Tasmanian Ambient PFAS Monitoring Program 2020

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Executive Summary

This report presents the ambient per- and poly-fluoroalkyl substance (PFAS) data collected under the Tasmanian Ambient PFAS Monitoring Program during 2020. The data provides a 'snapshot' for inland and estuarine surface waters for Tasmania. The primary objective of the Tasmanian Ambient PFAS Monitoring Program is to assess typical PFAS concentrations in urban and non-urban catchment areas.

The Tasmanian PFAS Ambient Monitoring Program was conducted at 76 sites across 32 surface water catchments. The sites were in freshwater or estuarine environments. Monitoring was conducted at 74 sites between 20 February and 20 March 2020, representing autumn and at 73 sites between 1 September and 8 October 2020, representing spring.

Of the sites monitored, PFAS compounds were found at 69 out of 76 sites (approximately 92% of sites). Of the seven sites where PFAS compounds were not detected, five were within freshwater and two were within estuarine environments.

The Tasmanian PFAS Ambient Monitoring Program investigated levels of a suite of 34 PFAS compounds. Of these 26 were detected at least once above the limits of reporting. Perfluorooctanesulfonic acid (PFOS) was detected on 59 occasions and Perfluorobutanoic acid (PFBA) on 60 occasions at levels above the limit of reporting. Overall, PFOS was detected at approximately 54% of sites and PFBA at 50% of sites at levels above the limit of reporting.

PFOS was found in the highest concentration at 0.5 - 2.2 µg/L downgradient of airport infrastructure. PFBA however was found more often at higher concentrations than PFOS, the 80th percentile concentration of PFBA being 0.0022 µg/L compared with 0.0014 µg/L for PFOS.

PFAS concentrations were typically found to increase lower down in the catchment and in areas of more intense land use before again decreasing in estuarine environments.

Between the autumn and spring rounds, results overall were comparable. There was some variance in the data generated in rural areas, however results were still generally low. As the program consisted of 2 monitoring rounds only, any significant statistical analysis of variation is not possible. No unexpected concentrations of PFAS were measured at levels sufficiently high to infer the presence of previously unknown sources of PFAS contamination.

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Introduction

Per- and polyflouroalkyl substances (PFAS) are synthetic organoflourine compounds typically characterised by chains of fully fluorinated carbon, often with a hydrophilic functional group attached to the chain. PFAS have been used since the 1950s in a wide range of applications where extremely low surface energy or surface tension and/or water and oil repellence is needed. Applications have included use as a flame retardant coating, in firefighting foams, as an additive to hydraulic fluid and lubricants, as a protective coating or additive for surface treatments, as a wetting agent in metal plating applications, in water repellent and stain resistant fabrics, non-stick coatings and as a surfactant in household cleaning and polishing agents (OECD, PFAS Portal). In a recent study conducted by the Organisation for Economic Co-operation and Development, 4370 PFAS compounds were identified that had been assigned a Chemical Abstract Service (CAS) registry number (OECD 2018).

PFAS are not manufactured in Australia but have been imported for use in manufacturing and the aviation industry where it is used particularly in firefighting foams. Historically PFAS were present in a wide variety of commercial products used in Australia (AICIS). Their use in firefighting foams has resulted in significant contamination at sites in Australia associated with firefighting training (DoD, Air Services Australia). In addition, PFAS is present in wastes sent to landfill and wastewater treatment plants (Australian Government, PFAS Task Force).

PFAS chemical structure and physical properties mean that they or their partial degradants are environmentally persistent and transported easily in water, leaching from soils and into groundwater and surface waters. Over time PFAS have migrated from source locations and are found more broadly in the environment (NEMP 2020).

PFAS are known to bioaccumulate in aquatic organisms and to bioaccumulate and biomagnify in mammals and birds (NEMP). Some PFAS compounds have been shown to be toxic to animals. Very few PFAS however have been studied. A 2018 study (Barlow*, et al.* 2018) indicated animal laboratory studies were only available for 11 compounds. The Australian Expert Health Panel for PFAS concluded that although there were consistent reports of links between PFAS exposure and health effects, the differences between high and low exposure were generally small. The panel concluded there could be other explanations for observed differences and that there is currently limited to no evidence of a causal link between PFAS exposure and significant health impacts. Nevertheless, significant impacts to particular individuals cannot be ruled out (Expert Health Panel, 2018).

Because of their persistent nature, their environmental mobility, potential to bioaccumulate, known ecotoxicological impacts and potential human health impacts, significant concerns have been raised globally regarding ongoing production and use of PFAS, and their presence in the environment. The Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment from chemicals that remain in the environment for long periods of time. Two groups of PFAS compounds have been listed under the Stockholm Convention and a third is currently under consideration for listing (Stockholm Convention);

1. perfluorooctanesulfonic acid (PFOS), its salts and perflourooctane sulfonyl fluoride, listed under Annex B of the convention restricting production and use;
2. perfluorooctanoic acid (PFOA) its salts and PFOA related compounds, listed under Annex A of the convention prohibiting production and use; and
3. Perfluorohexanesulfonic acid (PFHxS), its salts and related compounds are currently under consideration for listing under Annex A of the Convention.

Australia is a party to the Stockholm Convention. In relation to the PFAS listing, ratification in Australia is under consideration, with public consultation having been undertaken in 2017 and a review of PFAS usage and analysis of regulatory impact underway (NEMP).

In Australia, studies to determine ambient level of PFAS contamination in the environment are limited. Such information is necessary to inform policy development, regulatory responses, and management guidance and action in relation to PFAS. In Tasmania, environmental sampling for PFAS to date has been associated with known and potentially contaminated sites.

In light of this the Tasmanian Ambient Monitoring Program has been conducted to assess background environmental surface water PFAS levels for a standard PFAS analytical suite. The objective of the Program is to assess typical PFAS concentrations in urban and non-urban catchment areas. The Program therefore provides information to policy makers, regulators, resource managers, and the public on the range of ambient surface water concentrations of a standard suite of PFAS compounds throughout Tasmania.

Background

The Tasmanian Government is committed to a national approach in relation to PFAS. Tasmania is a signatory to the *Intergovernmental Agreement on a National Framework for Responding to PFAS Contamination* (IGA), which first came into effect on 20 February 2018 with subsequent revision coming into effect on 7 February 2020 (Council of Australian Governments 2020). The agreement encourages a nationally consistent, collaborative, adaptive and precautionary approach in jurisdictional responses to PFAS contamination.

The PFAS National Environmental Management Plan (NEMP) forms Appendix B of the IGA. A revised NEMP with contribution from all signatories was agreed by Heads of EPAs in October 2019. The NEMP provides nationally agreed guidance on the management of PFAS in the environment. The NEMP takes into consideration future ratification by Australia of PFAS listing under the Stockholm Convention.

To progress implementation of the IGA within Tasmania, a State Interagency Steering Committee chaired by the EPA Director prepared a PFAS Action Plan for Tasmania which was endorsed by the Tasmanian Government in September 2018 (Tasmanian Government 2018). Action item 6 of the Action Plan requires the conduct of the PFAS ambient water quality monitoring program to which this report relates.

The State PFAS ambient monitoring program has been developed and conducted in a manner consistent with the NEMP.

Environmental Monitoring for PFAS in Australia

Environmental Monitoring for PFAS across Australia has historically focused on contamination associated sites where PFAS containing firefighting foams have been used, notably at airports and at Department of Defence sites. Significant site investigation programs have been implemented by bodies such as Air Services Australia at airports nationally and the Commonwealth Department of Defence at sites under their jurisdiction. Information about these investigations can be found at the referenced web pages (DoD, Air Services Australia).

Other potential sources of PFAS discharged to the environment include municipal wastewater treatment plants and landfills. Studies of such facilities have found that a range of PFAS compounds are commonly detected in landfill leachate (Gallen *et al.* 2016) and wastewater treatment plant effluent and biosolids (Coggan *et al.*).

Baseline ambient monitoring programs have been less commonly carried out, however, consistent with the NEMP most jurisdictions have carried out some baseline monitoring (Table 1).

Table 1: Ambient PFAS water monitoring programs conducted in Australia (from Baddiley et al. 2020)

State	Program	Dates	Summary
Queensland	Brisbane River Catchment	2014	Samples taken following major flood event. 32 samples from upstream of urban area, through Brisbane to Moreton Bay
Queensland	Queensland Ambient Monitoring Program	May 2019-March 2020	6 monitoring rounds. 55 Sites across 5 NRM regions. Included targeted sediment and biota monitoring
New South Wales	Homebush Bay, Parramatta River	2011	Included sediment sampling
Victoria	Port Phillip Bay Snapshot, Land use and water quality survey	Two studies published 2019	7 sites in and around Port Phillip Bay and 25 Urban and Agricultural Rivers and Streams
South Australia	LeFevre Peninsula, Adelaide	2017	Focused on PFAS in dolphins but included water sampling

In Tasmania, PFAS monitoring programs have previously focused on contamination associated with fire training sites where PFAS containing firefighting foams had been used. Investigations have been conducted by Air Services Australia at Launceston and Hobart Airports and investigation by Tasmania Fire Service of their sites has commenced (EPA Tasmania 2021). In relation to identified contamination at Hobart and Launceston Airports, the Department of Health has conducted investigations of PFAS levels in Pittwater in fish, shellfish, and water, and in the North Esk River in fish (DoH Tasmania). It was concluded that it was safe to eat fish and shellfish from Pittwater. With regard the northern investigations, it was concluded that as a precaution fish and eels caught in the North Esk River downstream of Corra Linn Gorge should not be consumed.

Tasmanian Ambient Monitoring Program

An ambient monitoring program is defined in the NEMP as a program to "provide data to assess the distribution, concentrations and types of PFAS attributed to a range of sources within a region, such as a catchment, urban area or jurisdiction". The tailoring of the program to surface water was considered the most effective way to gain a snapshot of environmental levels of PFAS at a catchment scale statewide.

The objectives of the monitoring program were to:

- Measure PFAS concentrations in representative surface and estuarine waters statewide over two seasonal monitoring rounds.
- Identify typical PFAS concentrations against a range of rural and urban catchment land uses.
- Potentially identify sources of PFAS not otherwise identified as part of the development of the PFAS inventory[1].
- Employ best practice sampling and analysis techniques consistent with the NEMP.

[1] The PFAS inventory is action item 2 of the Tasmanian PFAS Action Plan.

The program investigated levels of a suite of 34 PFAS compounds in fresh and estuarine waters at 76 different sites across 32 water catchments (as classified under the Tasmanian Conservation of Freshwater Ecosystem Values (CFEV) Program) over 2 'snapshot' monitoring rounds. The program was focused on the major catchments and estuaries of the Tamar and Derwent Rivers and on representation of the range of natural, rural and urban land uses within Tasmania.

Selected catchments covered the state's 4 main hydrological regions (EPA Tasmania 2020). Sites were chosen in upper and middle sections of catchments as well as along the major estuarine hydrological gradients. For the major estuaries samples were taken across the catchments that feed into the estuaries and at multiple sites throughout the estuaries. A number of headwater stream samples were taken to provide background reference.

Method

Site Selection

Guidance provided by the UNEP *Global Monitoring Plan for Persistent Organic Pollutants* was referred to when choosing ambient monitoring sites (UNEP 2015). The NEMP is consistent with this guidance in expectation of possible ratification by Australia of the PFAS listings. Ideally samples should be selected to determine typical contaminant levels associated with land use and regional hydrology rather than known point sources. Based on the guidance provided, sample sites were selected using the following criteria in order of importance:

1. Estuarine water, to investigate residual concentrations from inputs along the entire river system.
2. River waters as far downstream as practicable from areas of intensive land use with consideration of the extent of the zone of mixing of any influent and tributaries, to investigate PFAS concentrations associated with land use.
3. Headwater streams and lakes to assess 'baseline' or 'reference' concentrations.
4. In tributaries to better investigate sources contributing to PFAS concentrations.
5. Some additional sites were selected to ensure all significant land use categories were represented.

Beside these criteria, sites were selected that could be readily accessed and preferentially where long term water quality datasets exist e.g., at river flow gauging stations or at existing estuarine monitoring sites. A complete list of sampling sites is provided in Appendix D, along with maps showing locations and associated land use.

Land Use

The Australian Land Use and Management (ALUM) Classification System Version 8 was used to classify predominant land uses within the region upgradient of each site (ABARES 2016). ALUM classification is hierarchical with up to 3 levels of classification. For this program, classification to the secondary level was undertaken where reasonable. Where there were several potential classifications of equal coverage the most intensive land use classification was chosen. Where a determination could not easily be made then classification at the primary level only was determined. The use of the 'Urban Residential' land use type was considered merited, which is a tertiary classification. Assigned lands uses by catchment are summarised in Table 2.

Table 2. Land use by catchment

Catchment	Land Use and associated site number
Leven	Other minimal use (94) and Estuary/Coastal Waters (73)
Mersey	Estuary/Coastal Waters (57, and 95)
Meander	Grazing modified pasture (69)
Rubicon	Estuary/Coastal Waters (96)
Tamar Estuary	Estuary/Coastal Waters (35,36, and 37)
Brumbys-Lake	Grazing irrigated modified pastures (68), and Residential and farm infrastructure (38)
South Esk	Production native forests (41), and Grazing modified pasture (42)
North Esk	Nature conservation (92), Grazing modified pasture (43). Production from dryland agriculture and plantations (45), Intensive uses (39), Urban residential (44), and Transport and communication (46 and 84)
Ringarooma	Managed resource protection (61)
Great Forester-Brid	Grazing modified pasture (60)
George	Production from relatively natural environments (62)
Tasman	Grazing modified pasture (65)
Derwent Estuary - Bruny	Nature conservation (12 and 26), Other minimal use (24), Urban residential (9, 22, 23 and 25), and Estuary/Coastal Waters (17, 14, 98, 99, 10, 13 and 89)
Macquarie	Grazing modified pasture (87)
Swan - Apsley	Grazing modified pasture (82)
Little Swanport	Other minimal use (64)
Pittwater-Coal	Grazing modified pasture (88 and 68, Transport and communication (86), and Estuary/Coastal Waters (67 and 85)
Jordan	Grazing modified pasture (20 and 27), and Residential and farm infrastructure (19)
Clyde	Other minimal use (33), Irrigated cropping (32), Grazing modified pasture (28)
Upper Derwent	Nature conservation (21), and Production from dryland agriculture and plantations (97)
Gordon-Franklin	Estuary/Coastal Waters (83)
King-Henty	Managed resource protection (47) and Intensive uses (48)
Huon	Nature conservation (3), Production native forests (4), Residential and farm infrastructure (5 and 6), and Estuary/Coastal Waters (7)
Lower Derwent	Nature conservation (90), Grazing modified pasture (31), Production from irrigated agriculture and plantations (34), and Estuary/Coastal Waters (18)
Blythe	Estuary/Coastal Waters (52)
Emu	Estuary/Coastal Waters (101)

Catchment	Land Use and associated site number
Cam	Urban residential (80).
Inglis-Flowerdale	Grazing irrigated modified pastures (100), and Estuary/Coastal Waters (51).
Duck	Grazing irrigated modified pastures (93), and Estuary/Coastal Waters (77).
Montagu	Production from dryland agriculture and plantations (50).
Welcome	Conservation and natural environments (71).
Arthur	Managed resource protection (70).

Parameters

Analysis was 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. The analytical methodology selected was the most sensitive available allowing for detection of ultra-trace levels of PFAS to concentrations below one nanogram per litre i.e., in parts per trillion. For a complete list of parameters measured refer to Appendix A. FOSA results from the spring monitoring round have been removed from the comparisons below leaving 33 PFAS compounds for that round. See Appendix C for discussion regarding removal of FOSA results.

In addition to PFAS, several other parameters which may support interpretation of results were analysed at the time of sample collection. These included electrical conductivity, pH, dissolved oxygen levels, nutrients, suspended solids and particulate organic carbon. Results for these parameters are not detailed in this report.

In this report, when a PFAS compound is identified as detected it means "detected above the limit of reporting". The limit of reporting is the lowest concentration that can be reliably measured within analytical method limits of precision and accuracy (Table 3). In some instances a Higher Limit of Reporting (HLOR) has been reported by the laboratory. Where this has occurred, the reported values have been identified in the results section.

Table 3. Parameters and associated Limit of Reporting (LOR)

Parameter / Indicator	Limit or Reporting (LOR)	Higher Limit or Reporting (HLOR)*
PFOS	0.0001 µg/L	
PFBA	0.0005 µg/L	0.01 µg/L
PFHxA	0.0001 µg/L	0.01 µg/L
PFHxS	0.0002 µg/L	0.02 µg/L
PFOA	0.0001 µg/L	
PFTeDA	0.0005 µg/L	0.05 µg/L
PFBS	0.0002 µg/L	0.02 µg/L
PFPeA	0.0002 µg/L	
PFHpA	0.0001 µg/L	0.01 µg/L
6:2 FTS	0.0005 µg/L	0.05 µg/L
PFTrDA	0.0005 µg/L.	
PFPeS	0.0001 µg/L	
PFDA	0.0002 µg/L	
PFNA	0.0002 µg/L	
N-EtFOSAA	0.0005 µg/L	0.001 µg/L
PFDoDA	0.0005 µg/L	0.0002 µg/L
PFDS	0.0002 µg/L	0.0001 µg/L
PFHpS	0.0001 µg/L	
N-MeFOSAA	0.0005 µg/L	0.001 µg/L
10:2 FTS	0.0005 µg/L	0.001 µg/L
N-MeFOSA	0.0005 µg/L	
PFHxDA	0.001 µg/L	
8:2 FTS	0.001 µg/L	
FOSA	0.0005 µg/L	
N-EtFOSA	0.0005 µg/L	
PFUnDA	0.0005 µg/L	

* Higher Limit of Reporting is indicated in results section when used.

Monitoring Schedule

Two sampling 'snapshot' events were undertaken in 2020:

- Autumn 2020, i.e., from 20 February to 20 March 2020.
- Spring 2020, i.e., from 1 September to 8 October 2020

It should be noted that one North Esk catchment site (Upper Kings Meadows Rivulet (43)), was not sampled in autumn as it was dry at the time. Two sites in the Huon catchment (Little Denison River (3) and Huon Estuary (7)) were not sampled in spring due to hazardous sampling conditions. The Blythe River Estuary (52) was sampled in autumn only and the Emu River Estuary (101) was sampled only in spring. This change was made to target an estuary with associated industrial and urban land uses rather than predominantly rural land uses.

Sampling Procedure

A sampling procedure was developed that was consistent with the established PFAS sampling methods outlined in the NEMP. Sample bottles used were free of Teflon and kept double bagged in specially cleaned cool chests. Cooling blocks were not used as cooling gels may contain PFAS. Instead, frozen bottles of distilled water were used. Hands were rinsed in distilled water and latex-free gloves were worn for sampling. Wet weather gear, sunscreen or makeup were not worn during sampling actions. Sampling equipment was washed in distilled water between sampling events.

Quality Control and Quality Assurance (QA/QC) sampling and results are detailed in Appendix B.

It is worth noting that the results for the compound FOSA from the spring monitoring round were determined to be inconsistent with that for all other parameters. It was concluded that this was due to a systemic contaminant, possibly associated with sample bottle batches. For this reason, results for FOSA from the spring monitoring round were removed from this report (refer to Appendix C).

Results

The results are presented in the following tables on the basis of broad geographic region and/or by drainage for Greater Derwent and Greater Tamar catchments. For brevity, each table only includes those parameters above the LOR. Those parameters not listed in a given table are below the LOR for all sites tabled.

Greater Derwent River Catchment

The Greater Derwent River catchment includes 6 surface water catchments. The catchments include the Upper Derwent, Lower Derwent, Ouse, Clyde, Jordan, and Derwent Estuary-Bruny. It should be noted that sampling was not conducted within the Ouse catchment.

Upper Derwent Catchment

Table 4. Upper Derwent catchment PFAS monitoring results

	Derwent River Upper (21)		Derwent River Mid (97)	
Parameter	**Autumn**	**Spring**	**Autumn**	**Spring**
PFTeDA	<LOR	0.0005	<LOR	<LOR
PFTrDA	<LOR	<LOR	<LOR	<LOR
Count	0	1	0	0

Lower Derwent Catchment

Table 5. Lower Derwent catchment PFAS monitoring results

	Russell Falls Ck (90)		Tyenna River (31)		Styx River (34)	
Parameter	**Autumn**	**Spring**	**Autumn**	**Spring**	**Autumn**	**Spring**
PFTeDA	<LOR	<LOR	0.0011	<LOR	<LOR	0.0018
PFTrDA	<LOR	<LOR	0.0006	<LOR	<LOR	0.001
Count	0	0	2	0	0	2

Clyde Catchment

Table 6. Clyde catchment PFAS monitoring results

	Clyde River Upper (33)*		Clyde River Middle (32)		Clyde River Lower (28)	
Parameter	**Autumn**	**Spring**	**Autumn**	**Spring**	**Autumn**	**Spring**
6:2 FTS	<LOR	<LOR	0.0034	<LOR	<LOR	<LOR
PFBA	<LOR	0.0009	0.0056	<LOR	<LOR	0.0006
PFBS	<LOR	0.0002	0.003	<LOR	<LOR	<LOR
PFHpA	0.02	<LOR	<LOR	<LOR	<LOR	<LOR
PFHxA	0.02	<LOR	<LOR	<LOR	<LOR	<LOR
PFHxS	0.02	<LOR	<LOR	<LOR	0.0005	<LOR
PFTeDA	<LOR	<LOR	0.0007	<LOR	<LOR	<LOR
Count	3	2	4	0	1	1

* HLOR as detailed in Table 3 apply to this site

Jordan Catchment

Table 7. Jordan catchment PFAS monitoring results

Parameter	Jordan River at Hunting Ground (27)		Jordan River at Broadmarsh (20)		Jordan River Lower (19)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring
6:2 FTS	0.007	<LOR	<LOR	<LOR	0.0035	<LOR
PFBA	0.0062	0.0041	0.0031	0.0036	0.0008	0.0033
PFBS	0.0016	0.0003	<LOR	0.0003	<LOR	0.0003
PFHxA	<LOR	<LOR	<LOR	<LOR	0.0002	0.0004
PFHxS	<LOR	0.0002	<LOR	0.0002	<LOR	0.0003
PFOA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0003
PFOS	0.0004	<LOR	0.0002	<LOR	0.0009	<LOR
PFPeS	0.0004	<LOR	0.0002	<LOR	<LOR	<LOR
Count	5	3	3	3	4	5

Derwent Estuary-Bruny Catchment

Table 8. Glenorchy Municipality PFAS monitoring results

Parameter	Newtown Rivulet Upper (24)		Newtown Rivulet Lower (25)		Humphreys Rvt Upper (26)		Humphreys Rvt Lower (23)		Littlejohn Creek (22)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
6:2 FTS	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0034
N-EtFOSAA	<LOR	<LOR	<LOR	0.0032*	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
PFBA	<LOR	<LOR	0.0016	0.0021	0.0005	<LOR	0.0046	0.0016	0.0069	0.033
PFBS	<LOR	<LOR	0.0078	0.00011	<LOR	<LOR	0.0016	0.0005	0.0033	0.017
PFDA	<LOR	<LOR	0.0005	0.0006	0.00021	<LOR	0.00033	<LOR	0.00033	0.0004
PFDS	0.00033	<LOR	<LOR	<LOR	0.0003	<LOR	<LOR	<LOR	<LOR	<LOR
PFHpA	<LOR	<LOR	0.00033	0.0007	<LOR	<LOR	0.0015	0.0006	0.004	0.029
PFHpS	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0017	0.002
PFHxA	<LOR	<LOR	0.0089	0.0017	<LOR	<LOR	0.0027	0.0012	0.0076	0.049
PFHxS	<LOR	<LOR	0.0012	0.0012	<LOR	<LOR	0.0047	0.0014	0.02	0.011
PFNA	<LOR	<LOR	0.00027	0.0003	<LOR	<LOR	0.00053	<LOR	0.00056	0.0012
PFOA	<LOR	<LOR	0.0017	0.0022	0.00017	<LOR	0.0035	0.0009	0.0053	0.025
PFOS	<LOR	<LOR	0.0042	0.0033	0.00023	<LOR	0.0097	0.0054	0.069	0.014
PFPeA	<LOR	<LOR	0.00038	0.002	<LOR	<LOR	0.0018	0.0019	0.0052	0.082
PFPeS	<LOR	<LOR	0.00018	0.0007	<LOR	<LOR	0.00084	0.0003	0.0025	0.0037
PFTeDA	0.00053	<LOR	<LOR	0.0011	<LOR	<LOR	0.001	<LOR	<LOR	<LOR
Count	2	0	13	11	5	0	12	13	12	9

* HLOR as detailed in Table 3 apply to this result

Table 9. Hobart Rivulet PFAS monitoring results

Parameter	Hobart Rivulet Upper (12)		Hobart Rivulet Middle (9)		Hobart Rivulet Lower (10)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring
10:2 FTS	<LOR	<LOR	0.0027*	<LOR	<LOR	<LOR
6:2 FTS	<LOR	<LOR	<LOR	<LOR	0.0009	0.0008
N-MeFOSAA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0005
PFBA	<LOR	<LOR	0.0039	0.0015	0.0045	0.0031
PFBS	<LOR	<LOR	0.00089	0.0004	0.0008	0.0007
PFDA	<LOR	<LOR	0.00076	0.0003	0.0003	0.0022
PFDS	<LOR	<LOR	0.00033	<LOR	<LOR	<LOR
PFDoDA	<LOR	<LOR	0.00076	<LOR	<LOR	0.001
PFHpA	<LOR	<LOR	0.00073	0.0009	0.0009	0.0021
PFHxA	<LOR	<LOR	0.0021	0.002	0.0022	0.0062
PFHxS	<LOR	<LOR	0.0015	0.001	0.0017	0.0013
PFNA	<LOR	<LOR	0.00034	0.0002	0.0003	0.0007
PFOA	<LOR	<LOR	0.0024	0.0021	0.0018	0.0042
PFOS	<LOR	<LOR	0.0039	0.0022	0.0064	0.006
PFPeA	<LOR	<LOR	0.0013	0.0026	<LOR	00.0056
PFPeS	<LOR	<LOR	0.0005	<LOR	<LOR	<LOR
PFTeDA	<LOR	<LOR	0.0017	<LOR	<LOR	<LOR
PFTrDA	<LOR	<LOR	0.0012	<LOR	<LOR	<LOR
Count	0	0	16	10	10	13

* HLOR as detailed in Table 3 apply to this result

Table 10. Derwent Estuary upstream of Tasman Bridge PFAS monitoring results

	Upper Estuary at New Norfolk (18)		Upper Estuary at Bridgewater (17)		Mid Estuary at New Town (98)		Mid Estuary at Lindisfarne (14)	
Parameter	**Autumn**	**Spring**	**Autumn**	**Spring**	**Autumn**	**Spring**	**Autumn**	**Spring**
PFBA	<LOR	<LOR	0.0005	<LOR	<LOR	<LOR	0.0005	<LOR
PFHxA	<LOR	<LOR	0.0001	<LOR	0.0001	0.0003	0.0003	<LOR
PFHxS	<LOR	<LOR	<LOR	<LOR	0.0002	0.0017	<LOR	<LOR
PFOA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0001	<LOR	<LOR
PFOS	<LOR	<LOR	<LOR	0.0003	0.0009	0.0038	<LOR	<LOR
PFPeA	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0003
PFPeS	<LOR	<LOR	<LOR	<LOR	<LOR	0.0003	<LOR	<LOR
PFTeDA	<LOR	0.0018	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
PFTrDA	<LOR	0.001	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Count	0	2	2	1	3	5	2	1

Table 11. Derwent Estuary downstream of Tasman Bridge PFAS monitoring results

	Mid Estuary at Kangaroo Bay (99)		Lower Estuary at Tranmere (13)		Lower Estuary at South Arm (89)	
Parameter	**Autumn**	**Spring**	**Autumn**	**Spring**	**Autumn**	**Spring**
10:2 FTS	<LOR	<LOR	0.0011	<LOR	<LOR	<LOR
N-EtFOSAA	<LOR	0.0006	0.0007	<LOR	<LOR	<LOR
PFDS	<LOR	<LOR	0.0003	<LOR	<LOR	<LOR
PFDoDA	<LOR	<LOR	0.0007	<LOR	<LOR	<LOR
PFOA	<LOR	<LOR	<LOR	<LOR	0.0001	<LOR
PFOS	<LOR	0.0005	<LOR	<LOR	<LOR	0.0004
PFTeDA	<LOR	<LOR	0.0007	0.0005	<LOR	<LOR
PFTrDA	<LOR	<LOR	0.0008	<LOR	<LOR	<LOR
Count	0	2	6	1	1	1

East Coast Tasmania

Pittwater-Coal Catchment

Table 12. Pittwater-Coal catchment PFAS monitoring results

Parameter	Coal River Upper (88)		Coal River Middle (66)		Coal River Estuary (67)^		Barilla Rivulet (86)		Pitt Water (85)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
6:2 FTS	<LOR	<LOR	0.0062	<LOR	<LOR	-	<LOR	0.02	<LOR	<LOR
FOSA	0.0005	-	<LOR	<LOR	<LOR	-	<LOR	<LOR	<LOR	<LOR
PFBA	0.014	0.0007	0.0041	0.002	0.0011	-	0.001	0.021	<LOR	<LOR
PFBS	0.0005	0.0002	0.0003	0.0005	<LOR	-	0.0006	0.045	<LOR	<LOR
PFDA	<LOR	<LOR	<LOR	<LOR	<LOR	-	<LOR	0.0014	0.0002	<LOR
PFHpA	<LOR	<LOR	<LOR	<LOR	<LOR	-	0.0019	0.024	<LOR	<LOR
PFHpS	<LOR	<LOR	<LOR	<LOR	<LOR	-	<LOR	0.012	<LOR	<LOR
PFHxA	<LOR	<LOR	<LOR	<LOR	<LOR	-	0.0012	0.062	0.0001	<LOR
PFHxS	<LOR	<LOR	<LOR	<LOR	0.0005	-	0.0039	0.18	0.0005	<LOR
PFNA	<LOR	<LOR	<LOR	<LOR	<LOR	-	0.0004	0.019	<LOR	<LOR
PFOA	<LOR	<LOR	<LOR	<LOR	0.0002	-	0.0003	0.018	<LOR	<LOR
PFOS	<LOR	<LOR	<LOR	<LOR	0.0005	-	0.0079	0.5	0.0016	<LOR
PFPeA	<LOR	<LOR	<LOR	<LOR	<LOR	-	<LOR	0.047	<LOR	<LOR
PFPeS	<LOR	<LOR	<LOR	<LOR	<LOR	-	0.0005	0.028	<LOR	<LOR
PFTeDA	0.0008	<LOR	<LOR	<LOR	<LOR	-	<LOR	0.0014	<LOR	<LOR
PFTrDA	<LOR	<LOR	<LOR	<LOR	<LOR	-	<LOR	0.0006	<LOR	<LOR
PFUnDA	<LOR	<LOR	<LOR	<LOR	<LOR	-	<LOR	0.007	<LOR	<LOR
Count	5	2	3	2	4	-	9	16	4	0

^ Coal River Estuary site was sampled in autumn only.

East Coast Catchments

Table 13. East Coast catchments PFAS monitoring results

Parameter	Carlton River (65)		Little Swanport River (64)		Swan River (82)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring
PFBA	0.0095	0.0018	<LOR	0.0013	<LOR	<LOR
PFBS	<LOR	0.0005	<LOR	<LOR	<LOR	<LOR
PFHpA	0.0012	0.0001	<LOR	<LOR	<LOR	<LOR
PFHxA	0.0015	0.0004	<LOR	<LOR	<LOR	<LOR
PFHxS	0.0008	<LOR	<LOR	<LOR	<LOR	<LOR
PFOA	0.0006	0.0004	<LOR	<LOR	<LOR	<LOR
PFOS	<LOR	0.0022	<LOR	<LOR	<LOR	<LOR
PFTeDA	<LOR	<LOR	<LOR	<LOR	0.0008	<LOR
PFTrDA	<LOR	<LOR	<LOR	<LOR	0.0006	<LOR
Count	5	6	0	1	2	0

North East Tasmania

Table 14. North East catchments PFAS monitoring results

Parameter	Great Forester River (60)		Ringarooma River (61)		George River (62)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring
PFBA	0.0021	0.0032	<LOR	0.001	<LOR	<LOR
PFDA	0.0005	<LOR	<LOR	<LOR	<LOR	<LOR
PFHpA	0.0053	0.0001	<LOR	<LOR	<LOR	<LOR
PFHxA	0.0048	0.0002	<LOR	0.0002	<LOR	<LOR
PFHxS	0.0004	0.0003	<LOR	<LOR	<LOR	<LOR
PFOA	0.015	0.0001	<LOR	<LOR	<LOR	<LOR
PFOS	0.0029	0.0005	<LOR	<LOR	<LOR	0.0002
PFPeA	0.0015	<LOR	<LOR	0.0034	<LOR	<LOR
Count	8	6	0	3	0	1

Greater Tamar River Catchment

The Greater Tamar River catchment includes seven surface water catchments. The catchments include the North Esk, South Esk, Macquarie, Great Lake, Brumbys-Lake, Meander and Tamar Estuary. It should be noted that sampling was not conducted within the Great Lake catchment.

North Esk

Table 15. North Esk catchment PFAS monitoring results

Parameter	Ford River (92)		North Esk River at Ballroom (45)		North Esk River Launceston (39)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring
6:2 FTS	<LOR	0.0006	<LOR	<LOR	0.0086	0.048
PFBA	<LOR	<LOR	<LOR	<LOR	0.0018	0.0005
PFBS	<LOR	<LOR	<LOR	<LOR	0.0003	0.0003
PFHpA	<LOR	<LOR	<LOR	<LOR	0.0003	0.0001
PFHxA	<LOR	<LOR	<LOR	<LOR	0.0008	0.0004
PFHxS	<LOR	<LOR	<LOR	<LOR	0.0019	0.0018
PFOA	<LOR	<LOR	<LOR	<LOR	0.0005	<LOR
PFOS	<LOR	<LOR	<LOR	0.0005	0.0043	0.0029
PFPeA	<LOR	<LOR	<LOR	<LOR	0.0005	<LOR
PFPeS	<LOR	<LOR	<LOR	<LOR	<LOR	0.0003
Count	0	1	0	1	0	2

Table 16. North Esk catchment urban and transportation PFAS monitoring results

Parameter	Springvale Creek (84)		Kellys Creek (46)		Kings Meadows Rivulet Upper (43)^		Kings Meadows Rivulet Lower (44)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
6:2 FTS	<LOR	0.0012	0.031	0.0015	<LOR	-	0.012	0.0006
8:2 FTS	<LOR	<LOR	0.0024	<LOR	<LOR	-	<LOR	<LOR
N-MeFOSAA	<LOR	0.0025	<LOR	0.0024	<LOR	-	<LOR	<LOR
PFBA	0.051	0.082	0.024	0.033	0.0022	-	0.0069	0.0045
PFBS	0.48	0.34	0.069	0.18	0.0004	-	0.0014	0.0021
PFDA	<LOR	<LOR	0.0013	0.0004	<LOR	-	0.0008	0.0004
PFHpA	0.06	0.063	0.029	0.03	<LOR	-	0.0018	0.002
PFHpS	0.16	0.18	0.043	0.063	<LOR	-	<LOR	0.0001
PFHxA	0.37	0.37	0.096	0.16	<LOR	-	0.0051	0.0046
PFHxS	3.1	1.7	0.59	0.74	<LOR	-	0.0025	0.0048
PFNA	0.0006	0.0022	0.0031	0.0014	<LOR	-	0.0006	0.00005
PFOA	0.095	0.12	0.035	0.048	<LOR	-	0.0032	0.0029
PFOS	1.4	2.2	1.2	1.1	<LOR	-	0.0053	0.0081
PFPeA	0.05	0.11	0.05	0.054	<LOR	-	0.003	0.0048
PFPeS	0.43	0.31	0.065	0.17	<LOR	-	0.0004	0.0015
PFTeDA	<LOR	<LOR	<LOR	<LOR	<LOR	-	<LOR	0.0018
PFTrDA	<LOR	<LOR	<LOR	<LOR	<LOR	-	<LOR	0.065
Count	11	13	14	14	2	-	12	15

^ Kings Meadows upper site was sampled in Autumn only.

South Esk

Table 17. South Esk Catchment PFAS monitoring results

Parameter	South Esk River Upper (41)		South Esk River at Perth (42)	
	Autumn	Spring	Autumn	Spring
N-MeFOSA	<LOR	<LOR	<LOR	0.0005
N-MeFOSAA	<LOR	<LOR	<LOR	0.0031
PFBA	<LOR	<LOR	0.0019	<LOR
PFHxDA	<LOR	<LOR	<LOR	0.0019
PFOS	<LOR	<LOR	0.0002	0.0006
PFTeDA	<LOR	<LOR	0.0007	0.0011
PFTrDA	<LOR	<LOR	<LOR	0.0011
Count	0	0	3	5

Macquarie, Brumbys-Lake and Meander Catchments

Table 18. Macquarie, Brumbys-Lake and Meander Catchments PFAS monitoring results

Parameter	Macquarie River Midlands (87)		Macquarie River Cressy (68)		Meander River, Lower (69)		South Esk River at Trevallyn (38)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
N-MeFOSAA	<LOR	<LOR	<LOR	0.0037	<LOR	<LOR	<LOR	<LOR
PFBA	0.0037	0.0028	<LOR	0.002	<LOR	<LOR	0.001	0.0008
PFBS	0.0004	0.0003	<LOR	<LOR	<LOR	<LOR	0.0003	<LOR
PFDS	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0003	<LOR
PFDoDA	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0005	<LOR
PFHxA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0001	<LOR	<LOR
PFHxS	<LOR	0.0004	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
PFOA	0.0002	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
PFOS	<LOR	0.0004	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
PFTeDA	<LOR	0.0014	<LOR	<LOR	<LOR	<LOR	0.0009	<LOR
PF TrDA							0.0009	<LOR
Count	3	5	0	2	0	1	5	1

Tamar Estuary

Table 19. Tamar Estuary PFAS monitoring results

Parameter	Tamar Estuary Upper (35)		Tamar Estuary Middle (36)		Tamar Estuary Lower (37)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring
10:2 FTS	<LOR	<LOR	0.0023	<LOR	<LOR	<LOR
6:2 FTS	<LOR	0.37	<LOR	0.032	<LOR	<LOR
8:2 FTS	<LOR	0.0012	<LOR	<LOR	<LOR	<LOR
N-EtFOSAA	<LOR	<LOR	0.0009	<LOR	<LOR	<LOR
PFBA	0.0033	0.001	0.001	0.001	<LOR	<LOR
PFBS	<LOR	0.0003	0.0004	<LOR	<LOR	<LOR
PFDS	<LOR	<LOR	0.0005	<LOR	<LOR	<LOR
PFDoDA	<LOR	<LOR	0.0012	<LOR	<LOR	<LOR
PFHpA	0.0002	<LOR	<LOR	<LOR	<LOR	<LOR
PFHxA	0.0004	0.0004	0.0002	0.0002	<LOR	<LOR
PFHxS	0.0004	0.0016	0.0004	0.0005	<LOR	0.0002
PFOA	0.0005	0.0001	0.0001	<LOR	<LOR	<LOR
PFOS	0.0013	0.0025	0.0006	0.0006	<LOR	0.0003
PFPeS	<LOR	0.0004	<LOR	<LOR	<LOR	<LOR
PFTeDA	<LOR	<LOR	0.001	0.0006	<LOR	<LOR
PFTrDA	<LOR	<LOR	0.0014	<LOR	<LOR	<LOR
Count	6	9	12	6	0	2

Central North Catchments

Table 20. Central North catchments PFAS monitoring results

Parameter	Leven River (94)		Leven Estuary (73)		Mersey River (95)		Mersey Estuary (57)		Port Sorell (96)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
10:2 FTS	0.0015	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
6:2 FTS	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0029	<LOR	<LOR
FOSA	0.0012	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
N-EtFOSAA	0.0006	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
N-MeFOSA	0.0009	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
PFDS	0.0006	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
PFDoDA	0.0006	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
PFHpA	<LOR	<LOR	<LOR	<LOR	0.0001	<LOR	<LOR	<LOR	<LOR	<LOR
PFHxA	<LOR	<LOR	<LOR	<LOR	0.0001	0.0001	<LOR	0.0001	<LOR	<LOR
PFHxS	<LOR	<LOR	<LOR	<LOR	<LOR	0.0002	<LOR	0.0004	<LOR	<LOR
PFOA	<LOR	<LOR	<LOR	<LOR	0.0003	<LOR	<LOR	<LOR	<LOR	<LOR
PFOS	0.0003	<LOR	<LOR	<LOR	0.0008	0.0005	<LOR	0.0005	<LOR	0.0004
PFPeA	<LOR	<LOR	<LOR	<LOR	<LOR	0.012	<LOR	0.0007	<LOR	<LOR
PFTeDA	0.0016	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
PFTrDA	0.0012	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Count	9	0	0	0	4	4	90	5	0	1

North West Catchments

Table 21. North West catchments PFAS monitoring results

Parameter	Blythe Estuary (52)*		Emu Estuary (101)*		Shorewell Creek (80)		Inglis River (100)		Inglis Estuary (51)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
6:2 FTS	<LOR	-	-	<LOR	0.0082	0.0044	<LOR	<LOR	<LOR	<LOR
N-EtFOSA	<LOR	-	-	<LOR	<LOR	<LOR	<LOR	0.0011	<LOR	<LOR
N-EtFOSAA	<LOR	-	-	<LOR	<LOR	0.0027	<LOR	0.0006	<LOR	<LOR
N-MeFOSA	<LOR	-	-	<LOR	<LOR	<LOR	<LOR	0.0012	<LOR	<LOR
PFBA	<LOR	-	-	<LOR	0.0072	0.0024	<LOR	<LOR	<LOR	<LOR
PFBS	<LOR	-	-	<LOR	0.0014	0.0011	<LOR	<LOR	<LOR	<LOR
PFDA	<LOR	-	-	<LOR	0.0004	<LOR	<LOR	<LOR	<LOR	<LOR
PFDoDA	<LOR	-	-	<LOR	<LOR	<LOR	<LOR	0.0013	<LOR	<LOR
PFHpA	<LOR	-	-	<LOR	0.004	0.0035	<LOR	<LOR	<LOR	<LOR
PFHpS	<LOR	-	-	<LOR	0.0012	0.0006	<LOR	<LOR	<LOR	<LOR
PFHxA	<LOR	-	-	<LOR	0.0086	0.0065	<LOR	<LOR	<LOR	0.0001
PFHxDA	<LOR	-	-	<LOR	<LOR	<LOR	<LOR	0.0017	<LOR	<LOR
PFHxS	<LOR	-	-	0.0002	0.01	0.0066	<LOR	<LOR	0.0004	0.0011
PFNA	<LOR	-	-	<LOR	0.0009	0.0005	<LOR	<LOR	<LOR	<LOR
PFOA	<LOR	-	-	<LOR	0.0049	0.0057	<LOR	<LOR	<LOR	<LOR
PFOS	<LOR	-	-	0.0003	0.03	0.015	<LOR	<LOR	0.0005	0.0028
PFPeA	<LOR	-	-	<LOR	0.01	0.0082	<LOR	<LOR	<LOR	<LOR
PFPeS	<LOR	-	-	<LOR	0.0012	0.0013	<LOR	<LOR	<LOR	<LOR
PFTeDA	<LOR	-	-	<LOR	<LOR	<LOR	<LOR	0.0055	<LOR	<LOR
PFTrDA	<LOR	-	-	<LOR	<LOR	<LOR	<LOR	0.0025	<LOR	<LOR
Count	0	-	-	2	13	13	0	7	2	3

* Blythe Estuary only sampled in autumn and ^Emu Estuary only sampled in spring.

Far North West Catchments

Table 22. Far North West catchments PFAS monitoring results

Parameter	Duck River (93)		Duck Estuary (77)		Montagu River (50)		Welcome River (71)		Arthur River (70)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
10:2 FTS	<LOR	<LOR	<LOR	<LOR	<LOR	0.0017	<LOR	<LOR	<LOR	<LOR
6:2 FTS	<LOR	<LOR	<LOR	0.0008	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
N-EtFOSAA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0007	<LOR	<LOR	<LOR	<LOR
N-MeFOSA	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0006	<LOR
PFBA	<LOR	0.011	<LOR	0.011	<LOR	0.0019	<LOR	0.0056	<LOR	<LOR
PFDoDA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0008	<LOR	<LOR	<LOR	<LOR
PFHxA	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0002
PFTeDA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0023	<LOR	0.0018	0.001	<LOR
PFTrDA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0014	<LOR	<LOR	<LOR	<LOR
Count	0	1	0	2	0	6	0	2	2	1

West Coast Catchments

Table 23. West Coast catchments PFAS monitoring results

Parameter	Queen River (48)		King River (47)		Macquarie Harbour (83)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring
6:2 FTS	0.0006	<LOR	<LOR	<LOR	<LOR	<LOR
N-EtFOSAA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0005
PFDS	0.0003	<LOR	<LOR	<LOR	<LOR	<LOR
PFDoDA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0008
PFHpA	0.0002	<LOR	<LOR	<LOR	<LOR	<LOR
PFHxA	0.0004	0.0003	<LOR	0.0001	<LOR	<LOR
PFHxS	0.0004	0.0004	<LOR	0.0002	<LOR	<LOR
PFOA	0.0005	0.0003	<LOR	0.0003	<LOR	0.0001
PFOS	0.0017	0.0014	<LOR	0.0008	<LOR	0.0007
PFPeA	<LOR	<LOR	<LOR	<LOR	<LOR	0.001
PFTeDA	<LOR	<LOR	<LOR	<LOR	<LOR	0.002
PFTrDA	<LOR	<LOR	<LOR	<LOR	<LOR	0.0009
Count	7	4	0	4	0	7

Huon Catchment

Table 24. Huon PFAS monitoring results

Parameter	Little Dension River (3)*		Upper Huon River at Southwood (4)		Mid Huon River (5)		Lower Huon River (6)		Huon Estuary (7)*	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
PFHxA	<LOR	-	0.0004	<LOR	0.0004	0.0001	0.0004	0.0002	0.0001	-
PFHxS	<LOR	-	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0002	-
PFOA	<LOR	-	0.0008	<LOR	<LOR	<LOR	<LOR	<LOR	0.0001	-
PFOS	<LOR	-	<LOR	<LOR	<LOR	<LOR	<LOR	0.0002	0.001	-
PFPeA	<LOR	-	<LOR	0.0007	<LOR	0.0008	<LOR	0.0013	<LOR	-
PFTeDA	<LOR	-	<LOR	0.0005	<LOR	<LOR	<LOR	<LOR	<LOR	-
Count	0	-	2	2	1	2	1	3	4	-

* Sampled during autumn only

Summary of PFAS detection

The table below summarises the number of detections above the LOR for each PFAS compound for each sampling round and the percentage of sites detected at.

Table 25: PFAS results above the limits of reporting by monitoring round and the percentage of sampling location at which each PFAS compound was detected in at least one monitoring round.

PFAS	Autumn	Spring	% Site detection
PFOS	27	32	53.9
PFBA	28	32	50.0
PFHxA	28	27	44.7
PFHxS	23	26	42.1
PFOA	23	18	35.5
PFTeDA	13	15	32.9
PFBS	17	21	30.3
PFPeA	10	18	26.3
PFHpA	17	13	22.4
6:2 FTS	10	13	22.4
PFTrDA	7	8	19.7
PFPeS	11	11	18.4
PFDA	11	7	15.8
PFNA	10	9	13.2
N-EtFOSAA	3	6	11.8
PFDoDA	5	4	11.8
PFDS	8	0	10.5
PFHpS	4	6	7.9
N-MeFOSAA	0	5	6.6
10:2 FTS	4	1	6.6
N-MeFOSA	2	2	5.3
PFHxDA	0	2	2.6
8:2 FTS	1	1	2.6
FOSA	2	NA	NA
N-EtFOSA	0	1	1.3
PFUnDA	0	1	1.3

Discussion

Catchment observations

Greater Derwent River Catchment

The greater Derwent Estuary catchment consists of 6 CFEV catchments, the Derwent Estuary-Bruny, Lower Derwent, Upper Derwent, Jordan, Clyde and Ouse. Sampling was conducted in 5 of these catchments, the exception being Ouse (Figure 3 and 4).

Upper and Lower Derwent

See Tables 4 and 5 for results.

Monitoring sites were located near the headwaters discharging from Lake St Clair, and below Repulse Dam lower in the catchment. Monitoring was also conducted in the major tributaries of the Tyenna at 2 locations and in the Styx River near its confluence with the Derwent

PFTeDA was detected at or near LOR on 3 occasions and was associated with detection of PFTrDA in the Tyenna and the Styx also near the limits of reporting. No compound was detected in both monitoring rounds at any location. The Lower Tyenna and Styx Rivers are in agricultural areas with grazing and hops cropping.

Clyde

See Table 6 for results.

The Clyde River was sampled at 3 locations: near the headwaters discharging from Lake Crescent, mid catchment at Bothwell and at the base of the catchment at Hamilton. Lake Crescent is a hydroelectric impoundment used for recreational boating and fishing activities. Agricultural activity dominates most of the catchment.

Waters discharging from Lake Crescent in autumn were very turbid due to a high concentration of suspended clays. Despite filtering this appears to have impacted the analytical methods as the limits of reporting were increased by at least 2 orders of magnitude indicating a loss of sensitivity of the analytical method.

Seven different PFAS compounds were detected in the upper Clyde, however none was detected during both monitoring rounds. Four PFAS compounds were detected in autumn in the middle catchment within an order of magnitude of the LOR. One compound was detected in the lower Clyde in each round at low levels (PFHxS in autumn, PFBA in spring).

There appear to be no obvious trends in the results. The upper catchment results are ambiguous given the potential impact of colloidal material in the water column on the results.

Jordan

See Table 7 for results.

The Jordan was sampled in the middle and low catchment at 3 locations. The middle catchment is rural while the lower site was located within the estuarine portion of the River below the township of Brighton and associated light industrial areas.

Eight different PFAS compounds were detected. PFBA was detected consistently and within approximately one order of magnitude at all sites. Other notable detections were low levels of PFBS in spring at all sites and in autumn higher in the catchment, detection of trace amounts of PFOS at all sites during the autumn round only and PFHxS at or near the LOR at all sites in the spring only. Flow rates in spring were low to moderate compared to higher flows in autumn. This seemed to have no obvious impact on results.

Glenorchy Municipality, Hobart

See Table 8 for results.

Glenorchy is the municipality to the north-west of Hobart and is part of the same urban area. Much of the municipality is medium density residential with significant areas of commercial light and heavy industrial use. Three rivulets flowing from the hills through Glenorchy to the Derwent were sampled (Figure 4). The headwaters of the rivulets are in the Wellington Park conservation area.

Trace amounts of PFAS compounds were detected in the upper catchments of New Town Rivulet and Humphreys Rivulet in spring only. More PFAS compounds at generally higher levels were detected at sites lower in the catchments and in urban areas with between 9 and 13 separate compounds detected at each of these sites. The highest PFAS concentrations were detected in Littlejohn Creek with a similar range of PFAS compounds in the Lower Humphreys Rivulet to which it drains. The levels of PFAS at urban monitoring sites were relatively consistent between autumn and spring monitoring rounds, even though most compounds were at relatively low levels.

Hobart Rivulet

See Table 9 for results

Hobart Rivulet runs from the Springs under the kunanyi/Mount Wellington Plateau, through conservation areas, lower density residential, downgradient of a landfill then through higher density residential areas prior to being channelised and flowing under the Hobart CBD then discharging to the Derwent Estuary. Samples were taken in the upper catchment above residential zones, mid catchment below the landfill, and at the confluence of the Rivulet with the Derwent Estuary (Figure 4).

No PFAS were detected in the upper catchment. A large number of PFAS compounds were detected in the mid and lower rivulet with 16 individual PFAS detected in autumn mid catchment. The range of compounds and concentrations detected at the mid and lower sites was relatively consistent between monitoring rounds. More compounds and higher concentrations were detected in the mid rivulet in autumn. It is noted that a higher suspended sediment level was also present in that sample than the spring sample.

The lower rivulet site was within the tidal zone of the Derwent Estuary. Although fresh water was sampled during both monitoring rounds, the autumn round was more saline indicating a greater mixing with estuarine water. This may have contributed to lower PFAS levels in the autumn sampling round at this site.

Derwent Estuary

See Table 10 and 11 for results.

Estuarine waters were sampled on outgoing tides as far as practicable. A wide range of PFAS compounds were detected in trace amounts throughout the estuary however only low numbers of PFAS compounds were detected at each site. The only sites where the same compounds were detected in both monitoring rounds were at New Town Bay where PFHxA, PFHxS and PFOS were detected, and near Tranmere where PFTeDA was detected in both monitoring rounds.

Eastern Catchments

A number of separate catchments were sampled in the region extended from the Coal River Valley and along the east coast from the Freycinet area to the Tasman Peninsula (Figure 5). The catchments sampled were Pittwater-Coal, Carlton River within the Tasman catchment, Little Swanport, and the Swan River within the Swan-Apsley.

Pitt Water-Coal

See Table 12 for results

Three monitoring sites were sampled along the Coal River, the lower site being in the estuarine section of the river. The estuarine site was sampled in autumn only. Land use along the river is mainly agricultural with townships through the valley. PFAS compounds were found at low levels at all Coal River sites, the most being 5 compounds detected in the upper catchment. PFBA was detected in all samples and PFBS in all but the estuarine sample. One of the 2 sites at which FOSA was detected in spring was in the upper Coal River.

One monitoring site was located in the mouth of the Barilla Rivulet where it enters Barilla Bay in Pittwater. Nine PFAS compounds were detected in the autumn monitoring round and 16 compounds were detected in the spring round including all those detected on the previous round. The total detected PFAS concentrations was significantly higher in the spring round. The autumn sample was saline whilst the spring sample was fresh with higher levels of suspended solids. This indicates the autumn sample was predominantly outgoing tidal water whilst the spring sample was more representative of freshwater discharge from the rivulet. The rivulet is located downstream of airport facilities.

Trace amounts of PFAS were detected in Pittwater in the autumn monitoring round whilst none were detected in the Spring monitoring round.

East coast catchments

See Table 13 for results.

Three rivers were sampled, the Little Swanport and the Swan Rivers discharging to the east coast and the Carlton River discharging to Frederick Henry Bay.

The Carlton River was sampled behind a weir prior to the estuarine zone. Five PFAS compounds in autumn and 6 in spring were detected with higher concentrations detected in autumn. The river was not flowing in autumn, whilst in spring the river was flowing at a low rate. This may account for the difference in concentrations.

Numbers of detections and concentrations of detected PFAS in the Little Swanport and Swan River were low.

North East Catchments

See Table 14 for results.

The catchments considered in the north east group extend from the east coast north of the Freycinet Peninsula to the Tamar Valley on the north Coast (Figure 6). Three of the 8 CFEV catchments in the region were sampled, the main rivers of which were sampled near the base of the catchments.

In the Ringarooma River and the George River low levels of PFAS were detected in the spring monitoring round only. A larger number of PFAS compounds were detected in the Great Forester River with higher levels detected in the autumn. All compounds detected in the spring monitoring round were also detected during the autumn monitoring round. The results for the Great Forester River were higher than was typically found in other predominantly rural catchments in the ambient monitoring programs. The reason is not known.

Greater Tamar River Catchment

The greater Tamar catchment consists of 7 CFEV catchments. These are the North Esk, South Esk, Macquarie, Great Lake, Brumbys-Lake, Meander and Tamar Estuary (Figure 7, Figure 8). Sampling was carried out in all these catchments except Great Lake.

The greater catchment drains over one fifth of Tasmania's landmass from the eastern ranges and Ben Lomond plateau, through the northern midlands and Meander Valley, and the Central Plateau to the south west. The Tamar Estuary itself is approximately 70km long from Launceston north northwest to George Town. The mouth of the estuary is open with high tidal exchange and waters are essentially marine. Water exchange within regions towards the head of the estuary, south of Long Reach, is more restricted due to topographic and bathymetric bottlenecks. These areas are more truly estuarine.

North Esk

See Tables 15 and 16 for results.

The North Esk River headwaters begin in the ranges north of Ben Lomond with its tributary the Ford River draining the Ben Lomond Plateau. Monitoring was undertaken on the Ben Lomond Plateau and mid catchment prior to the North Esk confluence with the St Patricks River. Trace levels of 6:2 FTS were detected in the Ford River in spring and PFOS in the North Esk. It is noted that the Ford River is located within a skiing area and does receive discharges form a wastewater treatment plant on the Plateau on occasion. PFOS was detected in the North Esk at the mid catchment monitoring site in the spring monitoring round. The lower North Esk site was below the confluence with other sampled catchment and results are thus discussed following those.

Springvale Creek and Kellys Creek are tributaries draining the region to the south of Launceston in the vicinity of Launceston Airport and discharging via Rose Rivulet into the North Esk below the Corra Linn Gorge. A wide range of the PFAS compounds were found at monitoring sites in these creeks at significant concentrations relative to sites in catchments without the presence of transport infrastructure. PFAS loads were consistent at each site between the autumn and the spring monitoring rounds.

The Kings Meadows Rivulet drains from a recreation reserve through urban areas of Launceston to the North Esk River. Monitoring was undertaken near the headwaters in spring only, and prior to the rivulet's confluence with the North Esk in both monitoring rounds. During the autumn monitoring round the headwaters were dry. PFBA and PFBS at low levels were detected in the upper rivulet. In the lower rivulet a wide range of PFAS compounds was detected with a high level of consistency between monitoring rounds in concentration. Notably the range of individual PFAS compounds detected was similar to that detected in Little John Creek in the suburbs of greater Hobart, although the concentrations were lower. PFTeDA and PFTrDA were detected in the Kings Meadows Rivulet in addition to the suite detected in Little John Creek.

Differences in the compounds detected in creek down gradient of Launceston Airport facilities and in Kings Meadows Rivulet were the presence of 8:2 FTS and N-MeFOSAA in samples from the former site and the presence of PFTeDA and PFTrDA in samples from the Kings Meadows Rivulet.

The final monitoring site was located at the base of the North Esk catchment within the zone subject to tidal cycles. Samples collected during both monitoring rounds were fresh water. 9 PFAS compounds were detected in autumn and 8 in spring with some variation between which compounds were detected in each monitoring round. Levels of each individual compound were generally low with only 6:2 FTS and PFOS greater than 1 order of magnitude above the LORs.

South Esk Catchments

See Tables 17 and 18 for results.

Two monitoring sites were located in the South Esk prior to its confluence with the Macquarie River in the Northern Midlands plains. No PFAS were detected in the upper catchment. Downstream of Perth low levels of PFAS were detected in both monitoring rounds however no individual compound was detected in both rounds.

The Macquarie River crosses the length of Midlands before draining into the South Esk. Two monitoring sites were located on the river, one within the Southern Midlands and one lower in the catchment near Cressy. PFAS were detected in the Southern Midlands site with PFBA and PFBS being detected in both monitoring rounds. PFBA levels were marginally elevated with respect to the LOR and other PFAS detection levels. PFBA was also detected at the Northern Midlands site as was N-MeFOSAA.

The only PFAS detected in the Meander was PFHxA in spring.

The South Esk was sampled below Trevallyn Dam. Low levels of 5 compounds were found in the autumn monitoring round. Only PFBA was above the LOR in the spring monitoring round.

Tamar Estuary

See Table 19 for results.

Three monitoring sites were located along the estuary. These were within the upper estuary in the Launceston area, within the mid estuary within the area still considered functionally estuarine, and at the head of the Tamar Estuary on the western shore across from George Town and the industrial area of Bell Bay. At the Upper and Middle estuary site between 6 and 12 compounds were detected in each monitoring round. 4 compounds were common to both sites in all monitoring rounds. It is noted that a relatively high concentration of 6:2 FTS was present in the upper estuary in spring and also detected in the middle estuary in spring only.

Monitoring near the estuary mouth found 2 compounds marginally above the LOR in the spring monitoring round only.

Central North Catchments

See Table 20 for results.

Four catchments are included in the central north grouping, these being the Leven, Forth-Wilmot, Mersey and Rubicon (Figure 9). Monitoring sites were located within the estuaries at the head of the Rubicon, the Mersey and the Leven, with additional sites at the confluence of the Mersey and Leven Rivers with the respective estuaries.

Nine PFAS compounds were detected in the Leven in the autumn monitoring round. This included one of the two detections of FOSA in autumn[2]. It is noted that the water was brackish in the former monitoring round and fresh in the later monitoring round. Although whether this may indicate the nature of the source is unclear. No PFAS were detected at the mouth of the estuary in either monitoring round.

Four compounds were found at or marginally above the LOR in the Mersey River at the head of the estuary with some variation between the autumn and spring round regarding which compounds were detected. Low levels of 5 compounds were found in the spring monitoring round at the mouth of the estuary whilst none were found in autumn.

In Port Sorell at the head of the Rubicon River trace amounts of PFAS were found in spring only.

North West Catchments

See Table 21 and 22 for results.

The north west region consists of nine separate CFEV catchments 8 of which were sampled as part of the program (Figure 10). The Blythe and Emu Estuaries were sampled in alternative rounds as it was felt subsequent to sampling the Blythe that the Emu would provide more data with regard to a catchment with historical heavy industries. Within the Cam catchment Shorewell Creek was sampled as an example of an urban creek. The Inglis and Duck were both sampled at 2 locations each (River and Estuary).

Trace levels of PFHxS and PFOS were found in the Emu River Estuary in spring. No PFAS were detected in the Blythe.

Shorewell Creek in Burnie was sampled in a duck pond, as flow through the creek prior to the pond was low. Fifteen different PFAS compounds were detected in the pond, 13 in each monitoring round. The levels for individual compounds were not dissimilar to the levels found in other urban streams monitored in this program. There was a high degree of reproducibility between the results for both monitoring rounds. The Shorewell Creek catchment is almost entirely urban with some historical landfilling and industrial activity, and service depots.

Low levels of PFAS compounds were found throughout other catchments, however only in the Inglis Estuary and Arthur River was PFAS detected in both autumn and spring, although in the Arthur different PFAS were detected in each round. Five compounds were detected in the Montague River and 7 in the Inglis River in spring. The reasons why a relatively broad range of PFAS were detected in spring, and none were detected in autumn, are unknown.

West Coast Catchments

See Table 23 for results.

The King-Henty catchment was sampled at the mouth of the King River where it discharges to Macquarie Harbour, and on the Queen River below Queenstown and the Mt Lyell mining operations. One additional monitoring site was located within Macquarie Harbour, which nominally lies within the Gordon-Franklin catchment (Figure 11).

The Wanderer-Giblin and Port Davey catchments are remote and substantially wilderness and were not sampled.

Seven PFAS compounds were found in the Queen River in autumn and 4 of these were again detected in spring these being PFHxA, PFHxS, PFOA and PFOS. The Queen River has been highly impacted by historical mining operations. These 4 compounds were also detected in the King River to which the Queen reports in the spring monitoring round at trace levels.

Seven PFAS compounds were detected in the Macquarie Harbour in the spring monitoring round only. PFOA and PFOS were the only compounds found at all sites in at least one monitoring round.

[2] FOSA results for the spring monitoring round were removed because of contamination concerns. Note no FOSA was detected in the Leven River in the spring monitoring round.

Huon

See Table 24 for results.

The Huon catchment lies in the far south of the state. The catchment headwaters are in wilderness areas. The township of Huonville is near the head of the estuary (Figure 11).

Five sites were sampled in the autumn. Only 3 of these sites could be resampled in the winter due to hazardous conditions. The headwater tributary of the Little Denison site was impacted by forestry operations whilst difficult weather conditions restricted sampling of the lower estuary.

No PFAS compounds were found in the Little Denison in the one monitoring round undertaken. Low levels of between 1 and 3 PFAS compounds were found along the length of the Huon River from Southwood to Huonville. Four PFAS compounds in trace amounts were found in the estuary during the one sampling round conducted. PFHxA was found at all sites except the Little Denison.

Overall findings

The program undertaken provides a snapshot of typical PFAS concentrations in surface fresh and estuarine water across the State. The program investigated a representative range of catchments in all regions of the Tasmanian mainland.

Of the sites monitored, PFAS compounds were found at 69 out of 76 sites (approximately 92% of sites). Of the seven sites where PFAS compounds were not detected, five were within freshwater and two were within estuarine environments.

Of the 34 PFAS compounds screened, 26 were detected at least once above the limits of reporting. The compounds detected, the number of detections in each monitoring round and the percentage of sites sampled at which the compound was detected is listed in Table 25.

PFOS was detected at the most sites, closely followed by PFBA, both at 50% or greater of all sites. PFOA, which together with PFOS is listed under the Stockholm Convention, was the fifth most common PFAS to be detected at any site, being detected at 35.5% of sampling locations at least once. PFHxS, currently under consideration for listing, was the fourth most common PFAS to be detected at any sampling location.

FOSA spring results were removed from the data for the purpose of this report (refer to Appendix C). FOSA was detected in only 2 sites in the autumn monitoring round in unrelated locations (Upper Coal River and Leven Estuary).

Compounds not detected were 10:2 FTA, 6:2 FTA, 8:2 FTA, 4:2 FTS, FOSAA, N-EtFOSE, N-MeFOSE and PFODA. However, the lack of positive results does not mean that these compounds are not present in the environment. Four other PFAS were found at only one or 2 sites and may equally have not been detected if alternative catchments or locations had not been sampled. This program focused on surface water only and given the potential variability in environmental chemistry the results are not an indication of the presence or otherwise of PFAS in soils, sediment, biota, or groundwater.

PFOS was found in the highest concentration at 0.5 - 2.2 µg/L downgradient of airport infrastructure. PFBA however was found more often at higher concentrations than PFOS, the 80th percentile concentration of PFBA being 0.0022 µg/L compared with 0.0014 µg/L for PFOS.

As well as PFAS, several other parameters were measured to provide information on the physical and chemical environment at each sampling location. PFAS concentrations in water are known to be affected by factors such as pH, salinity and the concentration of dissolved organic carbon (Baddiley et al. 2020). In this report, salinity has been considered in estuarine environments to effect concentrations between monitoring rounds due to the level of marine influence. Correlation of PFAS concentration with dissolved organic carbon was investigated but the data set from this program is insufficient for any meaningful information to be derived.

Between the autumn and spring round results overall were comparable. There was some variation in the numbers of compounds detected, and which compounds were detected at sites with very low detected concentrations. In particular, estuarine sampling sites varied in the compounds detected but not dramatically in the total concentration of PFAS above the LOR. Results were relatively consistent between

monitoring rounds for urban streams, which on average had greater numbers and higher levels of PFAS. It appears that concentrations were not appreciably affected by winter rain regardless of catchment hydrology. Insufficient data was generated to conduct any detailed statistical analysis in regard to seasonal variation.

The monitoring undertaken was targeted to be representative of land use. The purpose was not to investigate PFAS levels associated with any specific sites. The potential existed however to identify an otherwise unknown site and such investigation was one of the stated objectives of the program. There was some variance in the data generated in rural areas as noted in discussion, however results were still generally low and do not provide any specific indication of the presence of previously unknown PFAS contaminated sites in any sampled catchment.

PFAS was generally detected at levels close to the limits of reporting i.e., at levels in the parts per trillion. These are ultra-trace concentrations at the limits of contemporary analytical chemistry standard techniques. The quality control work undertaken indicates that absolute results at these concentrations are potentially highly variable in the level of precision and accuracy (Appendix B). There were 4 duplicate results that failed the selected level of reproducibility and inter-laboratory results show a marked difference with results from the secondary lab being universally lower than those from the primary lab.

At such low concentrations there is also a relatively high risk of sample contamination confounding interpretation. Six of 28 field banks returned positive results for one PFAS compound in each case at or near the limit if reporting. In addition, the anomalous spring FOSA results indicate a potential for systemic contamination.

Nevertheless, the results do provide a good snapshot of typical concentrations in surface waters in Tasmanian catchments. As a whole, the results from the program are higher than the results from the Queensland ambient monitoring programs and lower than reported information for Victorian ambient monitoring programs (Baddiley et. al 2020). This is likely a reflection of differences in land use intensity and study design. The Queensland survey involved multiple sampling rounds at less sites in locations more remote from potential sources. The Victorian programs were more limited in scope and targeted specific land uses and locations.

PFOS Concentration and Land use

In general, and as expected, PFAS concentrations were found to increase lower down in the catchment and in areas of more intense land use before again decreasing in estuarine environments. There were exceptions to these general trends. These have been discussed against the results.

Detections in upper catchments did occur. This may be associated with recreational activities in these areas. For instance, boating and fishing in Lake Crescent at the headwaters of the Clyde River, or skiing and associated facilities on the Ben Lomond Plateau in the North Esk catchment. In agricultural areas trace levels of PFAS were prevalent. In urban streams total PFAS concentrations were generally higher and relatively consistent between urban centres. Almost all estuaries returned positive results for PFAS at trace levels.

In Figure 1 below, PFOS concentrations are compared against ALUM land use classes. PFOS was selected as it is commonly used as a prime indicator of PFAS contamination, and it was detected at the largest number of sites. The number of sites for some land use classes is not sufficient for this to be a robust analysis. Nevertheless, it does accurately illustrate the general trends evident in the data set as a whole. It shows that PFOS is found in water associated with almost all land uses, that concentrations were higher with more intensive land use, and it confirms that airports sites are sources of PFOS due to historical uses at those locations.

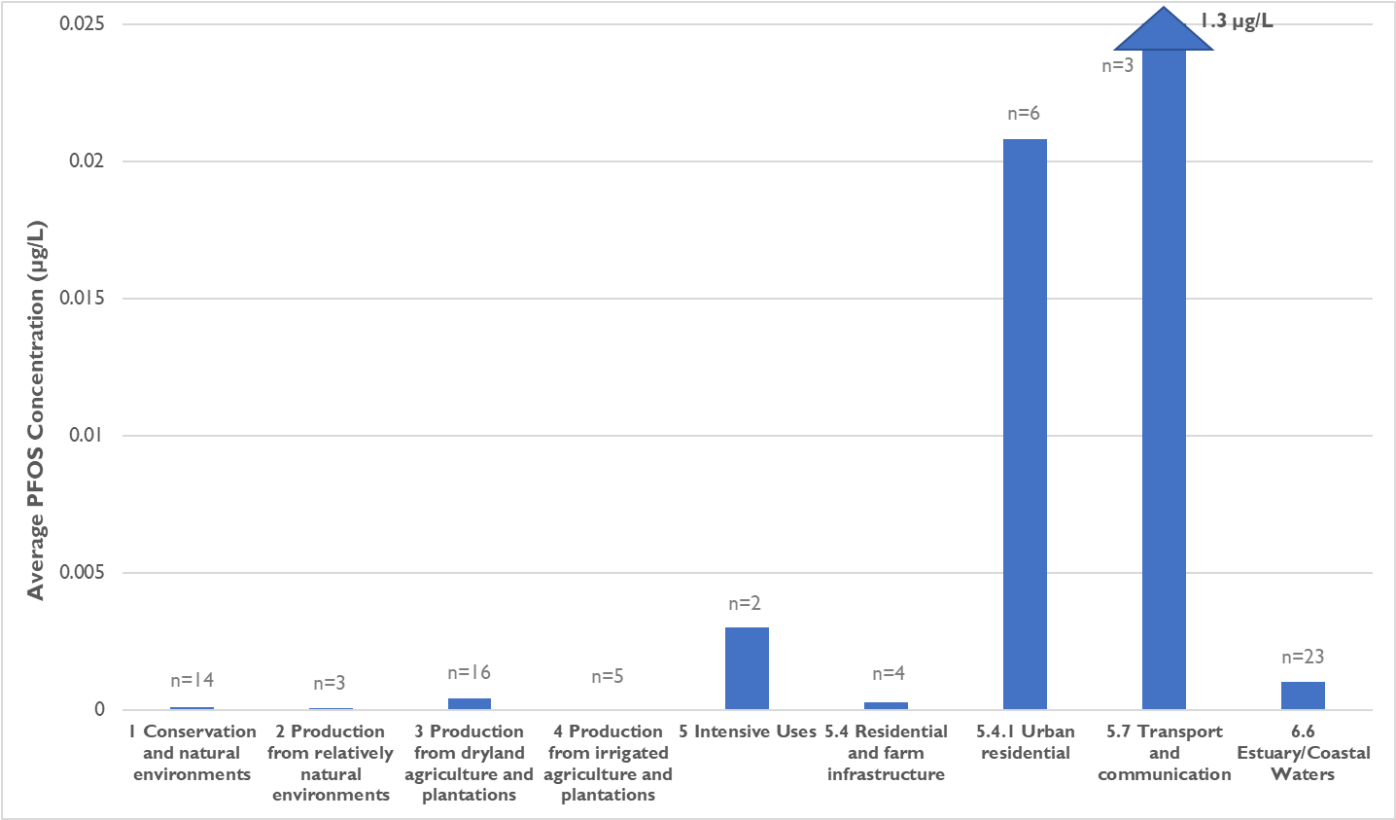

Figure 1. Comparison of average PFAS concentrations by land use

Conclusions

The PFAS ambient monitoring program is an important component of the PFAS Action Plan for Tasmania. The program has been successful in providing a 'snapshot' of typical background concentrations of PFAS in surface waters in Tasmania. This information provides a baseline to gauge the relevance of ambient monitoring results from other investigations.

The PFAS monitoring program is not definitive in relation to any one of the monitoring sites. Only 2 sampling rounds were undertaken. QA/QC results indicate that the potential exists for fugitive contamination to affect detection at such low levels of analytical sensitivity. It is important to take this into account when reviewing the results. That is, not all positive results may in fact be an accurate reflection of PFAS presence at any particular site.

Insufficient information is available for any significant statistical analysis and no comment can be made regarding longer term changes that may occurring. More comprehensive targeted monitoring programs are required to generate such information. The program did provide sufficient information to gain a general understanding of the variance in PFAS levels with land use intensity and location within the catchment (i.e. broadly the headwaters, rural areas, urban areas or estuarine).

The program was restricted to surface waters only and to a suite of 34 PFAS compounds. No inferences can be drawn from this work regarding levels of PFAS in other media or biota, or the presence of PFAS not included the standard analytical suite used.

The results of the PFAS monitoring program are summarised as follows:

- PFAS compounds are present in the Tasmanian environment at low levels in all sampled catchments, with the exception of the Blythe (which was only sampled on one occasion).
- Of the sites monitored PFAS was found at 92% of the sites on at least one occasion. PFOS and PFBA were the most commonly detected PFAS by number of times and by site (PFOS detected on 59 occasions at 54% of sites and PFBA detected on 60 occasions at 50% of sites).
- Headwaters are generally free of PFAS at detectable levels, however, wherever there is human activity in the area the presence of PFAS is more likely.
- PFAS concentrations were typically found to increase lower down in the catchment and in areas of more intense land use before again decreasing in estuarine environments
- Urban streams were found to have a relatively wide variety of PFAS compounds, the range of compounds and concentrations being relatively consistent between urban centres.
- As expected, the highest PFAS concentrations are associated with locations where PFAS containing firefighting foams are known to have historically been used.
- Overall PFAS detection rates and concentrations did not appear to vary significantly between monitoring rounds.

References

ABARES. 2016. "The Australian Land Use and Management Classification Version 8". Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 3.0

AICIS. Australian Government, Department of Health. Australian Industrial Chemicals Introduction Scheme. Per- and poly-fluorinated substances (PFAS). https://www.industrialchemicals.gov.au/consumers-and-community/and-poly-fluorinated-substances-pfas

Air Services Australia. National PFAS Management Program. https://www.airservicesaustralia.com/community/environment/pfas/

Australian Government, PFAS Task Force. https://www.pfas.gov.au/

Baddiley, B.L., Munns T., Braun C. and Vardy S. 2020. "Queensland Ambient PFAS Monitoring Program 2019-2020". Brisbane: Department of Environment and Science, Queensland Government.

C. Gallen, D. Drage, S. Kaserzon, C. Baduel, M. Gallen, A. Banks, S. Broomhall, J.F. Mueller. 2016. "Occurrence and distribution of brominated flame retardants and perfluoroalkyl substances in Australian landfill leachate and biosolids". Journal of Hazardous Materials 312 (2016) 55–64.

Christy A. Barlow, Cynthia A. Boyd, Megan J. Kemp, and Kimberly A. Hoppe Parr. 2019. "PFAS Toxicology – What is Driving the Variation in Drinking Water Standards". GZA GeoEnvironmental, Inc.

DoD. Australian Government, Department of Defence. PFAS Investigation & Management Program. https://defence.gov.au/Environment/PFAS/

DoH. Tasmanian Government, Department of Health. "Per- and poly-fluoroalkyl substances (PFAS)". https://www.health.tas.gov.au/health-topics/environmental-health/and-poly-fluoroalkyl-substances-pfas. Accessed 15 December 2021.

Environment Protection Authority (2020). "Technical Guidance for Water Quality Objectives (WQOs) Setting for Tasmania". Environment Protection Authority, Hobart, Tasmania.

EPA Tasmania 2021. "Progress Update, July 2021, PFAS Interagency Working Group, PFAS Action Plan for Tasmania". Tasmanian Government. https://epa.tas.gov.au/environment/land/area-wide-contaminated-land-issues/pfas-contamination

Expert Health Panel for Per- and Poly-Fluoroalkyl Substances. 2018. Report to the Minister. https://www1.health.gov.au/internet/main/publishing.nsf/Content/ohp-pfas-expert-panel.htm

IGA. Council of Australian Governments. 2020. "Intergovernmental Agreement on a National Framework for Responding to PFAS Contamination". https://federation.gov.au/about/agreements/intergovernmental-agreement-national-framework-responding-pfas-contamination

NEMP. "PFAS National Environmental Management Plan Version 2.0", Heads of EPA Australia and New Zealand 2020'. https://www.awe.gov.au/sites/default/files/documents/pfas-nemp-2.pdf

OECD. Organisation for Economic Co-operation and Development, Environment Directorate. Portal on Per and Poly Fluorinated Chemicals. https://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/#

Organisation for Economic Co-operation and Development. 2018. "Toward a new comprehensive global database of per- and polyfluoroalkyl substances (PFASs): Summary report on updating the OECD 2007 list of per- and polyfluoroalkyl substances (PFASs)."

Stockholm Convention 2019. http://chm.pops.int/TheConvention/ThePOPs/tabid/673/Default.aspx .Accessed 15 December 2021.

Tasmanian Government. 2018. "PFAS Action Plan for Tasmania". https://epa.tas.gov.au/environment/land/area-wide-contaminated-land-issues/pfas-contamination

Timothy L. Coggan, Damien Moodie, Adam Kolobaric, Drew Szabo, Jeff Shimet, Nicholas D. Crosbie, Elliot Lee, Milena Fernandes, and Bradley O. Clarke 2019. "An investigation into per- and polyfluoroalkyl substances (PFAS) in nineteen Australian wastewater treatment plants (WWTPs)". Heliyon, 2019 Aug; 5(8): e02316.

UNEP. United Nations Environment Program. 2015. "PFAS analysis in water for the Global Monitoring Plan of the Stockholm Convention Set-up and guidelines for monitoring". UNEP Division of Technology, Industry and Economics, Geneva.

Appendix A: List of PFAS compounds monitored

Table 26: PFAS Compounds, acronyms, and CAS Number.

PFAS groups and chemical names	PFAS acronym	CAS number
Perfluoroalkyl carboxylic acids (PFCA)		
Perfluorobutanoic acid acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnDA	2058-94-8
Perfluorododecanoic acid	PFDoDA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorhexadecanoic acid	PFHxDA	6795-19-5
Perfluoroalkyl sulfonic acids (PFSA)		
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	335-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
n:2 Fluorotelomer sulfonic acids (n:2 FTS)		
1H.1H.2H.2H-perfluorooctanesulfonic acid	6:2 FTS	27619-97-2
1H.1H.2H.2H-perfluorodecanesulfonic acid	8:2 FTS	39108-34-4
1H.1H.2H.2H-perfluorododecanesulfonic acid	10:2 FTS	120226-60-0
Perfluoroalkyl sulfonamido substances		
N-ethylperfluoro-1-octane sulfonamide	N-EtFOSA	4151-50-2
N-ethyl-perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6
N-methylperfluoro-1-octane sulfonamide	N-MeFOSA	31506-32-8
N-methyl-perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
Perfluorooctane sulfonamide	FOSA	754-91-6

Appendix B: Quality Control

Quality control sampling consisted of the following additional samples:

- 1 field blank per field trip;
- 1 duplicate sample approximately every 10 samples; and
- 4 interlab triplicate samples per monitoring round.

The primary laboratory which carried out analysis of collected samples was Analytical Services Tasmania. The laboratory which carried out analysis of the triplicate samples was the National Measurement Institute.

Table 27: Quality control samples collected

Monitoring Round	Sample No.	Field Blank	Duplicate
Autumn	74	12	8
Spring	72	16	7
Total	146	28	15

Field Blank Results

Field Blanks were prepared by taking a sample bottle of distilled water on the trip and pouring from this bottle into an empty sample bottle in the field adjacent to site locations where samples were collected. The sample in the filled bottle was then analysed for the PFAS suite along with the samples collected in the field.

Over both monitoring rounds there were a total of 5 field blanks (out if a total of 28) where results for PFAS compounds at or above the limit of reporting occurred. One in the autumn monitoring round and 4 in the spring monitoring round. PFOS was detected in 4 of those 5 field blanks and PFOA in 2 of the 5. Detections were generally at or near the LOR, however the results for PFOS in the Derwent Estuary off Tranmere in Spring was notably elevated. Generally, the positive results were not associated with positive results for samples collected at the locations.

Positive results for field blanks were not expected. It should be noted that these results were spread over 5 different sampling teams and occurred on 5 different sampling runs and thus are not associated with any one group's practice. It is also worth noting that positive results in field blanks were not more widespread indicating that it is unlikely to be a systemic failing. It is unknown how contamination could have occurred in each individual incidence. PFOS was the second-most detected PFAS, with PFBA being detected most. PFOA was the fourth-most detected compound.

The results indicate that at the extreme level of sensitivity of the PFAS analytical method used that the potential exists for positive results through ultra-trace levels of fugitive contamination introduced either prior, during or after sampling, even when taking specific precautions to avoid such contamination. It also indicates that it is likely that some of the positive results at or near the LOR may not entirely reflect the presence of PFAS in the environment. This is particularly relevant for very low PFOS and PFOA results.

Table 28: Field blank results for which PFAS was detected above the limits of reporting.

Monitoring Round	Sample location	PFAS compound	LOR (ug/L)	Result (ug/L)	Detected at site
Autumn	Lower Jordan, Autumn	PFOS	0.0001	0.0002	0.0009 (primary) 0.0004 (duplicate)
Spring	Lower Derwent Estuary, Tranmere	PFOA	0.0001	0.0002	<LOR
		PFOS	0.0001	0.0016	<LOR
Spring	Ringarooma River	PFOA	0.0001	0.0001	<LOR
Spring	Upper South Esk	PFOS	0.0001	0.0002	<LOR
Spring	Lower Tamar Estuary	PFOS	0.0001	0.0001	0.0003

Intra-Laboratory Duplicate Results

For intra-laboratory duplicates the relative percent difference (RPD) between results was used to gauge analytical accuracy. Where 1 of the 2 results was below the LOR the concentration was set as equal to the LOR. For results within an order of magnitude of the LOR, a RPD of 100% was considered acceptable. For results greater than an order of magnitude above the LOR, 30% was considered an acceptable RPD.

Four results did not meet the selected reproducibility specification. Two of the results were detection in one sample and non-detection in the other. Levels were still very low and could possibly result from variation in the concentration of particulates with adsorbed PFAS, as well as analytical variability. The other two results were exceedances of 30% relative percent difference. However, they were for results only marginally greater than one order of magnitude. Nevertheless, they do show that at ultra-trace levels analytical results for one sampling event can potentially vary significantly.

Table 29: Intra-laboratory duplicate results which failed to meet quality control criteria (100% relative percent difference if within one order of magnitude of the limit of reporting or 30% relative percent difference if greater than one order of magnitude)

Monitoring Round	Sample location	PFAS compound	RPD	Limit of Reporting (ug/L)	Result Primary (ug/L)	Result Secondary (ug/L)
Autumn	Middle Derwent Estuary, Lindisfarne	PFOS	167%	0.0001	<0.0001	0.0011
Autumn	Lower Jordan River	6:2 FTS	78%	0.0005	0.0035	0.0080
Autumn	Upper Tamar Estuary	PFOS	59%	0.0001	0.0013	0.0024
Spring	Springvale Creek, North Esk	N-MeFOSAA[3]	133%	0.0005	<0.0005	0.0025

[3] Results for FOSA also did not meet acceptance criteria. However because data for FOSA in the spring monitoring round was removed from results for the purpose of this report the result is not recorded here. Refer to the discussion on removal of FOSA results in this report for further information

Inter-Laboratory Duplicate Results

The analytical methods used by the National Measurement Institute resulted in limits of reporting from 5 to 10 times greater than the method used by Analytical Services Tasmania. The 4 samples collected in autumn were collected at a spread of sites determined to ensure samples were collected on different monitoring runs and approximately evenly spread throughout the sampling round. The net result was that PFAS was detected in only one interlaboratory sample. In the spring monitoring round, sampling was also targeted towards sites that would likely produce positive results in both sets of analyses, which was found to be the case.

For all parameters at all sites the result from the secondary laboratory was lower than the result from Analytical Services Tasmania (except for one result which was the same within the level of precision).

In the autumn monitoring round 3 results were obtained from the Lower Hobart Rivulet sampling for which a relative percent difference could be calculated. All were within the acceptance criteria used above for intra-laboratory duplicates. All 4 inter-laboratory duplicate samples in spring returned positive results. RPD exceeded criteria in almost 50% of results where it could be calculated.

A summary of the number of results for which RPDs could be calculated, overall relative percent differences, and number of results that failed the acceptance criteria is provided in Table 31.

It is worth noting that at the sites where inter-laboratory duplicates were taken, there were 2 detections of FOSA in samples analysed in the primary laboratory. FOSA was not detected in any inter-laboratory sample. This supports arguments to remove the FASO data set for the spring monitoring round as discussed in Appendix C below.

Table *30*: Inter-laboratory duplicate results and summary of relative percent differences

Monitoring Round	Sample location	Positive Results	RPD	No. fail criteria
Autumn	Lower Hobart Rivulet (10)	3	11-29%	0
Spring	Lower Hobart Rivulet (10)	8	7-95%	1
Spring	Barilla Rivulet (86)	14	0-181%	6
Spring	Springvale Creek (84)	13	18-67%	9
Spring	North Esk at Launceston (39)	3	6-192%	1

Appendix C: Removal of Spring PFAS Results

Upon comparison of the raw results between the autumn and spring monitoring rounds, it became apparent that detections of FOSA were significantly higher in the spring round than in the autumn round. FOSA was detected at only 2 of 74 sites in autumn but was detected at 42 of 73 sites in spring. This difference was not reflected to any obvious extent in the results for any other PFAS compound (See Figure 2). In addition, the concentration of FOSA did not appear to depend on site location within the catchment. The general pattern evident for PFAS levels is that concentrations increase as you move from headwaters downgradient and tend to be higher in areas of more intensive land use. It appears that FOSA concentrations were more dependent on monitoring run number than location. Figure 3 shows FOSA results against monitoring run and against PFOS results for comparison.

It was concluded that the pattern of results for FOSA did not appear to reflect environmental factors. Analysis of distilled water washings of wind stopper and raincoat garments were carried out to determine if they may potentially be a source of contamination, noting weather conditions were sometimes poor and such clothing was taken on runs even if not worn during sampling. A range of PFAS compounds were detected however FOSA was not amongst them. Based on the pattern of results and testing conducted, it was concluded that the sample bottles used in the spring monitoring round may have been contaminated by batch, potentially prior to receipt by the lab.

For the purposes of this report data for FOSA from the spring monitoring round has been removed from the analysis. No other data has been removed.

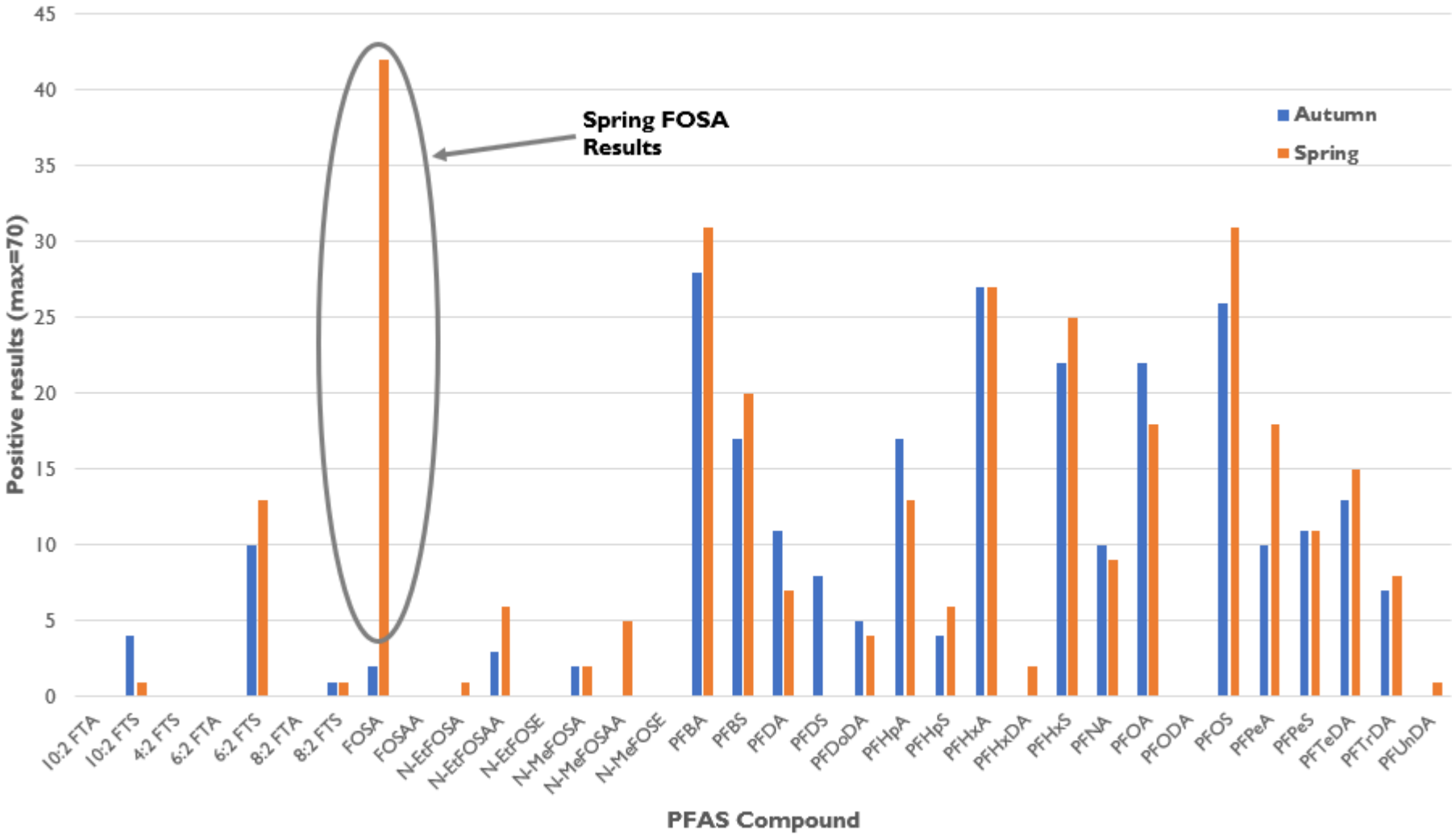

Figure 2: PFAS compound detection by number of sites

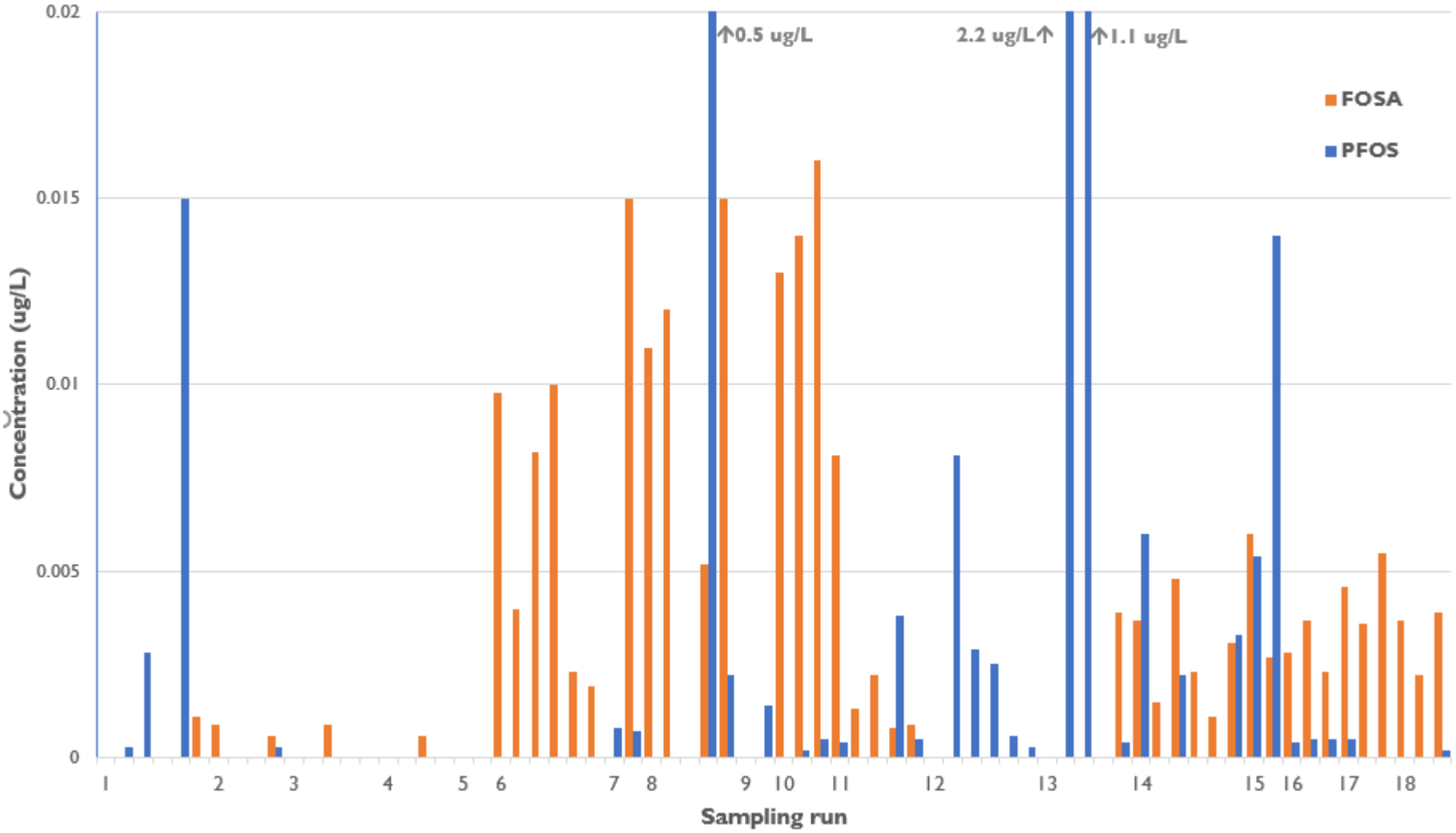

Figure 3: PFOS and FOSA concentrations by sampling run

Appendix D: Monitoring Site Location and Land Use

Table *1*: Monitoring site locations and associated land use

Catchment/Figure	Site Number	Name	Location (GDA 94 MGA Zone 55)		Land Use
Upper Derwent	21	Derwent River, Upper	435192	5335652	1.1 Nature conservation
Upper Derwent	97	Derwent River, Mid	471200	5293751	3 Production from dryland agriculture and plantations
Clyde	33	Clyde River, Upper	511631	5331328	1.3 Other minimal use
Clyde	32	Clyde River, Middle	500169	5308117	4.3 Irrigated cropping
Clyde	28	Clyde River Lower	485796	5287764	3.2 Grazing modified pasture
Lower Derwent	90	Russell Falls Creek	476993	5274572	1.1 Nature conservation
Lower Derwent	31	Tyenna River	488668	5274912	3.2 Grazing modified pasture
Lower Derwent	34	Styx River	492048	5271554	4 Production from irrigated agriculture and plantations
Jordan	27	Jordan River at Hunting Ground	510154	5291646	3.2 Grazing modified pasture
Jordan	20	Jordan River at Broadmarsh	514995	5274309	3.2 Grazing modified pasture
Jordan	19	Jordan River, Lower	521478	5269075	5.4 Residential and farm infrastructure
Derwent Estuary - Bruny	24	Newtown Rivulet, Upper	521046	5253106	1.3 Other minimal use
Derwent Estuary - Bruny	25	Newtown Rivulet, Lower	525380	5255799	5.4.1 Urban residential

Catchment/Figure	Site Number	Name	Location (GDA 94 MGA Zone 55)		Land Use
Derwent Estuary - Bruny	26	Humphreys Rivulet, Upper	520050	5255599	1.1 Nature conservation
Derwent Estuary - Bruny	23	Humphreys Rivulet Lower	522595	5258378	5.4.1 Urban residential
Derwent Estuary - Bruny	22	Littlejohn Creek	521299	5257134	5.4.1 Urban residential
Derwent Estuary - Bruny	12	Hobart Rivulet, Upper	521511	5249360	1.1 Nature conservation
Derwent Estuary - Bruny	9	Hobart Rivulet, Middle	525938	5251308	5.4.1 Urban residential
Derwent Estuary - Bruny	10	Hobart Rivulet, Lower	527721	5252750	6.6 Estuary/Coastal waters
Derwent Estuary - Bruny	18	Upper Estuary at New Norfolk	506955	5263592	6.6 Estuary/Coastal waters
Derwent Estuary - Bruny	17	Upper Estuary at Bridgewater	518447	5267712	6.6 Estuary/Coastal waters
Derwent Estuary - Bruny	98	Mid Estuary at New Town	526208	5256413	6.6 Estuary/Coastal waters
Derwent Estuary - Bruny	14	Mid Estuary at Lindisfarne	527526	5255658	6.6 Estuary/Coastal waters
Derwent Estuary - Bruny	99	Mid Estuary at Kangaroo Bay	529407	5253017	6.6 Estuary/Coastal waters
Derwent Estuary - Bruny	13	Lower Estuary at Tranmere	531437	5248242	6.6 Estuary/Coastal waters
Derwent Estuary - Bruny	89	Lower Estuary at South Arm	530802	5236692	6.6 Estuary/Coastal waters
Pitt Water - Coal	88	Coal River, Upper	538473	5300766	3.2 Grazing modified pasture
Pitt Water - Coal	66	Coal River, Middle	536132	5279686	3.2 Grazing modified pasture
Pitt Water - Coal	67	Coal River Estuary	536420	5266495	6.6 Estuary/Coastal waters
Pitt Water - Coal	86	Barilla Rivulet	538647	5259133	5.7 Transport and communication
Pitt Water - Coal	85	Pittwater	542818	5260407	6.6 Estuary/Coastal waters

Catchment/Figure	Site Number	Name	Location (GDA 94 MGA Zone 55)		Land Use
Tasman	65	Carlton River	557664	5253941	3.2 Grazing modified pasture
Little Swanport	64	Little Swanport River	577355	5312855	1.3 Other minimal use
Swan - Apsley	82	Swan River	589222	5341541	3.2 Grazing modified pasture
Great Forester - Brid	60	Great Forester River	539715	5460190	3.2 Grazing modified pasture
Ringarooma	61	Ringarooma River	578789	5470210	1.2 Managed resource protection
George	62	George River	605959	5425653	2 Production from relatively natural environments
North Esk	92	Ford River	555747	5402159	1.1 Nature conservation
North Esk	45	North Esk River at Ballroom	532095	5406241	3 Production from dryland agriculture and plantations
North Esk	39	North Esk River at Launceston	513258	5414066	5 Intensive uses
North Esk	84	Springvale Creek	520036	5402241	5.7 Transport and communication
North Esk	46	Kellys Creek	518617	5403291	5.7 Transport and communication
North Esk	43	Kings Meadows Rivulet, Upper	512634	5407250	3.2 Grazing modified pasture
North Esk	44	Kings Meadows Rivulet, Lower	514303	5411023	5.4.1 Urban residential
South Esk	41	South Esk River, Upper	560089	5414400	2.2 Production native forests
South Esk	42	South Esk River at Perth	517021	5394904	3.2 Grazing modified pasture
Macquarie	87	Macquarie River, Southern Midlands	532450	5360397	3.2 Grazing modified pasture
Brumbys-Lake	68	Macquarie River at Cressy	511447	5381494	4.2 Grazing irrigated modified pastures

Catchment/Figure	Site Number	Name	Location (GDA 94 MGA Zone 55)		Land Use
Brumbys-Lake	38	South Esk River at Trevallyn Dam	507184	5411291	5.4 Residential and farm infrastructure
Meander	69	Meander River, Lower	492132	5407147	3.2 Grazing modified pasture
Tamar Estuary	35	Tamar Estuary, Upper	510351	5413229	6.6 Estuary/Coastal waters
Tamar Estuary	36	Tamar Estuary, Middle	497787	5428543	6.6 Estuary/Coastal waters
Tamar Estuary	37	Tamar Estuary, Lower	484128	5447139	6.6 Estuary/Coastal waters
Rubicon	96	Port Sorell	463731	5443000	6.6 Estuary/Coastal waters
Mersey	95	Mersey River	450061	5434968	6.6 Estuary/Coastal waters
Mersey	57	Mersey River Estuary	446640	5441017	6.6 Estuary/Coastal waters
Leven	94	River Leven	425360	5443947	1.3 Other minimal use
Leven	73	River Level Estuary	430287	5443671	6.6 Estuary/Coastal waters
Blythe	52	Blythe River Estuary	414784	5452313	6.6 Estuary/Coastal waters
Emu	101	Emu River Estuary	409677	5453191	6.6 Estuary/Coastal waters
Cam	80	Shorewell Creek	407163	5455370	5.4.1 Urban residential
Inglis	100	Inglis River	390396	5463251	4.2 Grazing irrigated modified pastures
Inglis	51	Inglis River Estuary	393689	5461835	6.6 Estuary/Coastal waters
Duck	93	Duck River	339830	5475704	4.2 Grazing irrigated modified pastures
Duck	77	Duck River Estuary	341641	5477610	6.6 Estuary/Coastal waters

Catchment/Figure	Site Number	Name	Location (GDA 94 MGA Zone 55)		Land Use
Montague	50	Montague River	325470	5483100	3 Production from dryland agriculture and plantations
Welcome	71	Welcome River	311182	5486172	1 Conservation and natural environments
Arthur	70	Arthur River	304167	5453127	1.2 Managed resource protection
King-Henty	48	Queen River	377583	5334645	5 Intensive uses
King-Henty	47	King River	364920	5327564	1.2 Managed resource protection
Gordon-Franklin	83	Macquarie Harbour	359370	5319982	6.6 Estuary/Coastal waters
Huon	3	Little Denison	477995	5241806	1.1 Nature conservation
Huon	4	Upper Huon, Southwood	485260	5232759	2.2 Production native forests
Huon	5	Mid Huon River	494105	5239329	5.4 Residential and farm infrastructure
Huon	6	Lower Huon River	503734	5235626	5.4 Residential and farm infrastructure
Huon	7	Huon Estuary	498198	5219365	6.6 Estuary/Coastal waters

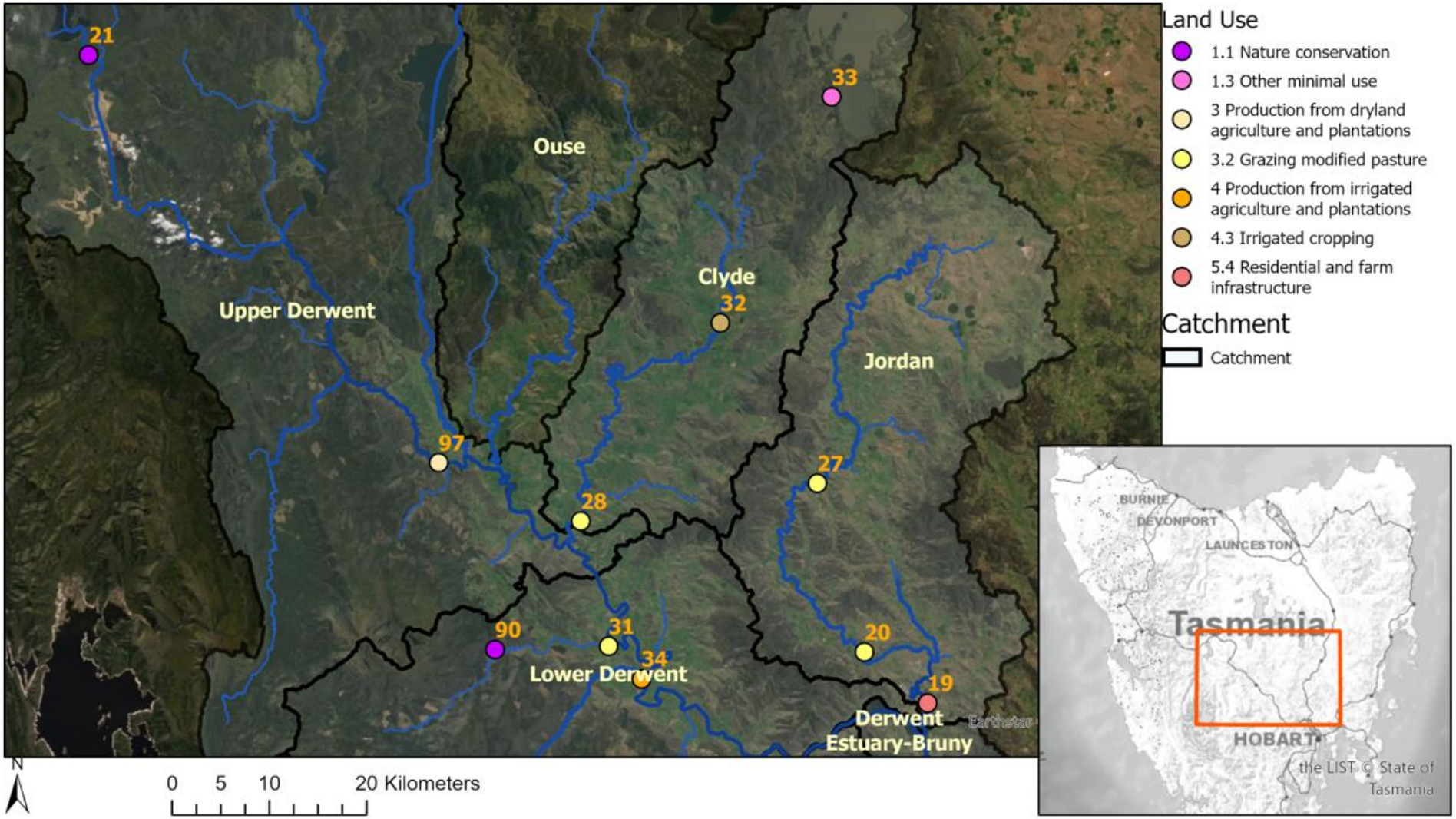

Figure 4: Derwent River Catchments and Sampling Locations

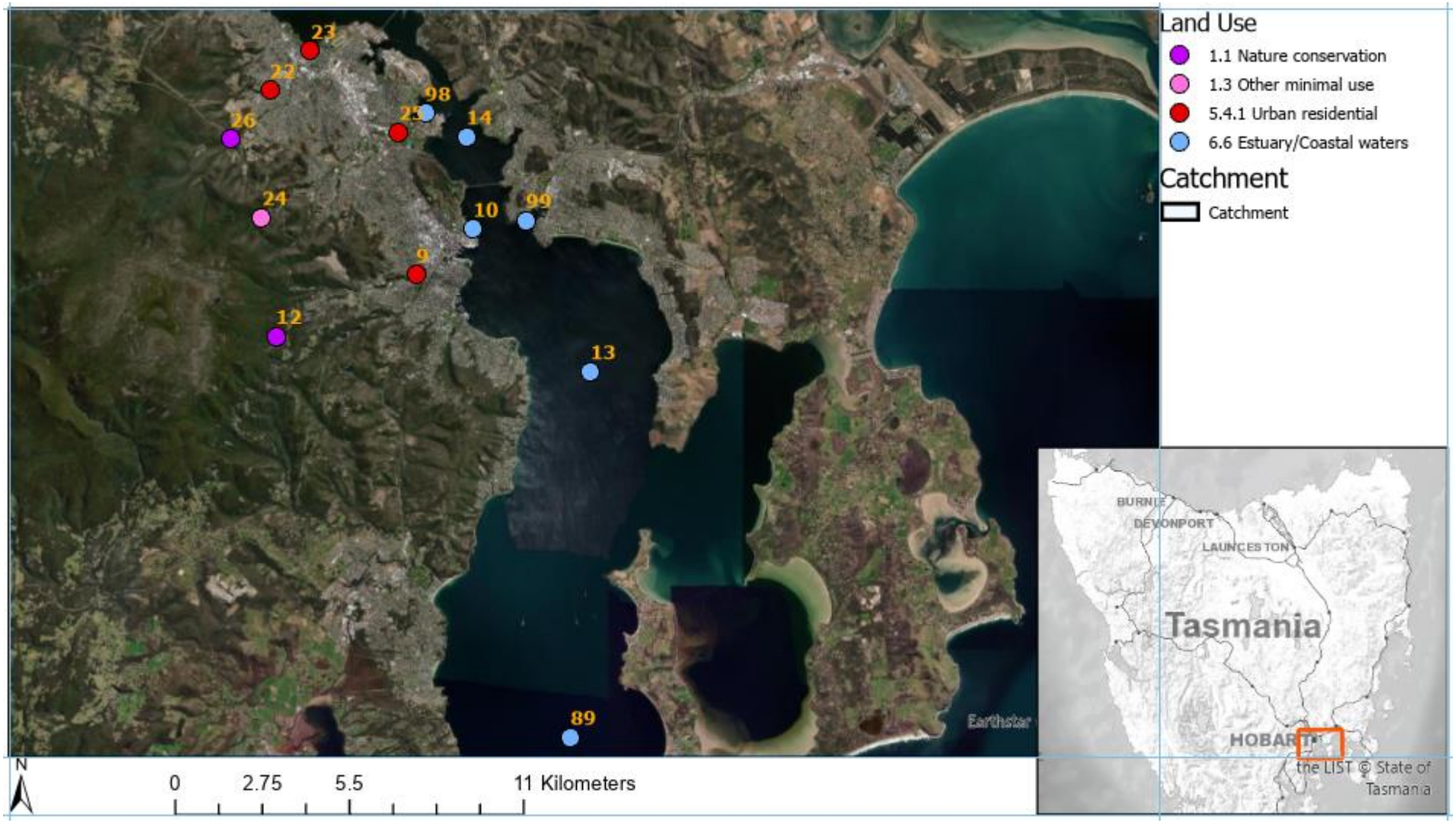

Figure 5: Derwent Estuary and Hobart Sampling Locations

Figure 6: Pittwater-Coal and East Coast sampling locations

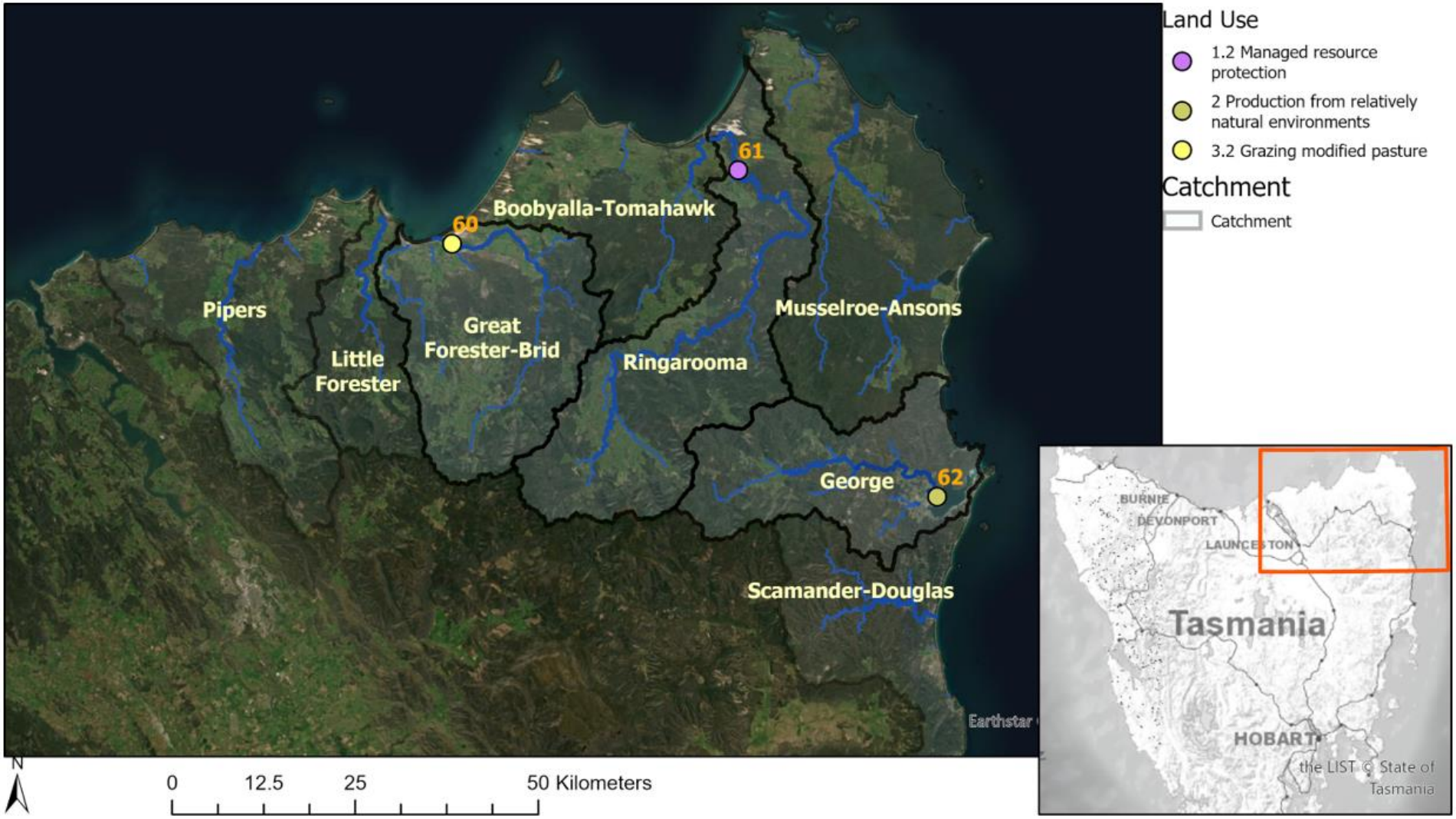

Figure 7: North East sampling locations

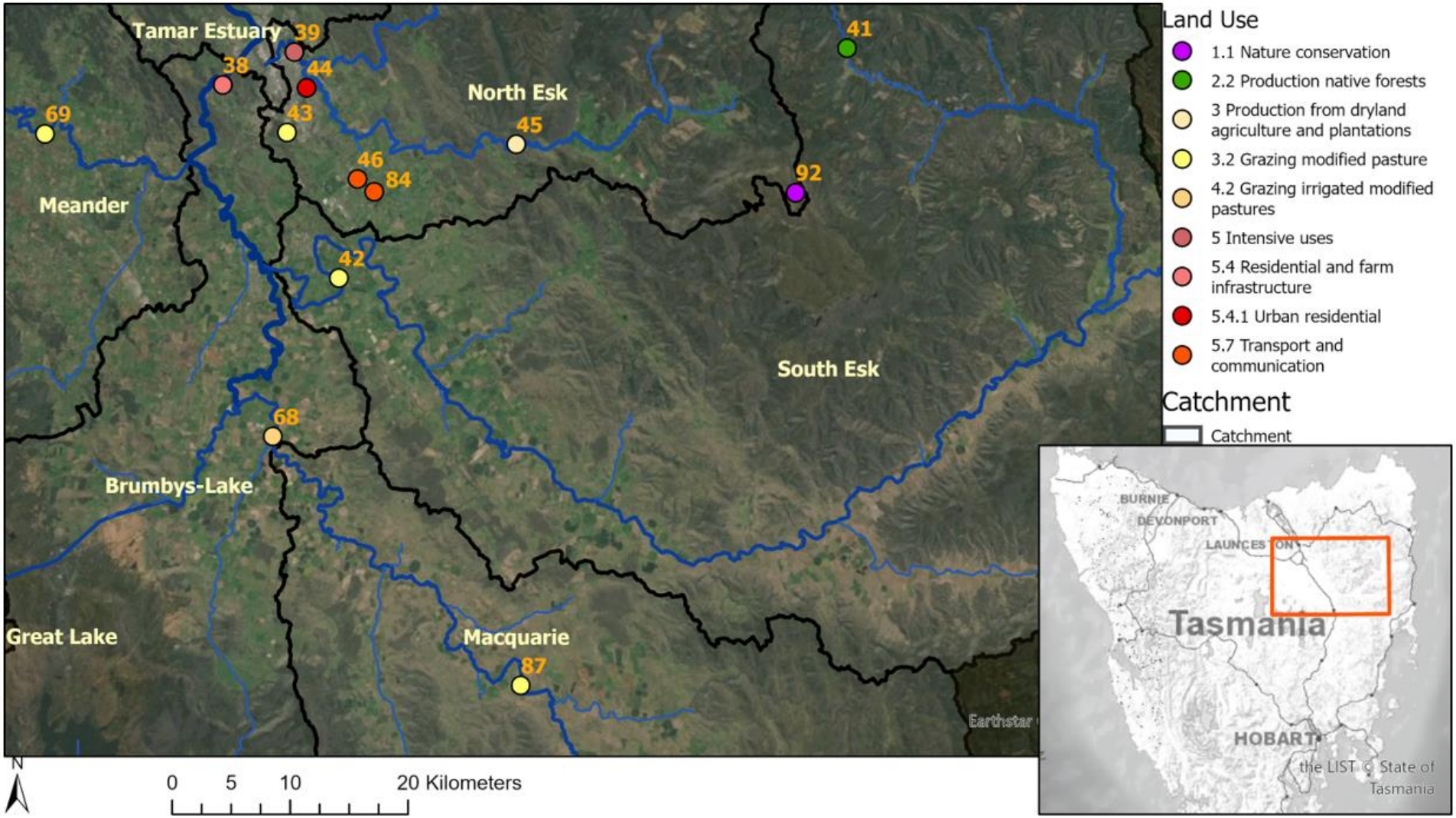

Figure 8: North and South Esk Rivers sampling locations

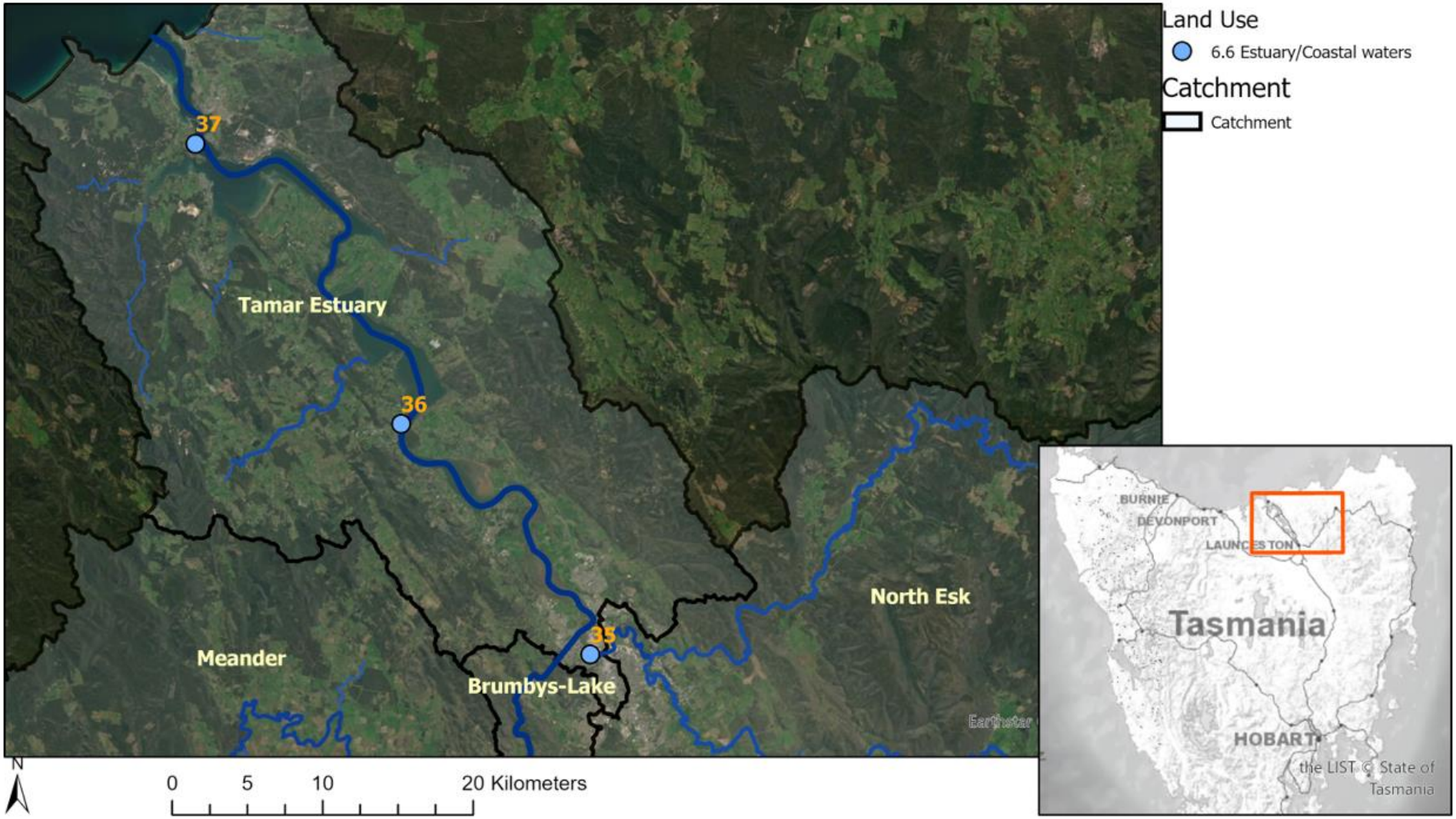

Figure 9: Tamar Estuary sampling locations

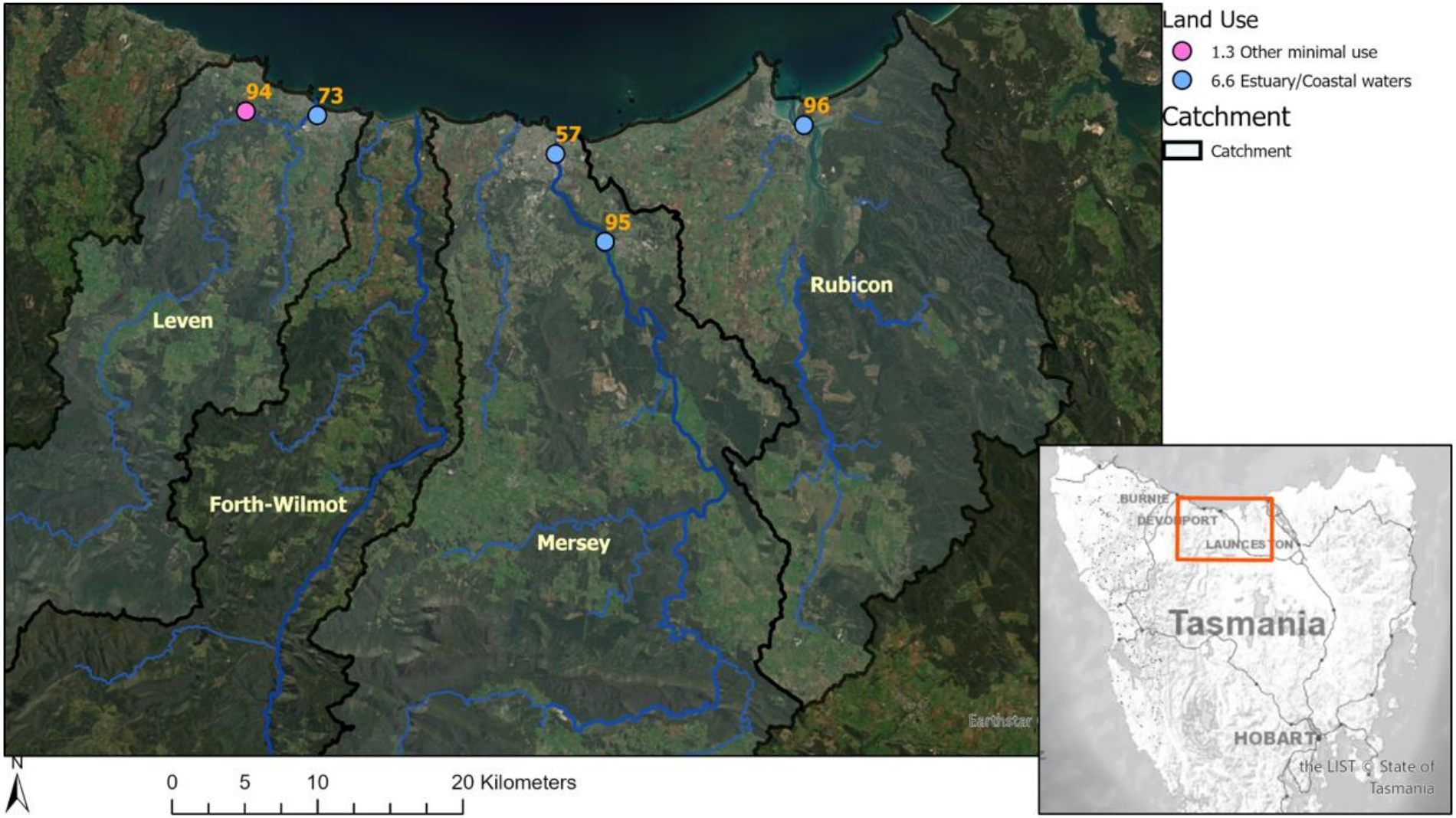

Figure 10: Monitoring locations along the central north coast

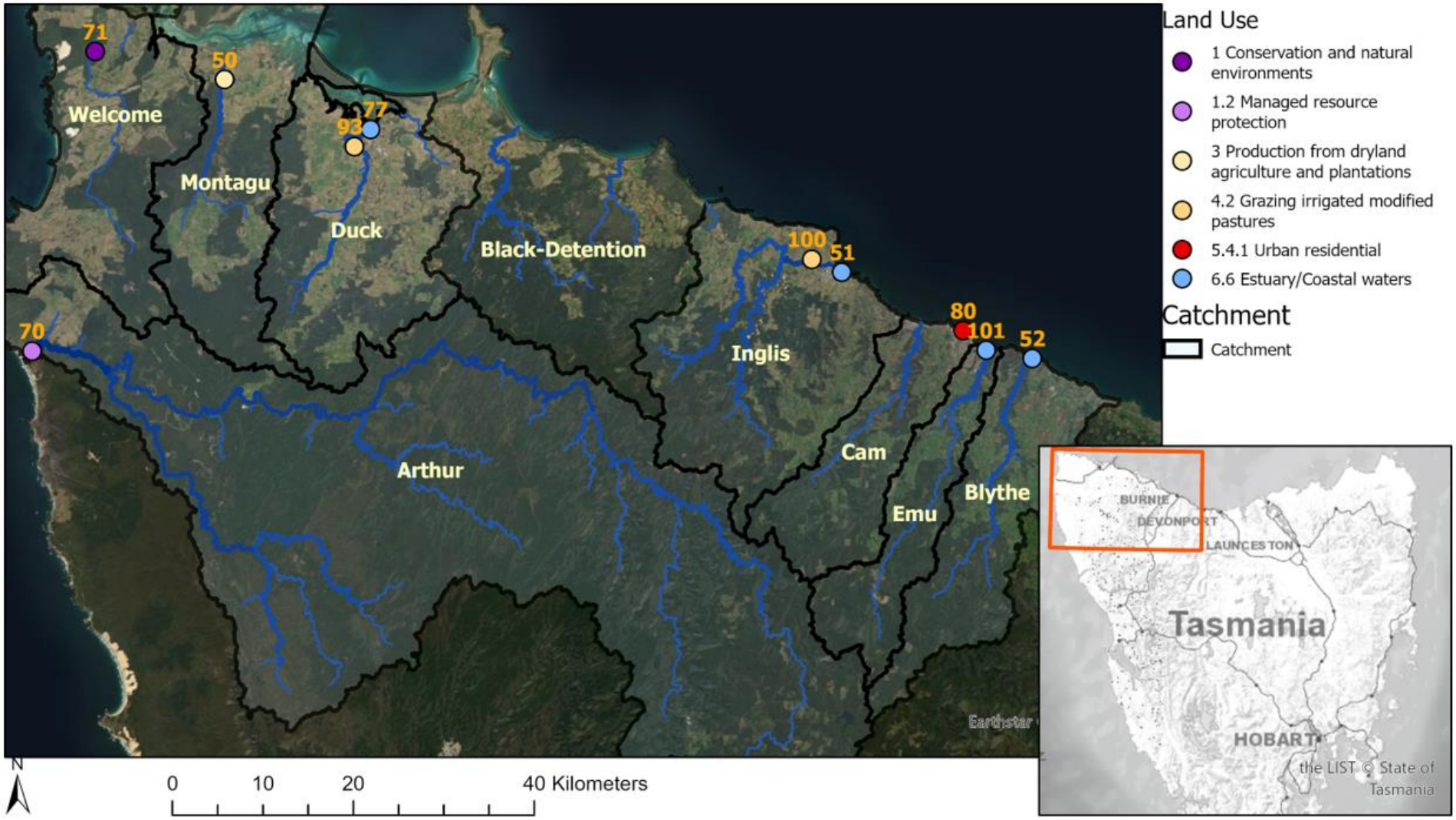

Figure 11: Northwest sampling locations

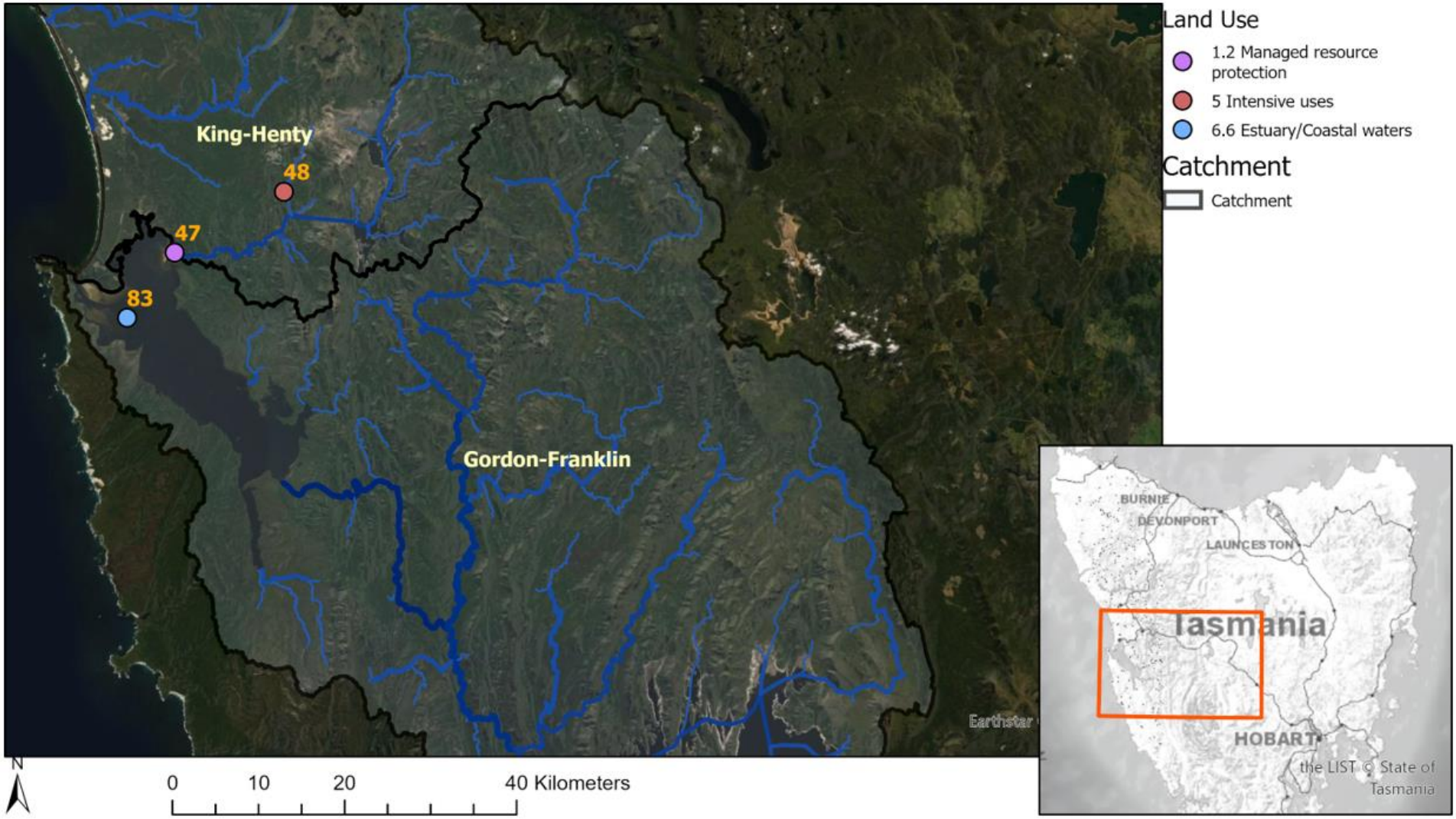

Figure 12: West coast sampling locations.

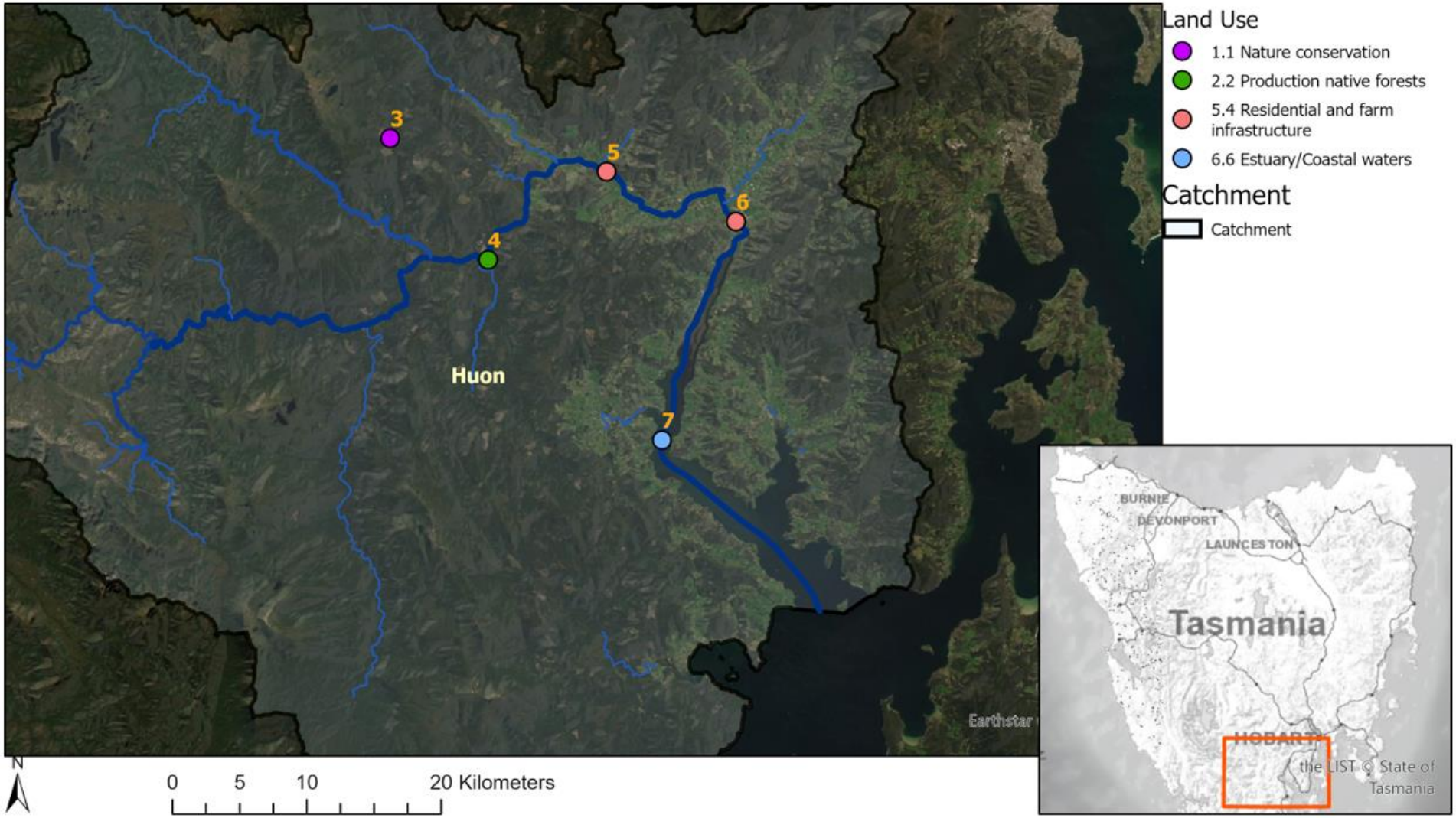

Figure 13: Monitoring Location in the Huon catchment.

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