



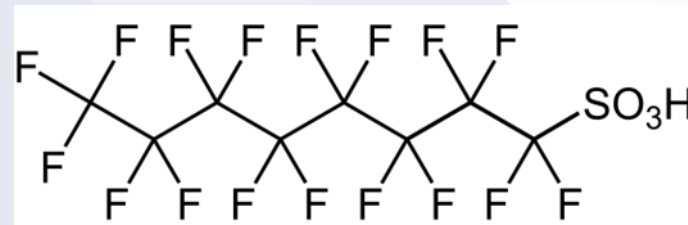
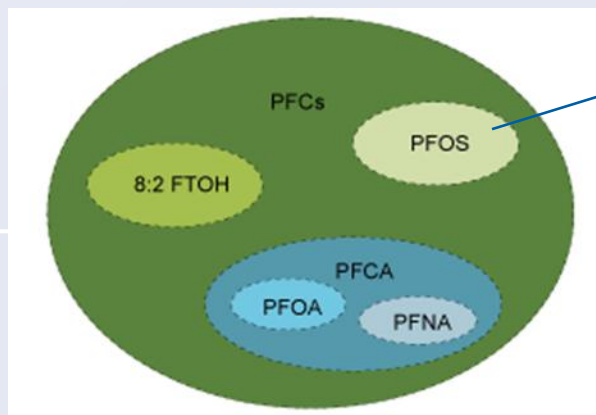
# **Polyfluorinated compounds at fire training facilities**

Assessing Contaminated soil at 43 Norwegian airports

Kine Martinsen, Section for Waste Treatment and Contaminated Ground  
Common Forum Meeting, Bilbao, 23.10.12

# PFOS

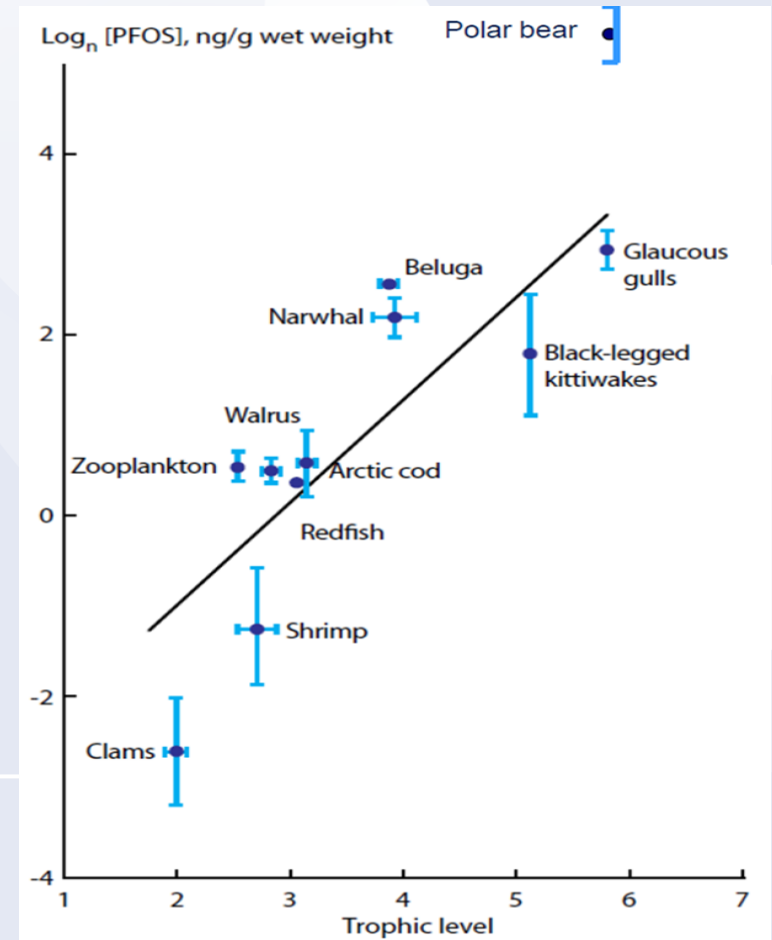
- **PFOS: one of the main components of fire fighting foam for extinguishing petroleum-based fires (AFFF foams)**
- **From these training grounds, PFOS has often been released in to the environment on a large scale since the early 1960's**
- **PFOS is not allowed used in fire fighting foam in Norway from 2007**
- **PFOS is included in the Stockholm convention on persistent organic pollutants**



# Properties of PFOS

- **Virtually non-destructable by all known abiotic and biotic mechanisms**
- **Resistant to chemical hydrolysis, photolysis and biodegeneration**
- **Extremely surface active (hydrophobic and lipophilic)**
- **PFOS is one of the most abundant anthropogenic organic compounds used throughout the industrialized world**
- **PFOS is readily biomagnified in the food chain**

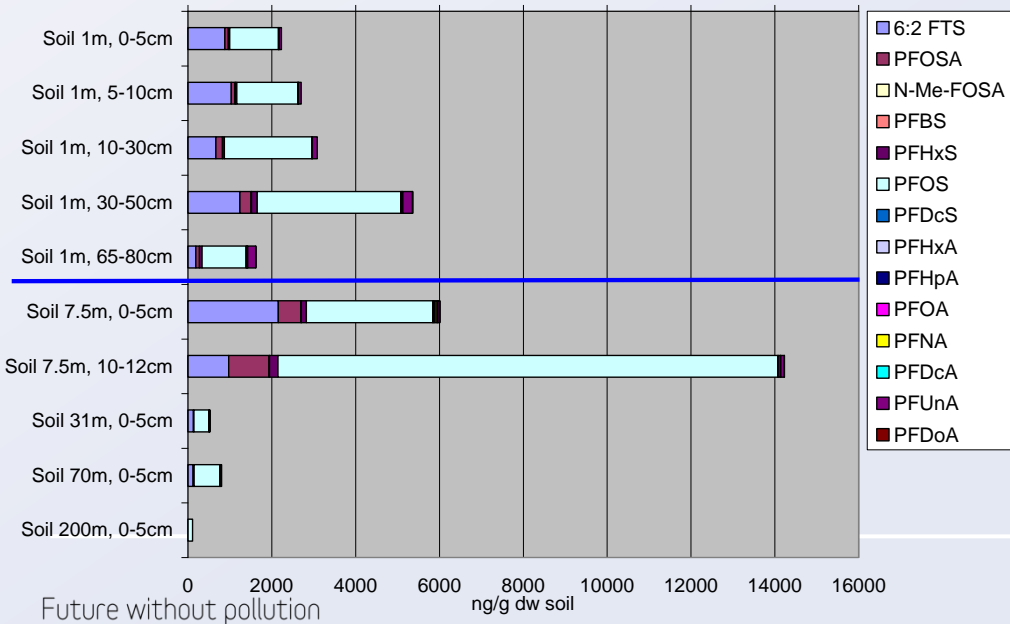
Biomagnification of PFOS in arctic food chains (AMAP 2009)



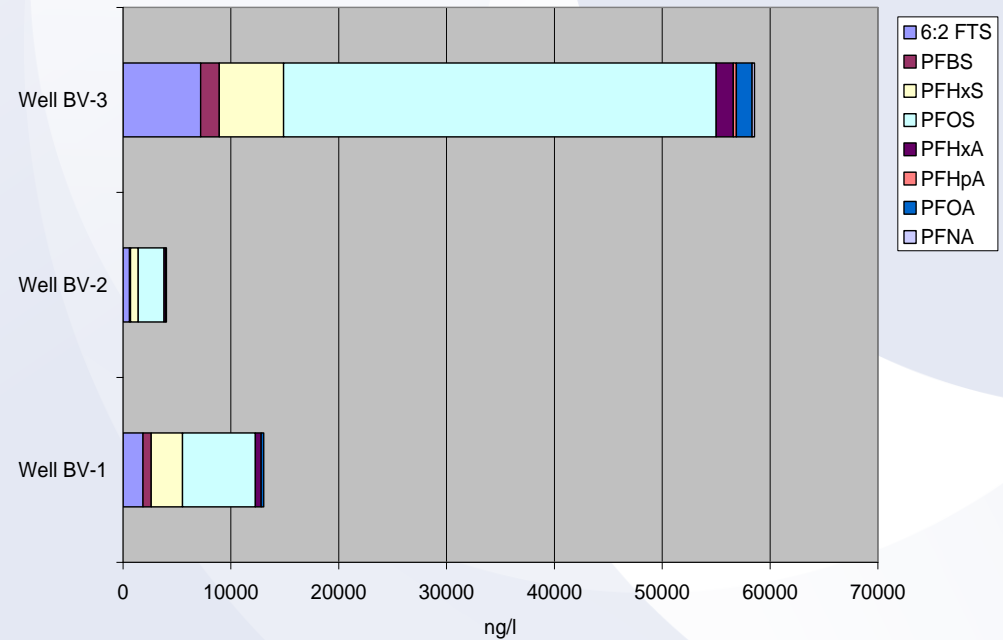
# Klifs study of four fire training sites 2007

Norwegian guideline value for PFOS in soil: 0.1 mg/ kg dw

Example:  
Results soil: Oslo airport



Example: Groundwater Oslo airport



Examples of Healthbased Quality Criteria ng/l

	PFOS	PFOA
Germany*	300	
UK	300	10000
US (Minnesota)	300	500

Source: SFT rapport- TA-2444/2009



CLIMATE AND  
POLLUTION  
AGENCY

# EQS values proposed for PFOS (WFD)

The EU Commission has proposed environmental quality standards (EQS) values for PFOS and PFOA in surface water for the Water Framework Directive (WFD)

EQS = 0,65 ng/l for pelagic waters and  
EQS = 0,13 ng/l for estuarine waters  
EQS = 0,0091 mg/kg ww for biota



EUROPEAN COMMISSION

Brussels, 31.1.2012  
COM(2011) 876 final

2011/0429 (COD)

Proposal for a

**DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**  
**amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy**

(Text with EEA relevance)

{SEC(2011) 1546 final}  
{SEC(2011) 1547 final}



# INVESTIGATIONS FOR PFC POLLUTION AT SELECTED FIRE FIGHTING STATIONS AT AVINORS AIRPORTS

Estimated release of 3500 kg/yr of PFOS (2002) and other perfluorinated compounds (2002-2012)

Runs 13 active fire training facilities today

Avinor is phasing out the use of AFFF and replacing it with PFC-free fire foam at all airports

Is investigating soil, biota ground- and surface waters at 43 airports for PFC contamination



Map of Norwegian airports being investigated. Source: Avinor

# Some results

## PFC in the ground

- Concentrations of PFOS much higher than Norwegian guideline values of 100 µg/kg were found near and around the central areas of the older fire training sites.
- Concentrations between 500 - 1000 µg/kg and higher were measured.
- Also measured far away from fire training sites
- It seems like PFOS may be absorbed better by higher humus content in soils ( example: more PFOS measured in peat, than underlying layers)

## PFC in water

- At several sites, high concentrations of PFOS was found in storm water and stationary ponds nearby. PFCS were also measured in drainage ditches and small
- At some sites, high concentrations were found in surface and/or groundwater, even though only low concentrations were found in the soil.
- Low concentrations of PFCs was also found in reference stations that are presumed to have little influence from the site

# PFC in biota

- Four airports with 195 biota samples were analyzed

## Goals:

- Clarify if there is PFC pollution in biota near fire training sites
- Understand if there still is an active dispersal of different PFCs from sites
- Evaluate possible toxicological effects on organisms and the ecosystem
- Evaluate bioaccumulation at different trophic levels

## Some temporarily observations:

- PFCs measured in several types of biota especially stationary species and bottom-dwelling organisms
- At some sites PFCs was not measured in sediments, but found in organisms living in sediments
- High concentrations found in terrestrial mammals





# Examples of PFOS concentrations measured at some airports

Tromsø

Soil 1810 µg/kg

FW: 33 µg/l

Polychaetes: 0.038 mg/kg

Bergen: soil 8250 µg/kg

groundwater: 5,7 µg/l

Trout (FW): 0.074 mg/kg

Results Haugesund

Soil: 17400 µg/kg PFOS

Groundwater: 50 µg/l

Sole: 0.0091 mg/kg

Results Kristiansand

Soil: 1090 µg/kg

Groundwater: 2,8 µg/l

Grumbler: 0.081 mg/kg



EQS = 0,65 ng/l for pelagic waters

and

EQS = 0,13 ng/l for estuarine

waters

EQS = 0,0091 mg/kg ww for biota



# Summary

- Surveys measure PFC at almost all fire fighting sites. PFOS is the dominant component, but active sites also contain 6:2 FTS. PFC was detected outside and far away of the fire training sites.
- PFC was also found in run-off and surrounding water bodies around sites, even if the concentrations in the soil samples were relatively low.
- Soil characteristics may influence the dispersal of PFOS.
- Different types of PFCs have unique chemical and physical properties that make them behave differently in the soil. Possible future remediation methods will therefore require detailed knowledge of local conditions.

## Future work

- How to interpret data on soil, groundwater, coastal and fresh water together with biota
- How to put forward a risk assessment for different PFCs based on available data
- What are suitable and acceptable remediation methods
- Follow up other fire training sites where PFCs have been used

**Thank you**  
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