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Environmental Preservation Division
Department of Environmental Affairs
Okinawa Prefectural Government

Survey of Perfluorinated Compounds in Okinawan Environmental Waters (Result of Winter Survey in 2018 Fiscal Year)

Results of Survey

1 Futenma Air Station surrounding area

The Okinawa Prefectural Government (OPG) has been conducting a survey of perfluorinated compounds in the prefecture's environmental waters since August 2016 in order to assess the perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) levels in groundwater.

In the last survey, 16 sites were surveyed in September for summer sampling in the 2018 fiscal year. The spring and groundwater from six sites around the Marine Corps Air Station (MCAS) Futenma exceeded the United States Environmental Protection Agency (USEPA)'s lifetime health advisory levels for drinking water * (70ng / L) (hereinafter referred to as "recommended levels" (140 - 2000 ng / L).

Furthermore, in the last survey, 6:2FTS and 8:2FTS, which were reported to be generated from fire extinguishing foam and decomposing, were also measured. As a result, it was confirmed that at some sites the PFOS and PFOA concentration exceeded the recommended levels; and it was detected at a higher concentration than at other points. This suggested the influence of fire extinguishing foam agent on groundwater.

The results of the most recent analysis of 16 samples from various sites (See Appendix 1) that were collected in January 2019 are listed in Appendix 2. The detected values of perfluorinated compounds in these samples were almost the same as the results of a previous survey, though there was some fluctuation. There are no standards set for perfluorinated compounds in water in Japan, however the total concentration levels of PFOS and PFOA at 7 out of 16 samples in groundwater around MCAS Futenma were found to have exceeded recommended levels.

Furthermore, 6:2FTS and 8:2FTS were also measured in this survey. As a result, it was confirmed that in some of the points the PFOS and PFOA concentration exceeded the recommended levels; and it was detected at a higher concentration than at other points as in previous survey.

Based on this, it is considered that at some sites, it is most likely that PFOS and PFOA being detected beyond the recommended levels is caused by fire extinguishing foam used in airports, etc.

2 Hija River surrounding area

A report from the PFOS survey conducted by the Okinawa Prefectural Enterprise Bureau (OPEB) in the spring water surrounding the Hija River in summer 2018 confirmed that there were points that exceeded the recommended levels. Taking this into account, the OPG conducted a survey of the water quality from 8 points collected from springs around the Hija River in January 2019. (See Appendix 1, 3)

As a result, values exceeding the recommended levels were confirmed at 5 points (490 - 2100 ng / L).

Furthermore, 6:2FTS and 8:2FTS were also measured in this survey. Consequently, it was confirmed that at some of the points the PFOS and PFOS concentration exceeded the recommended levels; and it was detected at higher concentrations than the other points.

3 Tengan River

A report from the PFOS survey conducted by the OPEB from 2016 to 2017 on the water quality of the Tengan River confirmed that there were points that exceeded the recommended levels. Taking this into account, the OPG conducted a survey of the water quality from samples collected from 7 points of the Tengan River December 2018. (See Appendix 1, 4)

As a result, values exceeding the recommended levels were confirmed at 4 points (95 – 1200 ng / L)

Furthermore, 6:2FTS and 8:2FTS were also measured in this survey. Consequently, it was confirmed that at some of the points the PFOS and PFOS concentrations exceeded the recommended levels; and it was detected at higher concentrations than the other sites, such as those from the MCAS Futenma surrounding area survey and the Hija River surrounding area survey. Conversely, there were points where PFOA was detected at a concentration three times higher than that of PFOS, and features differing from other surveys were also observed.

4 The OPG's Response

There are no standards for PFOS and PFOA in Japan, and evaluations such as toxicity levels towards humans have not been established by WHO, etc.

However, PFOS and such are cumulative, and a provisional recommended amount is set for drinking water in Europe and the United States.

Therefore, we are asking the local governments and residents associations to continue encouraging their residents to not use water from springs, etc. that exceed the recommended levels for direct consumption.

The OPG will continue to monitor points with relatively high concentration to assess the situation.

The USEPA's lifetime health advisory levels for drinking water are calculated assuming that 2 liters of drinking water is drunk per day for 70 years and is exposed to chemical substances. If the concentration of PFOS and PFOA together is 70 ng / L or lower, harmful effects on one's health are not expected even if consumed over the course of a lifetime (70 years).

*"ng" (nanogram) represents one billionth of a gram.
1 ng / L is the presence of 1 nanogram of chemical substance per liter of water.
This corresponds to a concentration of three salt grains (0.3 mg) of table salt dissolved in a school pool (25 m long x 12 m wide x 1 m average depth).

Reference Materials

The standards for PFOS and PFOA

○Japan (No standards.)

Ministry of Health, Labor and Welfare: Items regarding the necessity of examining tap water (2009)

Desired amount has not been set on PFOS nor PFOA

Ministry of Environment : Items regarding required research for programs for the conservation of the aquatic environment (March, 2014)

Although PFOS and PFOA are marked to be researched, neither standards nor advisories amongst others are set.

○The United States

Lifetime Health Advisories in drinking water

2016 : Total amount of PFOS and PFOA 70 ng/L

○Germany

Lifetime Health Advisories in drinking water

2006 : Total amount of PFOS and PFOA 300 ng/L

About PFOS and PFOA

- PFOS stands for Per Fluoro Octane Sulfonate while PFOA stands for Per Fluoro Octanoic Acid. Both of them are one of organofluorine compounds. Because PFOS and PFOA are hydrophobic (water-repellent) and oleophobic (oil-repellent), they have been widely used for fire extinguishing foam, water repellents, antifouling agents, etc.
- PFOS is mainly used for fire extinguishing foam, plating solution, aircraft hydraulic oil, water repellent, floor wax, etc. However, the authorized use of PFOS is currently limited to the production of etching solutions, semiconductor resist, and photographic film for business purposes, which cannot be replaced with substitutes. The use of PFOS for any other purposes than those mentioned above are prohibited. However, the use of PFOS in all products is prohibited in Japan since April 2018. PFOA is used for producing fluoroplastics. It is presently not a target of regulation, however it is expected to be regulated in the same way as PFOS in the future. Please note that fire extinguishing foam is not subject to the essential use of PFOS, however the use of PFOS for fire extinguishing foam is permitted on the condition that its producers must set the technical standards in handling PFOS and make them public in order to prevent environmental pollution. However, it is recommended to replace it with substitutes.
- PFOS and PFOA hardly decompose in the environment. Therefore, its persistence in the environment as well as its accumulation in living organisms are considered to be problematic and have been object to regulation as new environmental pollutants. Following that Lifetime Health Advisories in regard to drinking water in the U.S. is now based on the total of PFOS and PFOA, research

should be conducted on these two substances.

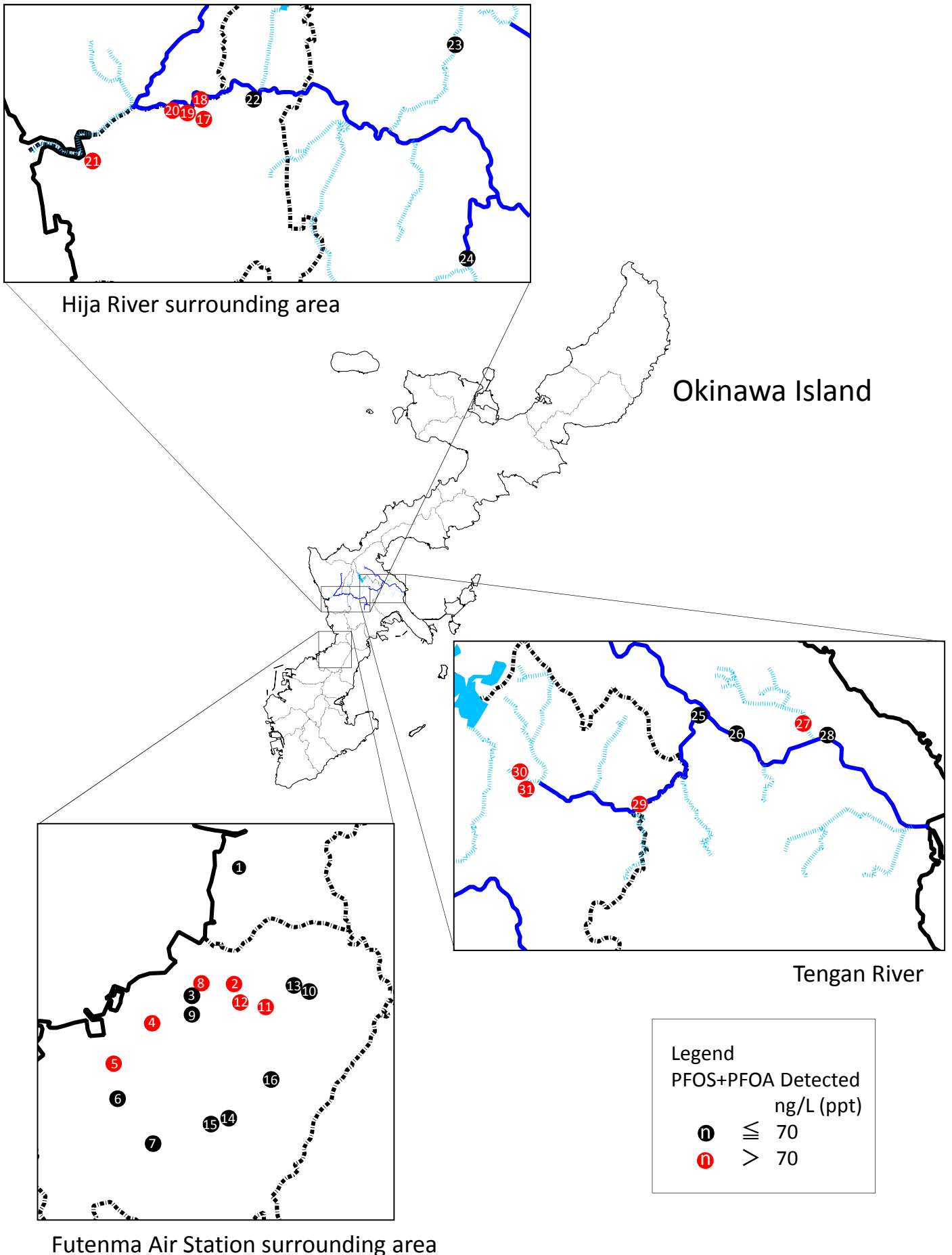
About 6:2FTS and 8:2FTS

- 6:2FTS stands for 1H, 1H, 2H, 2H-perfluoro octane sulfonate while 8:2FTS stands for 1H, 1H, 2H, 2H-perfluoro decane sulfonate. These substances were reported to be decomposed and generated from fire extinguishing foam in the presence of oxidizing agent^{*1}. Based on this fact, if 6:2FTS and 8:2FTS are detected in groundwater surrounding the air station, it is suggested that the groundwater may be affected by fire extinguishing foam. (Fire extinguishing foam is held at the base to cope with aircraft fires.)

*1 Cheng F, Mallavarapu M, Ravendra N, CHEMICAL OXIDIZATION OF SOME AFFFS LEADS TO THE FORMATION OF 6:2FTS AND 8:2FTS, Environmental Toxicology and Chemistry, 34(2015), 2625-2628

Sampling Points

Appendix 1



Result of Winter Survey in Fiscal Year 2018 (Futenma Air Station surrounding area)

Appendix 2

Analysis Items	Perfluorooctane sulfonate (PFOS)
	Perfluorooctanoic Acid (PFOA)
	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2FTS)
	1H,1H,2H,2H-Perfluorooctanoic Acid (8:2FTS)
Subject	Water quality

Result List			Summer Survey(JFY2016)			Winter Survey(JFY2016)			Summer Survey(JFY2017)			Winter Survey(JFY2017)			Summer Survey(JFY2018)					Winter Survey(JFY2018)							
	Municipality	Location	PFOS	PFOA	Total Value	PFOS	PFOA	Total Value	PFOS	PFOA	Total Value	PFOS	PFOA	Total Value	PFOS	PFOA	Total Value	6:2FTS	8:2FTS	PFOS	PFOA	Total Value	6:2FTS	8:2FTS			
①	Chatan Town	Camp Zukeran surrounding are, Western Drainage	30	11	41	57	7.5	64	29	9.1	38	30	8.0	38	27	8.3	35	5.4	1.4	38	9.4	47	9.5	2.1			
②	Ginowan City	Futenma Air Station surrounding area, Chunnaga (spring)	1200	190	1300	730	150	880	740	140	880	900	130	1000	1800	200	2000	390	40	1400	190	1500	260	28			
③	Ginowan City	Futenma Air Station surrounding area, Hunshinga (spring)	38	21	59	39	22	61	37	25	62	39	22	61	39	23	62	4.4	0.4	32	28	60	3.1	0.3			
④	Ginowan City	Futenma Air Station surrounding area, Hiyakaga (spring)	180	31	210	94	26	120	120	33	150	160	36	190	150	29	170	75	6.9	170	38	200	52	2.1			
⑤	Ginowan City	Futenma Air Station surrounding area, Mendakarihiga (spring)	680	35	710	670	42	710	590	43	630	640	42	680	600	50	650	150	31	730	42	770	140	24			
⑥	Ginowan City	Futenma Air Station surrounding area, Morinokawa (spring)	30	9.4	39	40	5.4	45	39	11	50	71	25	96	46	6.4	52	2.0	<0.1	38	7.9	45	1.9	<0.1			
⑦	Ginowan City	Futenma Air Station surrounding area, Samashita Ubuga (spring)	24	9.0	33	30	11	41	18	8.8	26	13	7.2	20	25	9.9	34	<0.1	<0.1	43	15	58	<0.1	<0.1			
⑧	Ginowan City	Futenma Air Station surrounding area, Isaufuga (spring)	/	/	/	130	62	190	120	35	150	250	42	290	220	60	280	17	14	200	54	250	10	5.3			
⑨	Ginowan City	Futenma Air Station surrounding area, Furuchinga (spring)				96	22	110	66	17	83	49	14	63	30	11	41	21	0.8	41	22	63	50	1.7			
⑩	Ginowan City	Futenma Air Station surrounding area, Aragusuku A (groundwater)				15	4.4	19	17	4.8	21	15	4.3	19	<0.1	<0.1	14	4.4	18	<0.1	<0.1	14	4.4	18	<0.1	<0.1	
⑪	Ginowan City	Futenma Air Station surrounding arean, Kyuna A (groundwater)				260	26	280	320	29	340	280	24	300	<0.1	<0.1	410	34	440	<0.1	<0.1	410	34	440	<0.1	<0.1	
⑫	Ginowan City	Futenma Air Station surrounding area, Kyuna B (groundwater)				40	31	71	34	23	57	76	72	140	0.1	<0.1	50	76	120	0.3	<0.1	50	76	120	0.3	<0.1	
⑬	Ginowan City	Futenma Air Station surrounding area, Aragusuku B (groundwater)				40	15	55	35	12	47	42	13	55	<0.1	<0.1	64	16	80	0.2	<0.1	64	16	80	0.2	0.1	
⑭	Ginowan City	Futenma Air Station surrounding area, In Civic Park (upstream Surface-Water)				6.6	3.8	10	11	4.6	15	6.9	3.9	10	6.8	4.1	10	0.2	<0.1	4.4	4.8	9.0	0.3	<0.1			
⑮	Ginowan City	Futenma Air Station surrounding area, Ginowan Kumaibu Ritual Site (spring)				7.2	3.9	11	6.7	3.0	9.7	11	5.5	16	6.2	3.5	9.0	9.4	3.4	12	<0.1	<0.1	7.8	3.5	11	<0.1	<0.1
⑯	Ginowan City	Futenma Air Station surrounding area, Akamichi (upstream Surface-Water)				12	4.1	16	11	5.1	16	7.8	4.7	12	13	4.9	17	0.2	<0.1	5.4	3.5	8.0	0.4	<0.1			

(Note) The results of measurement are shown in two effective digits (disregarding the third digit) in accordance with "Designation of Water Type in Environmental Standards Based on the Environmental Basic Law and Processing Standards Including Continuous Monitoring Based on the Water Pollution Prevention Act (Ref. 1303271 of March 27,2013)." When any substance is below the lowest detectable limit, the total value is calculate using the lowest detectable limit.

(Note) Regarding past measurement results, only the survey measurement points in FY2018 are shown.

Result of Winter Survey in Fiscal Year 2018 (Hija River surrounding area)

Appendix 3

Analysis Items	Perfluorooctane sulfonate (PFOS)
	Perfluorooctanoic Acid (PFOA)
	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2FTS)
	1H,1H,2H,2H-Perfluorooctanoic Acid (8:2FTS)
Subject	Water quality

(ng/L)

Result List			Winter Survey(JFY2018)				
	Municipality	Location	PFOS	PFOA	Total Value	6:2FTS	8:2FTS
⑰	Kadena Town	Hija River surrounding area, Yara-Shiriga (spring)	920	67	980	0.3	<0.1
⑱	Kadena Town	Hija River surrounding area, Yara-Ubuga (spring)	1900	220	2100	440	22
⑲	Kadena Town	Hija River surrounding area, Yara-Hijaga (spring)	1500	270	1700	490	13
⑳	Kadena Town	Hija River surrounding area, Nuruga (spring)	370	120	490	160	9.3
㉑	Kadena Town	Hija River surrounding area, Mizugama (groundwater)	1900	160	2000	2600	200
㉒	Kadena Town	Hija River surrounding area, Yara (groundwater)	28	5.1	33	<0.1	<0.1
㉓	Okinawa City	Hija River surrounding area, Uchikina Bridge (river water)	16	17	33	2.0	<0.1
㉔	Okinawa City	Hija River surrounding area, Kayama Bridge (river water)	6.1	3.8	9.9	0.5	<0.1

(Note) The results of measurement are shown in two effective digits (disregarding the third digit) in accordance with "Designation of Water Type in Environmental Standards Based on the Environmental Basic Law and Processing Standards Including Continuous Monitoring Based on the Water Pollution Prevention Act (Ref. 1303271 of March 27,2013)." When any substance is below the lowest detectable limit, the total value is calculate using the lowest detectable limit.

Result of Winter Survey in Fiscal Year 2018 (Tengan River)

Appendix 4

<u>Analysis Items</u>	<u>Perfluorooctane sulfonate (PFOS)</u>
	<u>Perfluorooctanoic Acid (PFOA)</u>
	<u>1H,1H,2H,2H-Perfluorooctane sulfonate (6:2FTS)</u>
	<u>1H,1H,2H,2H-Perfluorooctanoic Acid (8:2FTS)</u>
<u>Subject</u>	<u>Water quality</u>

(ng/L)

Result List

			Winter Survey(JFY2018)				
			PFOS	PFOA	Total Value	6:2FTS	8:2FTS
	Municipality	Location					
②5	Uruma City	Tengan River, Rushikawa Bridge (river water)	29	38	67	16	0.7
②6	Uruma City	Tengan River, Uyamanukawa Bridge (river water)	21	27	48	11	0.4
②7	Uruma City	Tengan River, Bridge over waterway connected to Tengan Bridge (surface water)	180	40	220	210	51
②8	Uruma City	Tengan River, Tengan Bridge (river water)	21	19	40	13	1.3
②9	Uruma City	Tengan River, Fukkoh Bridge (river water)	40	55	95	29	1.1
③0	Okinawa City	Tengan River, North of the western tributary upstream of the Kawasaki River (river water)	77	250	320	180	3.7
③1	Okinawa City	Tengan River, South of the western tributary upstream of the Kawasaki River (river water)	940	350	1200	820	63

(Note) The results of measurement are shown in two effective digits (disregarding the third digit) in accordance with "Designation of Water Type in Environmental Standards Based on the Environmental Basic Law and Processing Standards Including Continuous Monitoring Based on the Water Pollution Prevention Act (Ref. 1303271 of March 27,2013)." When any substance is below the lowest detectable limit, the total value is calculate using the lowest detectable limit.