

Updates to Health Canada Soil Screening Values for Perfluoroalkylated Substances (PFAS)

May, 2019

Currently there are no Canadian Guidelines for PFAS in soil. In the absence of a soil quality guideline, Health Canada has developed soil screening values (SSVs) for 11 select perfluoroalkylated substances including, perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA)¹, perfluorobutanoate (PFBA), perfluorobutane sulfonate (PFBS), perfluorohexane sulfonate (PFHxS), perfluoropentanoate (PFPeA), perfluorohexanoate (PFHxA), perfluoroheptanoate (PFHpA), perfluorononanoate (PFNA)², 6:2 fluorotelomer sulfonate (6:2 FTS) and 8:2 fluorotelomer sulfonate (8:2 FTS)³. These SSVs can be used to determine whether the concentrations detected in soils are likely to be of concern to human health. Screening values are developed at the request of a federal department, province or territory when there is a need for a quick response and there are no existing formal guidelines. They are based on readily-available scientific studies, and are not subject to a review as thorough as that of the Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines, which undergo internal peer review and public consultation prior to CCME approval. However, the toxicity assessment of PFOS and PFOA, which are the basis for the SSVs listed below, are described in the recently published DWQGs for PFOS and PFOA (HC 2018a; HC 2018b). Soil screening values are provided as guidance, and apply to soils to which humans may be exposed.

PFAS Name	PFAS Acronym	Soil Screening Values (SSVs) (mg/kg)		
		Agricultural/ Residential Parkland Land Use	Commercial Land Use	Industrial (Commercial without Toddler) Land Use
Perfluorooctane sulfonate	PFOS	2.1	3.2	30.5
Perfluorooctanoic acid	PFOA	0.70	1.05	9.94
Perfluorooctane sulfonate + Perfluorooctanoic acid	PFOS + PFOA	$\frac{[PFOS]}{SSV_{PFOS}} + \frac{[PFOA]}{SSV_{PFOA}} \leq 1$		
Perfluorobutanoate	PFBA	114	173	1630
Perfluorobutane sulfonate	PFBS	61	92	872

¹ The SSVs for PFOA and PFAS for which the PFOA TRV is used as a surrogate (i.e. PFPeA, PFHxS and PFHpA) have been updated in this memo to reflect a change in the PFOA toxicity reference value (HC 2018b).

² PFNA SSVs were updated in January 2019 to reflect changes to the Drinking Water Screening Value (HC 2018c).

³ SSVs for 6:2 FTS and 8:2 FTS are based on the same background and toxicological information as the Drinking Water Screening Values for 6:2 FTS and 8:2 FTS (HC 2019).

Updates to Health Canada Soil Screening Values for Perfluoroalkylated Substances (PFAS)

May, 2019

Perfluoropentanoate ^b	PFPeA	0.80	1.21	11.41
Perfluorohexane sulfonate ^a	PFHxS	2.3	3.5	33
Perfluorohexanoate ^b	PFHxA	0.80	1.21	11.41
Perfluoroheptanoate ^b	PFHpA	0.80	1.21	11.41
Perfluorononanoate	PFNA	0.08	0.13	1.2
6:2 fluorotelomer sulfonate ^b	6:2 FTS	0.80	1.21	11.41
8:2 fluorotelomer sulfonate ^b	8:2 FTS	0.80	1.21	11.41

a – SSV is based on PFOS toxicity and an estimated daily intake from other sources assumed to be 0 mg/kg-day.

b – SSV is based on PFOA toxicity and an estimated daily intake from other sources assumed to be 0 mg/kg-day.

Notes:

- The health effects of PFOS and PFOA are similar (notably liver effects) and well documented. Thus, when PFOS and PFOA are found together in soil it is recommended that both chemicals be considered together when comparing to the screening values using the hazard index approach (HC 2018a; HC2018b). This is done by summing the ratios of the measured concentrations of PFOS and PFOA in soil to their respective screening value; if the resultant hazard index (summed hazard quotient) is below or equal to 1.0, then the soil is considered acceptable for its expected use. Science currently does not justify the use of this approach for other PFAS.
- As noted in the table above, the recommended screening approach is:

$$\frac{[PFOS]}{SSV_{PFOS}} + \frac{[PFOA]}{SSV_{PFOA}} \leq 1$$

Where:

- [PFOS] and [PFOA] are the measured soil concentrations, and
 - SSV_{PFOS} and SSV_{PFOA} are the soil screening values.
- In order to ensure that the SSVs are protective of all exposure pathways, the final SSV for each land use is set at the lowest value of the applicable SSVs calculated for each pathway considered as per the 2006 *CCME Protocol for the Derivation of Soil Quality Guidelines*.
 - Industrial land use SSVs are based on the off-site migration check value, which protects more sensitive adjacent lands from contamination due to industrial sites.
 - The SSV for the protection of potable groundwater could not be calculated due to insufficient data. Concerns about PFAS in groundwater used as drinking water should be addressed on a site specific basis.
 - The SSV check value for consumption of produce, meat and milk could not be calculated due to insufficient data. Concerns regarding consumption of foods and PFAS should be addressed on a site specific basis.
 - Since PFAS are essentially non-volatile, the inhalation of indoor air check was not calculated.
 - SSVs and supporting guidance may change without notice. Please check for published values and confirm that these values are appropriate prior to use.
 - Further details are available in SLR 2017, *Toxicological Literature Review and Soil Screening Values for Perfluoroalkylated Substances (PFAS) “C4” to “C7&C9” Compounds*.

Updates to Health Canada Soil Screening Values for Perfluoroalkylated Substances (PFAS)

May, 2019

References

Health Canada. 2019. Drinking Water Screening Value for Fluorotelomer Sulfonates – Technical Summary. April 2019.

Health Canada. 2018a. Guidelines for Canadian Drinking Water Quality. Guideline Technical Document. Perfluorooctane Sulfonate (PFOS). December 2018.
<https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-perfluorooctane-sulfonate.html>

Health Canada. 2018b. Guidelines for Canadian Drinking Water Quality. Guideline Technical Document. Perfluorooctanoic Acid (PFOA). December 2018.
<https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-technical-document-perfluorooctanoic-acid.html>

Health Canada. 2018c. Drinking Water Screening Value for Perfluorononanoic Acid. July 5, 2018.

SUMMARY TABLE: Health Canada Draft Guidelines, Screening Values and Toxicological Reference Values (TRVs) for Perfluoroalkyl Substances (PFAS)

Date: May, 2019

Canadian Drinking Water Guidelines (CDWGs) are available for perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) (HC 2018a; HC 2018b). Currently there are no guidelines for other PFAS in drinking water in Canada. Further, there are no guidelines available for PFAS in soil in Canada.

In the absence of drinking water guidelines, Health Canada has developed drinking water screening values (DWSVs) for some PFAS, which can be used to determine whether the concentrations detected are likely to be of concern to human health. Screening values are developed at the request of a federal department, a province or territory in the event of a spill, leak or other contamination event, and are based on readily-available scientific studies. They are not subject to a review as thorough as that of the Guidelines for Canadian Drinking Water Quality, which undergo peer review and public consultation prior to approval by the Federal-Provincial-Territorial Committees on Drinking Water and on Health and the Environment. Drinking water screening values are provided as guidance, and apply to water intended for human consumption.

In the absence of Soil Quality guidelines, Health Canada has developed soil screening values (SSVs) for some PFAS, which can be used to determine whether the concentrations detected are likely to be of concern to human health. Screening values are developed at the request of a federal department, a province or territory in the event of a spill, leak or other contamination event, and are based on readily available scientific studies. They are not subject to a review as thorough as that of the Canadian Council of Ministers of the Environment (CCME) SQGs, which undergo peer review and public consultation prior to CCME approval. However, the toxicity assessment of PFOS and PFOA, which are the basis for the SSVs listed below, are described in the recently published DWQGs for PFOS and PFOA (HC 2018a; HC 2018b). Soil screening values are provided as guidance, and apply to soil which humans may be exposed.

Draft SQGs, screening values and interim TRVs may change without notice. Please check for published values and confirm that these values are appropriate prior to use.

PFAS	DWG (µg/L)	DWSV (µg/L)	SSV (mg/kg)	TRV (mg/kg-day)	Critical Health Effect	Key Study	Notes
Perfluorooctane sulfonate (PFOS)	0.6	NA	2.1 (Agr/Res/Park ^a) 3.2 (Comm ^b) 30.5 (Comm/Ind ^c)	6 x 10 ⁻⁵	Liver toxicity (hepatocellular hypertrophy) (rat)	Butenhoff <i>et al.</i> (2012)	HC (2018a)
Perfluorooctanoic acid (PFOA)	0.2	NA	0.70 (Agr/Res/Park ^a) 1.05 (Comm ^b)	2.1 x 10 ^{-5*}	Liver toxicity (hepatocellular	Perkins <i>et al.</i> (2004)	HC

			9.94 (Comm/Ind ^c)		hypertrophy) (rat)		(2018b)
PFOS + PFOA [†]	$\frac{[PFOS]}{0.6} + \frac{[PFOA]}{0.2} \leq 1$	NA	$\frac{[PFOS]}{SSV_{PFOS}} + \frac{[PFOA]}{SSV_{PFOA}} \leq 1$	See above	See above	See above	See above
Perfluorobutanoate (PFBA)	NA	30	114 (Agr/Res/Park ^a) 173 (Comm ^b) 1630 (Comm/Ind ^c)	3 x 10 ^{-3**}	Liver toxicity (hepatocellular hypertrophy and increased liver weights), and histological changes in thyroid (male rat)	van Otterdijk (2007a;b)	HC (2011)
Perfluorobutane sulfonate (PFBS)	NA	15	61 (Agr/Res/Park ^a) 92 (Comm ^b) 872 (Comm/Ind ^c)	1.6 x 10 ^{-3**}	Haematological and biochemical changes (male rat)	Lieder <i>et al.</i> (2009)	HC (2011)
Perfluoropentanoate (PFPeA)	NA	0.2	0.80 ^d (Agr/Res/Park ^a) 1.21 ^d (Comm ^b) 11.41 ^d (Comm/Ind ^c)	2.1 x 10 ^{-5**} (based on PFOA)	See PFOA (PFOA TRV adopted)		
Perfluorohexanesulfonate (PFHxS)	NA	0.6	2.3 ^d (Agr/Res/Park ^a) 3.5 ^d (Comm ^b) 33 ^d (Comm/Ind ^c)	6 x 10 ^{-5**} (based on PFOS)	See PFOS (PFOS TRV adopted)		
Perfluorohexanoate (PFHxA)	NA	0.2	0.80 ^d (Agr/Res/Park ^a) 1.21 ^d (Comm ^b) 11.41 ^d (Comm/Ind ^c)	2.1 x 10 ^{-5**} (based on PFOA)	See PFOA (PFOA TRV adopted)		
Perfluoroheptanoate (PFHpA)	NA	0.2	0.80 ^d (Agr/Res/Park ^a) 1.21 ^d (Comm ^b) 11.41 ^d (Comm/Ind ^c)	2.1 x 10 ^{-5**} (based on PFOA)	See PFOA (PFOA TRV adopted)		
Perfluorononanoate (PFNA)	NA	0.02 [‡]	0.08 (Agr/Res/Park ^a) 0.13 (Comm ^b) 1.2 (Comm/Ind ^c)	2.19 x 10 ^{-6**}	Liver toxicity (hepatocellular hypertrophy)	Stump <i>et al.</i> (2008)	HC (2018)

6:2 fluorotelomer sulfonate (6:2 FTS) ^e	NA	0.2	0.80 ^d (Agr/Res/Park ^a) 1.21 ^d (Comm ^b) 11.41 ^d (Comm/Ind ^c)	2.1 x 10 ^{-5**} (based on PFOA)	See PFOA (PFOA TRV adopted)
8:2 fluorotelomer sulfonate (8:2 FTS) ^e	NA	0.2	0.80 ^d (Agr/Res/Park ^a) 1.21 ^d (Comm ^b) 11.41 ^d (Comm/Ind ^c)	2.1 x 10 ^{-5**} (based on PFOA)	See PFOA (PFOA TRV adopted)

Notes:

NA = not applicable

* PFOA TRV has been updated as a result of comments received during public consultation in order to better reflect the currently available data (HC 2018b). Accordingly, the SSVs for PFOA and PFAS for which the PFOA TRV is used as a surrogate have been updated in this table.

** TRV is interim

† The health effects of PFOS and PFOA are similar (notably liver effects) and well documented. Thus, when PFOS and PFOA are found together in soil or groundwater it is recommended that both chemicals be considered together when comparing to the drinking water guidelines using the hazard index approach (HC 2018a; HC 2018b). This is done by summing the ratios of the measured concentrations of PFOS and PFOA (in soil or groundwater) to their respective guideline (drinking water) or screening value (soil); if the resultant hazard index (summed hazard quotients) is below or equal to 1.0, then the soil or groundwater is considered acceptable for its expected use. Science currently does not justify the use of this approach for other PFAS.

‡ PFNA DWSV and SSVs were updated in 2018 to incorporate new science (HC 2018c).a – Agricultural / Residential / Parkland land use

b – Commercial land use

c – Industrial / Commercial without toddler land use. Based on off-site migration of contaminated soils.

d – SSV based on an assumed estimated daily intake (EDI) of 0 mg/kg-day

e - SSVs for 6:2 FTS and 8:2 FTS are based on the same background and toxicological information as the DWSVs for 6:2 FTS and 8:2 FTS (HC 2019)

- In order to ensure that the SSVs are protective of all exposure pathways, the final SSV for each land use is set at the lowest value of the applicable SSVs calculated for each pathway considered as per the 2006 *CCME Protocol for the Derivation of Soil Quality Guidelines*.
- Industrial land use SSVs are based on the off-site migration check value, which protects more sensitive adjacent lands from contamination due to industrial sites.
- The SSV for the protection of potable groundwater could not be calculated due to insufficient data. Concerns about PFAS in groundwater used as drinking water should be addressed on a site specific basis.
- The SSV check value for consumption of produce, meat and milk could not be calculated due to insufficient data. Concerns regarding consumption of foods and PFAS should be addressed on a site specific basis.

- Since PFAS are essentially non-volatile, the inhalation of indoor air check was not calculated.

References

Butenhoff, J.L., Chang, S.C., Olsen, G.W. and Thomford, P.J. 2012. Chronic dietary toxicity and carcinogenicity study with potassium perfluorooctanesulfonate in Sprague Dawley rats. *Toxicology* 293(1-3): 1-15.

Health Canada. 2019. Drinking Water Screening Value for Fluorotelomer Sulfonates – Technical Summary. April 2019.

Health Canada. 2018a. Guidelines for Canadian Drinking Water Quality. Guideline Technical Document. Perfluorooctane Sulfonate (PFOS). December 2018. <https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-perfluorooctane-sulfonate.html>

Health Canada. 2018b. Guidelines for Canadian Drinking Water Quality. Guideline Technical Document. Perfluorooctanoic Acid (PFOA). December 2018. <https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-technical-document-perfluorooctanoic-acid.html>

Health Canada. 2018c. Drinking Water Screening Value for Perfluorononanoic Acid. July 5, 2018.

Health Canada. 2011. Drinking Water Guidance Value: Various perfluorinated alkyl compounds. June 28, 2011.

Lieder, P.H., Chang, S.C., York, R.G. and Butenhoff, J.L. 2009. Toxicological evaluation of potassium perfluorobutanesulfonate in a 90-day oral gavage study with Sprague-Dawley rats. *Toxicology* 255: 45-52.

Perkins, R., Butenhoff, J., Kennedy, G. and Palazzolo, M. 2004. 13-Week dietary toxicity study of ammonium perfluorooctanoate (APFO) in male rats. *Drug Chem. Toxicol.* 27: 361-378.

Stump, D.G., Holson, J.F., Murphy, S.R., Farr, C.H., Schmit, B., and Shinohara, M. 2008. An oral two-generation reproductive toxicity study of S-111-S-WB in rats. *Reprod. Toxicol.* 25(1): 7-20.

van Otterdijk, F.M. 2007a. Repeated dose 28-day oral toxicity study with MTDID-8391 by daily gavage in the rat, followed by a 21-day recovery period. NOTOX Project 470677.

van Otterdijk, F.M. 2007b. Repeated dose 90-day oral toxicity study with MTDID 8391 by daily gavage in the rat followed by a 3-week recovery period. NOTOX Project 484492.