	25	Approx 2 serves (1 serve cherabin meat = 11 g)	About 16 serves of cherabin meat per week	63	21
Poultry eggs	Chicken eggs	152	Approx 3 eggs (1 large chicken egg = 50 g)	About 21 chicken eggs per week	58	22
Vegetables	Spinach	736	Approx 49 serves leaves (1 serve = 15 g)	About 343 serves of spinach leaves per week	48	22

Commodity class	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption** (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)
	Sweet potato	2000	Approx 20 pieces roast sweet potato (1 piece sweet potato = 100 g)	About 140 serves (pieces) sweet potato per week	273	123

^ Measures taken from AUSNUT 2011-12 Measures File, measure for prawns applied to all crustacea [AUSNUT Food Measures File](#).

\* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight.

# Limited data (<10 data points).

~ Species sampled only in the Katherine River. Analysis the same as the main report including sampling from all areas.

\*\* Actual food consumption for all fish as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey.

## no food consumption data available, Population 2+ years, median consumption assumed to be 5 g (weight of one liver). Source: FSANZ report on Edith River, Northern Territory 2013, [https://dpir.nt.gov.au/\\_data/assets/pdf\\_file/0006/260187/TraceElementsNTFish.pdf](https://dpir.nt.gov.au/_data/assets/pdf_file/0006/260187/TraceElementsNTFish.pdf).

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**Table 8** Amount of fish and fish livers and other foods sourced from the Katherine River and investigation zones 1, 2 and 3 only, at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI\* for children aged 2-6 years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption** (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption (1 serve = 75 g)	P90 (consumers only)	Mean (consumers only)
Fish flesh	<b>All species</b>	<b>11</b>	<b>Approx 1/10 fillet (1 fillet/cutlet = 75 g)</b>	<b>About 1 serve of a range of fish per week (1 serve = 75 g)</b>	73	24
	Barramundi	20	Approx 1/4 fillet	About 1 serve of Barramundi per week		
	Tarpon#~	2	Approx 1/50 fillet	< 1 serve of Tarpon <b>per month</b>		
	Archerfish#~	7	Approx 1/10 fillet	About 3 serves Archerfish <b>per month</b>		
	Barred Grunter#	4	Approx 1/15 fillet	About 2 serves of Barred Grunter <b>per month</b>		
	Black Catfish#	4	Approx 1/15 fillet	Approx 2 serves of Black catfish <b>per month</b>		
	Blue Catfish#~	30	Approx 2/5 fillet	About 2 serves of Blue Catfish per week		
	Bony Bream#	30	Approx 2/5 fillet	About 2 serves Bony Bream per week		
	Butler's Grunter#~	3	Approx 1/20 fillet	About 1 serve Butler's Grunter <b>per month</b>		
	Catfish#~	11	Approx 1/8 fillet	About 1 serve Catfish per week		
	Mullet~	4	Approx 1/20 fillet	About 1 serve Mullet <b>per month</b>		
	Ord River Mullet	2	Approx 1/50 fillet	About 1 serve Ord River Mullet <b>per month</b>		
	Sleepy Cod	20	Approx 1/4 fillet	About 1 serves Sleepy Cod per week		
	Sooty Grunter	16	Approx 1/5 fillet	About 1 serves Sooty Grunter per week		
Fish liver	<b>All species</b>	<b>2</b>	<b>&lt; 1 liver (1 liver = 5 g)</b>	<b>About 3 serves fish liver from a range of species per week (1 serve liver = 5 g)</b>		5##
	Barramundi	2	< 1 liver	About 3 serves Barramundi liver per week		
	Blue Catfish#~	1	< 1 liver	About 2 serves Blue Catfish liver per week		
	Bony Bream#	1	< 1 liver	About 2 serves Bony Bream liver per week		
	Butler's Grunter#~	1	< 1 liver	About 1 serve Butler's Grunter liver per week		
	Mullet#~	0.5	< 1 liver	About 3 serves Mullet liver <b>per month</b>		
	Ord River Mullet#	0.7	< 1 liver	About 1 serve Ord River Mullet liver per week		
	Sleepy Cod	4	< 1 liver	About 5 serves Sleepy Cod liver per week		



Matrix	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption** (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption (1 serve = 75 g)	P90 (consumers only)	Mean (consumers only)
Crustacea	Sooty Grunter <sup>#</sup>	1	< 1 liver	About 2 serves of Sooty Grunter liver per week		
	Cherabin	7	< 1 serve (1 serve cherabin meat = 11 g)	About 4 serves of cherabin meat per week	21	8
Poultry eggs	Chicken eggs	41	< 1 egg (1 large chicken egg = 50 g)	About 5 chicken eggs per week	36	13
Vegetables	Spinach	200	Approx 13 serves leaves (1 serve = 15 g)	About 93 serves of spinach leaves per week	26	9
	Sweet potato	542	Approx 5 pieces roast sweet potato (1 piece sweet potato = 100 g)	About 38 serves (pieces) sweet potato per week	164	66

<sup>^</sup> Measures taken from AUSNUT 2011-12 Measures File, measure for prawns applied to all crustacea [AUSNUT Food Measures File](#).

\* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight.

<sup>#</sup> Limited data (<10 data points).

~ Species sampled only in the Katherine River. Analysis the same as the main report including sampling from all areas.

\*\* Actual food consumption for all fish as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey.

<sup>##</sup> no food consumption data available, Population 2+ years, median consumption assumed to be 5 g (weight of one liver). Source: FSANZ report on Edith River, Northern Territory 2013, [https://dpir.nt.gov.au/data/assets/pdf\\_file/0006/260187/TraceElementsNTFish.pdf](https://dpir.nt.gov.au/data/assets/pdf_file/0006/260187/TraceElementsNTFish.pdf).