

MINNESOTA POLLUTION CONTROL AGENCY
AQUATIC LIFE CRITERIA AND WATER QUALITY STANDARDS

Page 1 SUMMARY

A. Chemical/Element: Perfluorooctanesulfonic acid (PFOS)	CAS# 1763231	Dates Proposed/Promulgated /	Aquatic Tox. & Human Health
Site-specific Pool 2, Mississippi R.		Developed 3Aug2007	AL and HH
		Revised 30 Oct 2009	HH
		Revised 23 January 2013	HH

B. Minnesota Water Quality Standards: µg/l (unless noted otherwise)					
Water Class	Use	CS	MS	FAV	CS Basis ¹
1,2A	DW, Salmonid	14 ng/L	85 µg/L	170 µg/L	PCA Hs
1,2Bd	DW, NonSalmonid	14 ng/L	85 µg/L	170 µg/L	PCA Hs
2B, 2C, 2D	NonSalmonid	14 ng/L	85 µg/L	170 µg/L	PCA Hs
	Other				
CS: Chronic Standard, DW: Drinking Water, FAV: Final Acute Value, MS: Maximum Standard					

Toxicity related to water quality?:
If yes, above criteria values determined for:
Slope: Acute:
Chronic:

Formulas:	MPCA	EPA
CS:		
MS:		
FAV:		

Notes:

C. EPA Criterion: µg/l	CCC: none	Basis:
Date:	MC: none	Basis:
	FAV: none	Basis:

D. Other Criteria µg/l	Source
0.2 (based on 10 kg child and 1 L drinking water intake)	EPA Office of Water Provisional Health Advisory under the Safe Drinking Water Program at http://www.epa.gov/waterscience/criteria/drinking/

E. Notes: Mississippi River site-specific criterion for PFOS is based on BAF information collected from Pool 2, Mississippi River.

¹ Criteria basis codes for part B:

- EPA = From U. S. Environmental Protection Agency (EPA) criterion
- PCA = Criterion developed by Minnesota Pollution Control Agency staff
- T1 = Direct aquatic life toxicity, EPA national criteria procedures used
- T2 = Direct aquatic life toxicity, EPA advisory procedures used
- Hs = Human health systemic effects
- Hc = Human health carcinogenic effects
- R = Tissue residue (bioaccumulation)
- W = Wildlife effects
- O = Organoleptic (taste and odor)
- Other = Criterion based on other end point

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Page 2 DIRECT AQUATIC LIFE TOXICITY - EPA Criterion Available

A. Chemical/Element: PFOS	CAS# 1763231
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B. EPA Criterion: $\mu\text{g/l}$	CCC: none	Basis:
Date:	MC: none	Basis:
	FAV: none	Basis:

1. Related to water quality?: no			
2. Toxicity:	FAV:	N:	ACR:
$\mu\text{g/l}$	Chronic value:	N:	
3. Residue	Food and Drug Administration (FDA) action level:		
	BCF Final:	N total:	N used:
	geo mean at 1% lipid:		
	% lipid:		
	geo man unadjusted for lipid:		
ACR: Acute to Chronic Ratio, BCF: Bioconcentration Factor, CCC: Chronic Criterion, MC: Maximum Criterion			

- C. MPCA Evaluation of EPA Criterion
- Four lowest GMAVs (Genus Mean Acute Values):
 - Commercially or recreationally important species:
 - Plant data:
 - Extrapolation of water quality effects:
 - Chronic data No. of values:
 No. below criterion:

Notes:

6. ACRS	ACR used by EPA:	N:
	Geo. mean, all ACRs:	N:
	ACR used by MPCA: 9.12	N: 3

Notes: EPA has no surface water criteria for PFOS

- D. Separate Cool/Warm Water Criterion, $\mu\text{g/l}$
- No. of Salmonids deleted from lowest 4 GMAVs:
 N(nonsal): FAV: MC: CC:
- Adjustments to FAV:

Notes:

- E. Summary of changes made to EPA criterion

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Page 3 DIRECT AQUATIC LIFE TOXICITY when no EPA criterion is available

A. Chemical/Element: PFOS	CAS# 1763231
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B. EPA National Method			
Data requirements:	Salmonid (2A water only):	<i>Onchorynchus mykiss</i>	
	Osteichthyes (fish):	<i>Pimephales promelas</i>	
	Chordata (fish, amphibian):	<i>Pseudacris crucifer</i>	
	Planktonic crustacean:	<i>Daphnia magna</i>	
	Benthic crustacean:	<i>Hyalella azteca</i>	
	Aquatic insect:		
	Phylum other than Arthropoda or Chordata:	<i>Unio complamatus</i>	
	Second insect or phylum not already rep.:	<i>Lumbriculus variegatus</i>	
2. GMAVs	Lowest 1(2A): See Tier II method	Lowest 4(2B,2C, 2D): See Tier II method	
μg/l			
	N:	N:	
3. FAV:	2A:	2B, 2C, 2D:	
4. Adjustments to FAVs:			
5. Chronic data:	See Table 2a	No.	Species:
mean values			
μg/l			
6. ACR Measured:	Acute value	Chronic value	ACR
	9100	410	22.19
Generic: 18	67,200	5,350	1.9
	Generic	Generic	18
Final: 9.12			
7. Final Plant Value: NOEC = 300 μg/L, Northern milfoil			
8. Chronic Criterion (FAV/ACR) see Tier II method			

C. EPA Advisory Method (Tier II method)			
1. Data requirements:	Fish:	<i>Pimephales promelas</i>	
N = 7	Crustacean:	<i>Daphnia magna</i>	
No. SMAVs: 8	Third animal:	<i>Lumbriculus variegatus</i>	
No. GMAVs: 7	Plant for herbicide:		
Adjustment Factor: 4.3	Insect for pesticide:		
2. Lowest GMAV: 5600 μg/L	Species:	<i>Lumbriculus variegatus</i>	
3. FAV: 1302 μg/L (reduced to 170 μg/L)	MC:	85 μg/L	
4. Chronic data: See B.5.			
5. ACR: 9.12 (See B.6)			
6. CC: 18.6 μg/L (rounded up to 19 μg/L)			
7. Citation for lowest GMAV: STS-334			

D. Notes: FAV = GMAV ÷ Adjustment Factor; EAO staff lowered the Tier II calculated FAV of 1302 μg/L to the project EC50 of 170 μg/L to protect *Chironomus tentans*. The original *Chironomus tentans* study used the highest exposure concentration of 150 μg/L and reported the EC50 as greater than 150 μg/L. Therefore, EAO staff determined an estimated EC50 for the test at 170 μg/L.

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Page 4 HUMAN HEALTH

A. Chemical/Element: PFOS	CAS# 1763231
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B. EPA Human Health Criterion (µg/l):	DW and fish: none	fish only: none	DW only: Perfluorooctane Sulfonate. Provisional short-term value 0.2 µg/L
Reference Dose: mg/kg/day	Cancer Potency Slope: (mg/kg-d) ⁻¹		
Final BCF:	%lipid:		
Relative Source Contribution (RSC):			

C. Minnesota Human Health Criterion			
1. Ref.dose: 0.00008 mg/kg/day	Source: MDH		
Additivity endpoint(s): Development (body weight/weight gain), Hepatic (liver) system, Thyroid	Source: MDH		
RSC: 0.2	Source: MDH		
2. Cancer Potency Slope: n/a (mg/kg-d) ⁻¹	Source:		
3. Measured BAFs: Species/Tissue	BAF	%lipid	Norm BAF
1. Bluegill/ Fillet	2700	n/a	2700
2. Carp/ Fillet	1237	n/a	1237
3. Freshwater Drum / Fillet	3077	n/a	3077
4. Smallmouth Bass/ Fillet	2845	n/a	2845
5. White Bass/ Fillet	4618	n/a	4618
Geo mean:	2667		
4. Measured BCFs: Species/Tissue	BCF	%lipid	Norm. BCF
1.	none		
Geo mean:			
5. Edible portion BAF or BCF	BAF		BCF
Cold water: 6.0 % lipid	n/a		
Warm water: 1.5 % lipid	n/a		
6. Geo mean unadjusted for lipid:	n/a		
7. log Kow: adjust. for % lipid:	meas.	QSAR (6% lipid):	Est. BCF:
8. Parachor: n/a			
9. BCF to BAF conversion factor: n/a			
10. Final BAF: 2A (6% lipid): 2667	2B & 2Bd,2C, 2D (1.5% lipid): 2667		
11. Criteria: ug/l	2A: 14 ng/L *	2Bd: 14 ng/L *	2B/2C, 2D: 14 ng/L #
			HRL/HBV: 0.3 µg MDH Health Risk Limit Based Value for Groundwater

D. Organoleptic: n/a	Source:
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E. Notes: E. Notes: * Criterion developed using 2 L/day water and 70 kg body wt. as specified in Minn. R. ch.7050
F. # Criterion developed using 0.01 L/day water incidental ingestion and 70 kg body wt. as specified in Minn. R. Ch. 7050.

Data used for calculation of fish BAF values for PFOS were reported fish tissue and surface water samples collected from the Mississippi R, Pool 2 in 2012. Methods used for calculating water quality criteria can be found in the MPCA water quality guidance manual (Maschwitz, 2000).

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Water Quality Criteria development for 2012 Mississippi River PFOS sample analysis

Individual fish tissue values were measured from fillets of fish captured from pool 2 in 2012 and from surface water samples collected from the same area (Table 1). Procedures and results of those measurements are reported elsewhere. Briefly, fish and water were collected from the sites throughout pool 2 segregated by four discrete sampling sections of the pool. An arithmetic average of the measured water concentrations was calculated for each section of pool 2 sampled. Field BAFs were calculated for individual fish using the measured tissue value divided by the average measured water concentration from the corresponding section of the fish collection site. These individual BAFs were used to calculate a pool-wide geometric mean BAF. Values analyzed and reported as non-detect were given the value of the reporting limit for that analysis. Presently, guidance is being developed to better serve MPCA in its use of censored data.

		Species BAF (L/Kg)					
		Blue Gill Sunfish	Carp	Freshwater Drum	Smallmouth Bass	White Bass	Section GeoMean
Section	2	4081.30	1210.32	6106.25	5092.91	8726.25	4138.21
	3	4964.34	953.26	3536.58	4823.07	9166.39	3748.31
	4	4385.94	4695.43	3969.28	3608.00	5627.30	4405.58
	5	598.29	432.09	1045.7	738.82	882.12	702.35
Grand Geometric mean							2632.09

Table 1. Summary BAFs (units = L/Kg) computed using geometric mean of BAFs from individual fish tissue residue measured from fish collected in each section divided by the arithmetic average water concentration of PFOS measured from the corresponding section.

Pool-wide BAF and Water Quality Criteria equations:

fCC =

$$\frac{RfD \times BW \times RSC}{[IW + (BAF \times CR)]}$$

Where: fCC = fish consumption criterion (mg/L)
 RfD = reference dose = 0.00008 (mg/kg-d)
 BW = standard body weight (70 kg)
 RSC = Relative Source Contribution factor: exposure fraction attributed to water and fish consumption (0.2)
 IW = incidental ingestion of water (0.01 L/d)
 CR = fish consumption rate (0.030 kg/d)
 BAF = Biological Accumulation Factor (L/Kg)

$$fCC = \frac{0.00008 \text{ mg/kg-d} \times 70 \text{ kg} \times 0.2}{[0.01 \text{ L/d} + (2632.09 \text{ L/kg} \times 0.030 \text{ kg/d})]} = 0.0000142 \text{ mg/L}$$

WQC based on fish tissue BAFs for all of Pool 2:

BAF (L/Kg) = 2632.09

fCC (ng/L) = 14

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