

Per- and polyfluorinated alkyl substances (PFAS) in the municipal raw and drinking water in Sweden

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Outline

- 1 Regulation, guidelines
- 2 Background to the survey, methods
- 3 Levels in drinking water
- 4 Levels in raw water
- 5 Uncertainties, conclusions



Guidelines, Regulation

❖ Drinking water:

- **2014: Swedish Threshold limit** – 90 ng/l - 7 PFAS
- 2016: 11 PFAS 90 ng/l
- Detected in DW
- **2021: EU New Drinking water directive**
- 20 PFAS 100 ng/l
- Minimum directive
- 2 years to implementation

Nr	PFAS11	PFAS20
1		Perfluorbutansulfonsyra (PFBS)
2		Perfluorhexansulfonsyra (PFHxS)
3		Perfluoroktansulfonsyra (PFOS)
4		Perfluorbutansyra (PFBA)
5		Perfluorpentansyra (PFPeA)
6		Perfluorhexansyra (PFHxA)
7		Perfluorheptansyra (PFHpA)
8		Perfluoroktansyra (PFOA)
9		Perfluornonansyra (PFNA)
10		Perfluordekansyra (PFDA)
11	Fluorotelomersulfonsyra (6:2 FTS)	Perfluorundekansyra (PFUnDA)
12		Perfluordodekansyra (PFDoDA)
13		Perfluortridekansyra (PFTrDA)
14		Perfluorpentansulfonsyra (PFPeS)
15		Perfluorheptansulfonsyra (PFHpS)
16		Perfluornonansulfonsyra (PFNS)
17		Perfluordekansulfonsyra (PFDS)
18		Perfluorundekansulfonsyra (PFUnDS)
19		Perfluordodekansulfonsyra (PFDoDS)
20		Perfluortridekansulfonsyra (PFTrDS)

Background

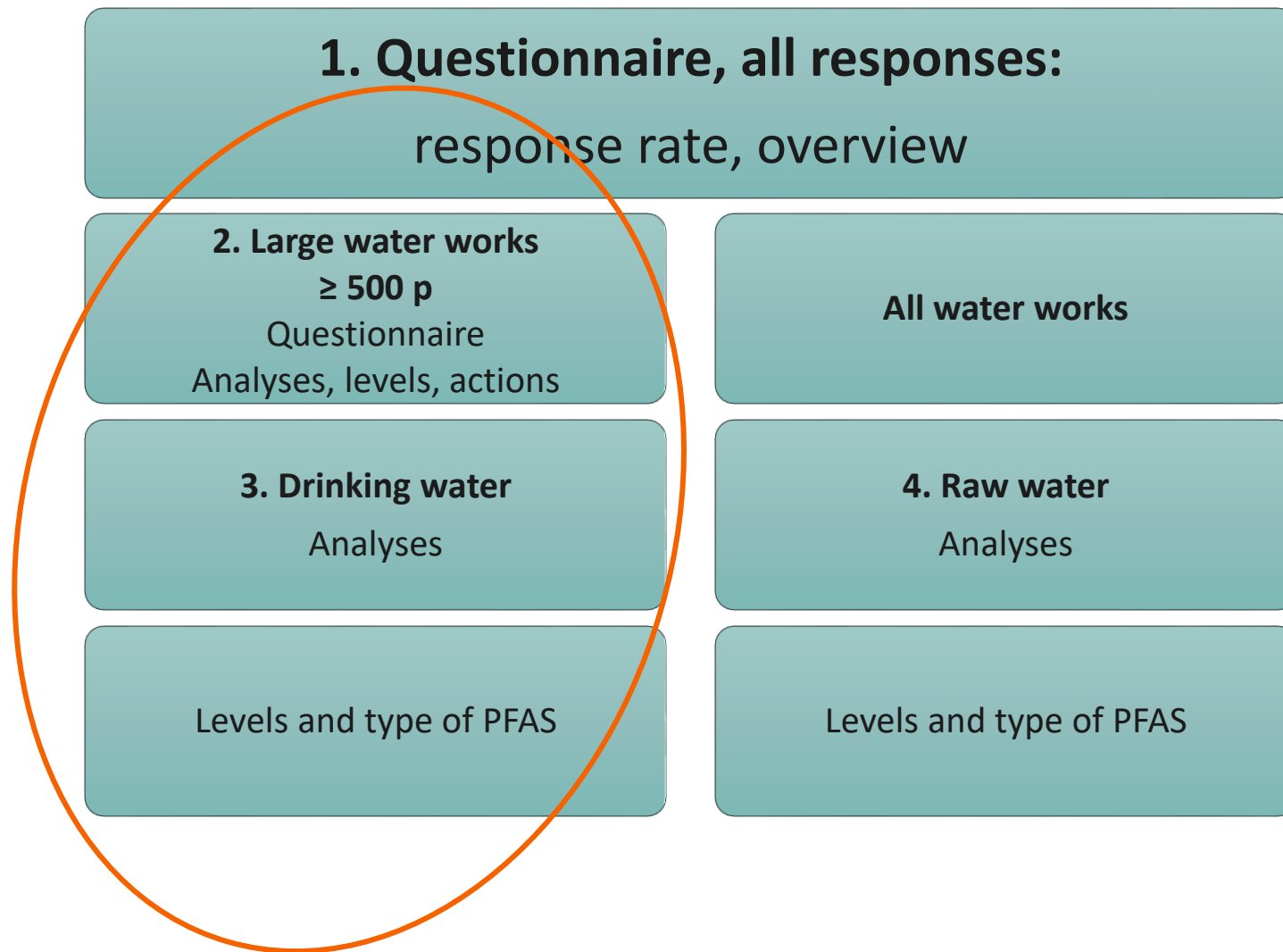
- 2014 – Questionnaire *“Risk of PFAS-contamination”*
- 2020 – Questionnaire + analyses
 - DW + Raw
 - Update of the current exposure situation
 - Future regulation

Aim:

“ Map the levels of PFAS in the the municipal raw and drinking water in Sweden”

- 85 % of the Swedish population

Methods



Analyses, detectable levels

	Raw water		Drinking water	
	<i>Municipalities</i>	% (of 257)	<i>Municipalities</i>	% (of 257)
Analysis	195	76	123	48
Detectable levels	138	54	86	33

- 257 of 261 municipalities
- At least one WW/DWS

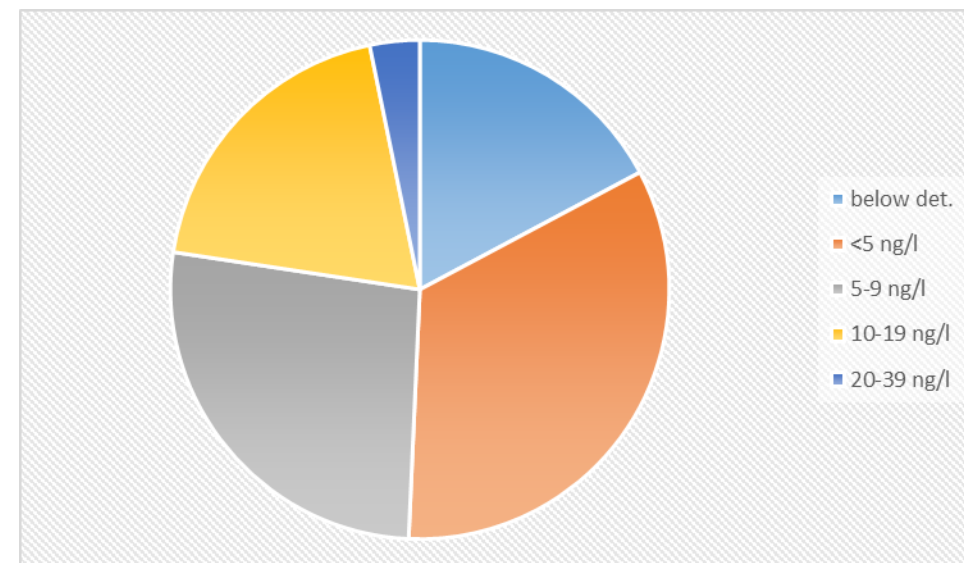
2. Large water works
≥ 500 p
Questionnaire
Analyses, levels, actions

3. Drinking water
Analyses

PFAS levels in drinking water

	Detectable levels		Levels below detection	Total
Sum levels PFAS	≥10 ng/l	<10 ng/l		
Number of water works	15	59	80	154
Supplied persons	2 192 239	3 589 249	1 202 546	6 984 034

Individual measurements



Mean values from all measurements

**2. Large water works
≥ 500 p**
Questionnaire
Analyses, levels, actions

**3. Drinking water
Analyses**

- Highest levels 40 ng/l

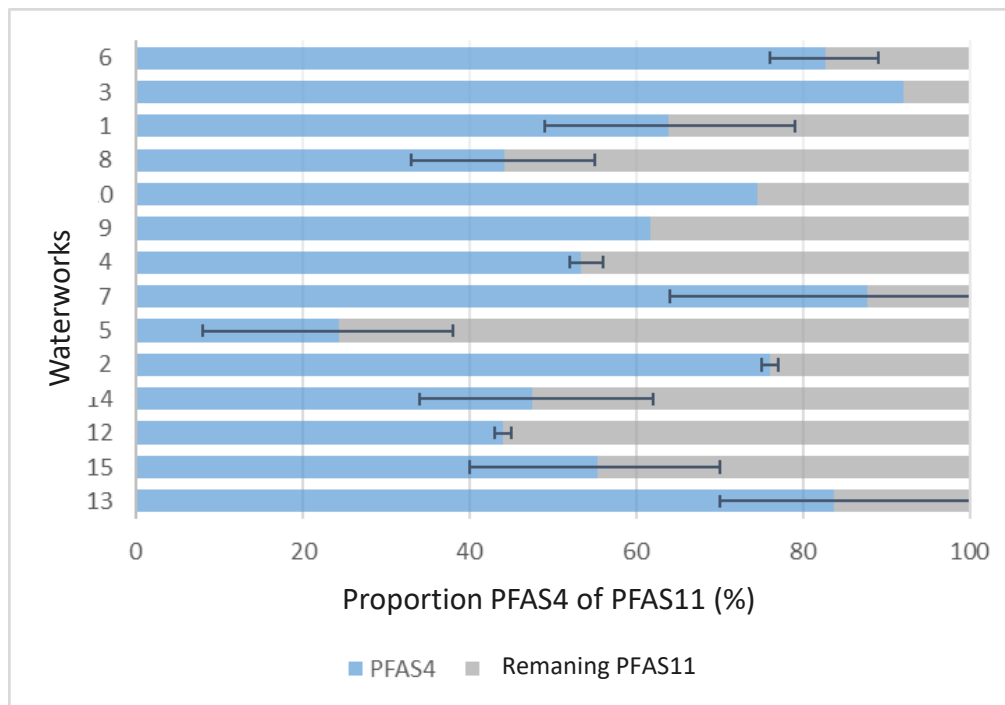
Sweden:
PFAS11
90 ng/l

EU:
PFAS20
100 ng/l

		Efsa TWI	Sw. threshold limit
	Municipality/ Drinking water producer	Supplied persons	PFAS4 PFAS11
	Västerås	120 000	8,3–19,5 10,5–39,8
	Halmstad	5 000	23,1–30,2 31,0–39,2
	Arvidsjaur³	10	28,1 30,5
	Uppsala	100 000	11,6–15,0 22,1–28,8
	Halmstad	500	0,3–10,6 4,1–28,0
	Karlskrona³	229	16,7–22,9 ⁴ 22,0–25,6 ⁴
	Söderhamn	16 000	3,3–14,3 ² 3,3–22,2 ²
	Västerås	120 000	4,3–5,7 7,8–17,1
	Uppvidinge	5 000	10,3 16,7
	Uppvidinge	500	10,3 13,8
	Ljungby	17 000	13,2 ¹
	Norrvatten	650 000	5,5–5,9 12,8–13,0
	Sydvatten	500 000	0–7,7 0–11,4
	Södertälje, Nykvarn	98 000	3,0–5,1 7,0–10,8
	Stockholm Vatten	560 000	4,6–6,4 8,8–10,7
		2 192 239	

Proportion PFAS 4 of PFAS 11

- 10 of 14 WW PFAS4 > 50 %
- Majority of exposure
(European Food Safety Authority 2020)
(Similar trend in raw water)
- Variation within and between WW



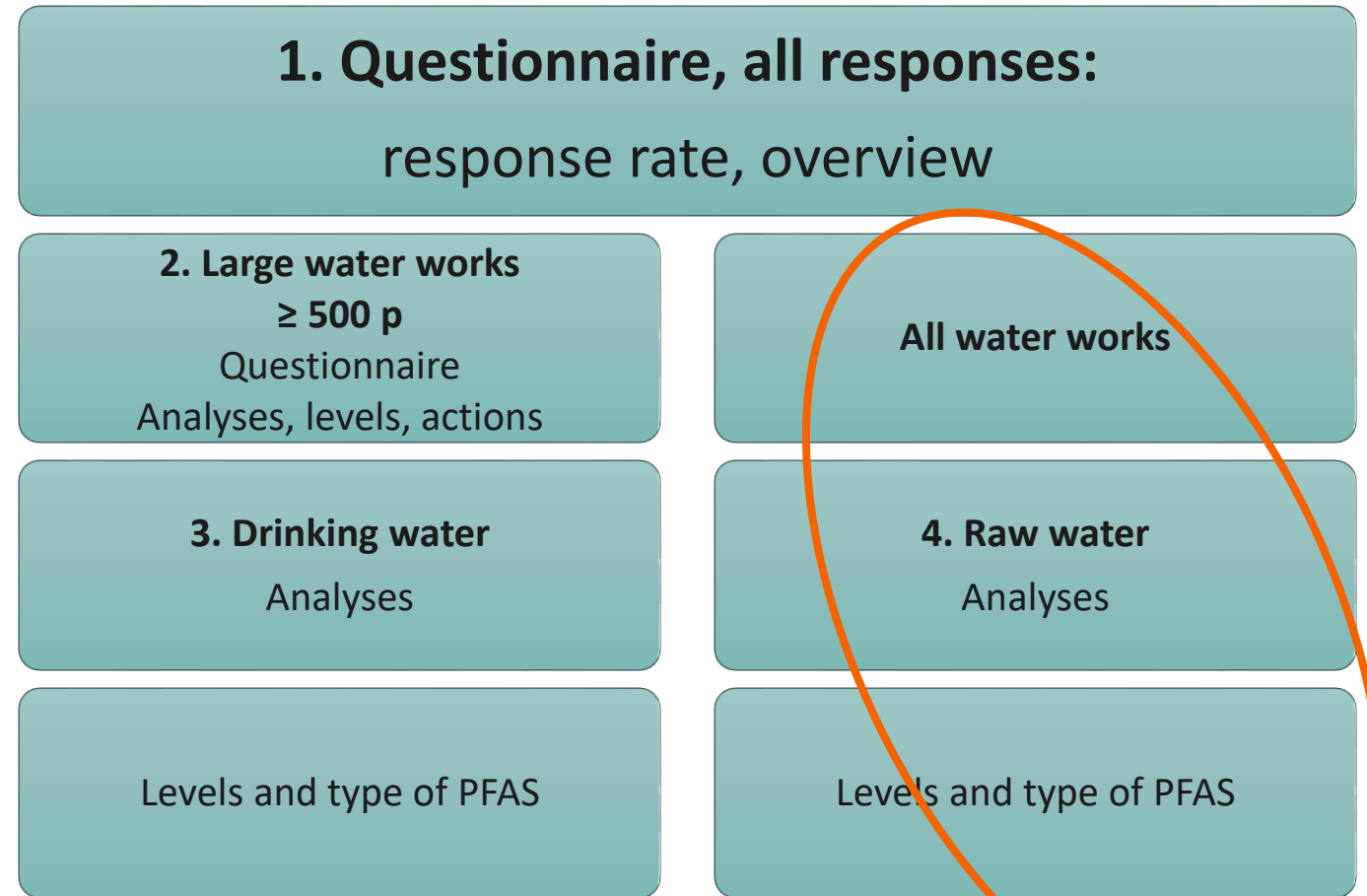
Efsa TWI/TDI

1. PFOA
2. PFNA
3. PFHxS
4. PFOS

4.4 ng/kg/w

0.63 ng/kg/d

Method



PFAS levels in raw water

- All analyses

Sum level (ng/l)	≥ 10 ng/l	< 10 ng/l	Below detection	Total
Municipalities	48	108	82	-
Sampling points	43	139	134	316
<i>Analyses only in raw water</i>	<i>20</i>	<i>86</i>	<i>109</i>	<i>215</i>



- Sum levels above 10 ng/l
- Full table in the report
- 43 sampling points
- 7 sampling points > 90 ng/l
183-2182 ng/l

Municipality	Sampling point	PFAS 4 (ng/l)	PFAS 7/11 (ng/l)	ΣPFAS (ng/l)	Analyses	Year
Arvidsjaur	40	1120-1300	2007-2182	2209	3	2018
Båstad	31	7,2-11,2	7,2-11,2		2	2014
Båstad	33	10,0-11,0	10,0-11,0		2	2014
Eskilstuna	45	2,6-5,7	2,8-13,4	14,4	14	2017, 18,19,20
Essunga	28	5,0	18,6		1	2019
Falkenberg	30	2,2	13,2		1	2014
Gävle	20	42,7-43,3	45,1-48,9	45,6-49,3	3	2019
Gävle	23	1,3-25,1	5,3-33,3	5,1-28,9	45	2019

All water works

4. Raw water
Analyses

2. Large water works
≥ 500 p
Questionnaire
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3. Drinking water
Analyses

- Analyses in both raw and DW
- Few examples
- Quite similar levels
- Lower levels – actions have been put in place

Municipality	Raw water (PFAS 7/11, ng/l)	Drinking water (PFAS 7/11, ng/l)	Measures taken
Arvidsjaur	2007-2182	< LOQ	Carbon filter
Halmstad	121-347	4,1-28,0	Carbon filter
Ljungby	20,9-81,0	13,2	Limited withdrawal
Eskilstuna	2,8-13,4	4,4-9,2	
Halmstad	37,9-41,7	31,0-39,2	
Södertälje	10,4-13,7	7,0-10,8	

Uncertainties

- Old analyses - high detection limits
- Below detection limits $\rightarrow 0 \rightarrow$ underestimation of the “true value”
- In drinking water – levels above 10 – newer analyses – lower detection limits – lower uncertainty
- Raw water – larger part old analyses compared to DW – higher uncertainty

Conclusions

- Relatively low levels in the municipal drinking water
- Majority of water works **average sum levels < 5 ng/l** in DW
- The **highest sum level 40 ng/l** (compared to 90 ng/l)
- Efsa:s **PFAS 4 significant part** of PFAS 11
- The highest levels of **PFAS 4 > TWI**
- Higher levels in raw water
- **New DW-directive** – regular analyses - better picture



Thank you!

Questions?

Kartläggning av
per- och polyfluorerade
alkylsubstanser (PFAS)
i Sveriges kommunala rå-
och dricksvatten



[L 2021 nr 21 - Kartläggning av per- och polyfluorerade
alkylsubstanser \(livsmedelsverket.se\)](https://www.livsmedelsverket.se/l/2021/nr21)