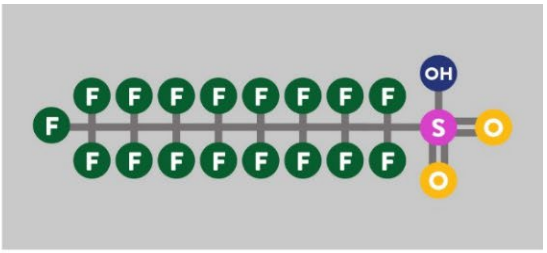
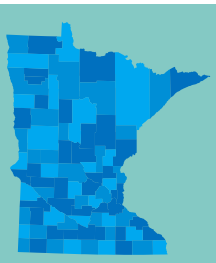
Water quality standards

July 2025

Water Quality Standards Technical Support Document: Human Health Protective Water Quality Criteria for Perfluorooctane Sulfonate (PFOS): Application to Specific Water bodies, Appendix B



MINNESOTA POLLUTION CONTROL AGENCY



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Contributors/acknowledgements

Photos

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Revisions

July 2025

- Update of document number for separate Mississippi River water quality criteria

May 2024

- Removal of portion of Mississippi River that has new, separate water quality criteria

January 2023

- Addition of water body identifiers to Project 1007

November 2022

- Updates to water body identifiers
- Clarification on use classifications that apply to the St. Croix River and Lake St. Croix

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Document number: wq-s6-61d

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Appendix B1. Application of perfluorooctane sulfonate water quality criteria to specific water bodies: Lake Elmo (Washington County)

Water body: Lake Elmo, Washington County (DNR Lake ID: 82010600)

Water body use class: 2B

Pollutant: Perfluorooctane Sulfonate (PFOS)

Beneficial uses/use classes: Aquatic consumption

Reason for application: The Minnesota Pollution Control Agency (MPCA) has developed site-specific water quality criteria (WQC) for application in Lake Elmo as the basis for remediation and other efforts to reduce PFOS and associated per- and polyfluoroalkyl substance (PFAS) contamination.

The MPCA must protect all surface waters so that they are safe for people recreating, eating fish affected by contamination, and used as source waters for drinking (designated for domestic consumption) as described in Minn. R. chs. 7050 and 7052 (Lake Superior Basin).[1] In collaboration with the Interagency Fish Contaminant Monitoring Program, the MPCA has documented high concentrations of perfluorooctane sulfonate (PFOS) in multiple species of fish. This WQC is based on the information found in *Water Quality Standard Technical Support Document: Human Health Protective Water Quality Criteria for Perfluorooctane Sulfonate (PFOS)* (available at https://www.pca.state.mn.us/water/site-specific-criteria).

The area around Lake Elmo has been broadly affected by PFAS contamination. In 2018, based on a lowering of the Minnesota Department of Health's (MDH) Fish Consumption Advisory thresholds and ongoing elevated PFOS concentrations, the MDH alerted the public that they recommended no fish be consumed from Lake Elmo (https://www.co.washington.mn.us/DocumentCenter/View/20895/FAQ-2018-Fish-Consumption-Advisory-NR).

Criteria information:

The WQC are chronic criteria (CC) (see Minn. R. 7050.0217 to 7050.0219). PFOS is a developmental toxicant, so the CC reflect this aspect of its toxicological profile. There are three CC_{DEV} that provide the basis for regulatory action under Minnesota's WQS methods and rules:

- A fish-tissue based $CC_{FT\text{-}DEV}$ applicable in all Class 2 surface waters
- Water column-based $CC_{DFR\text{-}DEV}$ applicable in surface waters classified as Classes 1/2A and 1/2Bd:
- Water column-based $CC_{FR\text{-}DEV}$ applicable in surface waters classified as Classes 2B or Class 2D wetlands

The applicable site-specific WQC are found in Table B-1. For more information, see; MPCA, 2020 *Water Quality Standard Technical Support Document: Human Health Protective Water Quality Criteria for Perfluorooctane Sulfonate (PFOS).* Online, https://www.pca.state.mn.us/water/site-specific-criteria.

[1] *The MPCA's Water Quality Standard rules also address impacts to aquatic life and fish-eating wildlife. Those evaluations are not covered in this WQC based only on human health.*

Table B-1: PFOS water quality criteria for the protection of surface water and fish consumers.

PFOS (CAS numbers)	**Site-specific water quality criteria: *Chronic Criteria* (*CC*)**			***Health Risk Index Endpoints*** **(Additive risk)**
	Class 1/2A or Class 1/2Bd– drinking water, fish and recreational exposure ($CC_{DFR\text{-}DEV}$) (Applied as a 30-day average)	**Class 2B/2D[#]** – fish and recreational exposure ($CC_{FR\text{-}DEV}$) (Applied as a 30-day average)	**Class 2 fish-tissue (fillet)** ($CC_{FT\text{-}DEV}$) (Applied as the 90th percentile of 5 or more fish per water body)	
PFOS (45298-90-6: anion 1763-23-1: acid 29081-56-9: ammonium salt 70225-14-8: diethanolamine salt 2795-39-3: potassium salt 29457-72-5: lithium salt)	0.05 ng/L (Information only)	0.05 ng/L (Applicable to Lake Elmo)	0.37 ng/g (Applicable to Lake Elmo)	Developmental, Adrenal (Endocrine), Hepatic (Liver) System, Immune System, Thyroid (Endocrine)

Description of CC:

$CC_{DFR\text{-}DEV}$: Applied in Class 1/2A and Class 1/2Bd surface waters (D: Domestic Consumption, drinking water/food processing, F: Fish consumption, and R: Recreational exposure); used for a pollutant with acute, short-term, or subchronic developmental ("less-than-chronic") toxicity and higher early-life exposure rates (developmental toxicity as a Health Risk Index Endpoint)

$CC_{FR\text{-}DEV}$: Applied in Class 2B surface waters (F: Fish consumption and R: Recreational exposure); used for a pollutant with acute, short-term, or subchronic ("less-than-chronic") toxicity, higher early-life exposure rates, or developmental toxicity as a Health Risk Index Endpoint.

[#]PFOS CC that includes drinking water or domestic consumption protection ($CC_{DFR\text{-}DEV}$) is the same concentration as the $CC_{FR\text{-}DEV}$, which is also more stringent than the MDH HBV of 15 ng/L, and protective of any downstream drinking water uses.

$CC_{FT\text{-}DEV}$: Applied for Bioaccumulative Chemicals of Concern (BCC) in fish (fillet/muscle) for all Class 2 waters (FT: fish-tissue); used for a pollutant with acute, short-term, or subchronic ("less-than-chronic") toxicity, higher early-life exposure rates, or developmental toxicity as a Health Risk Index Endpoint.

Application of the CC in regards to comparing to water and fish monitoring data should follow Minn. R. chs. 7050 and 7052 *Human Health-based Water Quality Standards Technical Support Document* (Final June 2017) (MPCA 2017), available online at https://www.pca.state.mn.us/sites/default/files/wq-s6-12a.pdf.

Appendix B2. Application of perfluorooctane sulfonate water quality criteria to specific water bodies: Washington County surface waters in 3M Settlement area (Project 1007)

Water bodies (MPCA WID or DNR Lake ID): Beutel's Pond (82039900); Brown's Pond (82011100); Downs Lake (82011000); Friedrich Pond (82010800); Goose Lake (bayed lake: 82011301 and 82011302); Horseshoe Lake (82007400); Legion Pond (82046200); Margaret Lake (82041900); Rest Area Pond (82051400); Rose Lake (82011200); Sunfish Lake (82010700); Unnamed creek (headwaters to Farney Creek)(07030005-805); Unnamed (Farney) creek (07030005-795); Unnamed creek (headwaters Raleigh Creek)(07030005-806); Unnamed (Raleigh) creek (07030005-558, 633, 635); Unnamed creek (0703005-613, 615, 616); Unnamed (Tartan) pond (82047100); West Lakeland Ponds (82048800); Lake Edith (82000400); Unnamed creek (0703005-773, 774); Lake St. Croix (82000100)

Water body use class: 2B/2D (wetland definition may apply to some of these waters)

Water bodies (DNR Lake ID): Eagle Point Lake (82010900)

Water body use class: 2D

Water bodies (MPCA WID or DNR Lake ID): Valley Branch Creek (07030005-566, 560); Valley Creek (07030005-567, 622); Valley Creek Unnamed tributaries (07030005-618, 621, 623, 676, 677, 678, 679)

Water body use class: 1/2A

Water bodies (DNR Lake ID): St. Croix River (07030005-785; Lake St. Croix to Mississippi River)

Water body use class: 1/2Bd

Pollutant: Perfluorooctane Sulfonate (PFOS)

Beneficial uses/use classes: Aquatic consumption

Reason for application: The MPCA has developed site-specific water quality criteria (WQC) for application in Project 1007 lakes, streams, and ponds as the basis for remediation and other efforts to reduce PFOS and associated per and polyfluoroalkyl substance (PFAS) contamination.

The MPCA must protect all surface waters so that they are safe for people recreating, eating fish affected by contamination, and used as source waters for drinking (designated for domestic consumption) as described in Minn. R. chs. 7050 and 7052 (Lake Superior Basin).[2] In collaboration with the Interagency Fish Contaminant Monitoring Program, the MPCA has documented high concentrations of perfluorooctane sulfonate (PFOS) in multiple species of fish. PFOS is also detected in high concentrations in these surface waters. This WQC is based on the information found in *Water Quality Standard Technical Support Document: Human Health Protective Water Quality Criteria for Perfluorooctane Sulfonate (PFOS)* (available at https://www.pca.state.mn.us/water/site-specific-criteria).

A significant area of PFOS contamination is documented in Washington and other area counties of Minnesota. The MPCA is applying the PFOS water quality criteria to surface waters in Washington County that are slated for remediation efforts from the 3M Settlement, called Project 1007 (https://3msettlement.state.mn.us/). There is both documented surface water connections from the headwaters at Raleigh Creek that flow through the Oakdale Landfill site to the St. Croix River and

[2] *The MPCA's Water Quality Standard rules also address impacts to aquatic life and fish-eating wildlife. Those evaluations are not covered in this WQC based only on human health.*

widespread contamination of water resources due to the high mobility of PFOS and other PFAS through groundwater-surface water connections.

Criteria information:

The WQC are chronic criteria (CC) (see Minn. R. 7050.0217 to 7050.0219). PFOS is a developmental toxicant, so the CC reflect this aspect of its toxicological profile. There are three CC_{DEV} that provide the basis for regulatory action under Minnesota's WQS methods and rules:

- A fish-tissue based $CC_{FT\text{-}DEV}$ applicable in all Class 2 surface waters.
- Water column-based $CC_{DFR\text{-}DEV}$ applicable in surface waters classified as Classes 1/2A and 1/2Bd.
- Water column-based $CC_{FR\text{-}DEV}$ applicable in surface waters classified as Classes 2B or Class 2D wetlands.

The applicable site-specific WQC are found in Table B-2. For more information, see; MPCA, 2020 *Water Quality Standard Technical Support Document: Human Health Protective Water Quality Criteria for Perfluorooctane Sulfonate (PFOS).* Online, https://www.pca.state.mn.us/water/site-specific-criteria.

Table B-2: PFOS water quality criteria for the protection of surface water and fish consumers

PFOS (CAS numbers)	**Site-specific water quality criteria: *Chronic Criteria* (*CC*)**			***Health Risk Index Endpoints*** **(Additive risk)**
	Class 1/2A or Class 1/2Bd– drinking water, fish and recreational exposure ($CC_{DFR\text{-}DEV}$) (Applied as a 30-day average)	**Class 2B/2D#** – fish and recreational exposure ($CC_{FR\text{-}DEV}$) (Applied as a 30-day average)	**Class 2 fish-tissue (fillet)** ($CC_{FT\text{-}DEV}$) (Applied as the 90th percentile of 5 or more fish per water body)	
PFOS (45298-90-6: anion 1763-23-1: acid 29081-56-9: ammonium salt 70225-14-8: diethanolamine salt 2795-39-3: potassium salt 29457-72-5: lithium salt)	0.05 ng/L	0.05 ng/L	0.37 ng/g	Developmental, Adrenal (Endocrine), Hepatic (Liver) System, Immune System, Thyroid (Endocrine)

Description of CC:

$CC_{DFR\text{-}DEV}$: Applied in Class 1/2A and Class 1/2Bd surface waters (D: Domestic Consumption, drinking water/food processing, F: Fish consumption, and R: Recreational exposure); used for a pollutant with acute, short-term, or subchronic developmental ("less-than-chronic") toxicity and higher early-life exposure rates (developmental toxicity as a Health Risk Index Endpoint)

$CC_{FR\text{-}DEV}$: Applied in Class 2B surface waters (F: Fish consumption and R: Recreational exposure); used for a pollutant with acute, short-term, or subchronic ("less-than-chronic") toxicity, higher early-life exposure rates, or developmental toxicity as a Health Risk Index Endpoint.

#PFOS CC that includes drinking water or domestic consumption protection ($CC_{DFR\text{-}DEV}$) is the same concentration as the $CC_{FR\text{-}DEV}$, which is also more stringent than the MDH HBV of 15 ng/L, and protective of any downstream drinking water uses.

$CC_{FT\text{-}DEV}$: Applied for Bioaccumulative Chemicals of Concern (BCC) in fish (fillet/muscle) for all Class 2 waters (FT: fish-tissue); used for a pollutant with acute, short-term, or subchronic ("less-than-chronic") toxicity, higher early-life exposure rates, or developmental toxicity as a Health Risk Index Endpoint.

Application of the CC in regards to comparing to water and fish monitoring data should follow Minn. R. chs. 7050 and 7052 *Human Health-based Water Quality Standards Technical Support Document* (Final June 2017) (MPCA 2017), available online at https://www.pca.state.mn.us/sites/default/files/wq-s6-12a.pdf.

Appendix B3. Application of perfluorooctane sulfonate water quality criteria to specific water bodies: Bde Maka Ska (Hennepin County)

Water body: Bde Maka Ska, Hennepin County (DNR Lake ID: 27003100)

Water body use class: 2B

Pollutant: Perfluorooctane Sulfonate (PFOS)

Beneficial uses/use classes: Aquatic Consumption

Reason for application: The MPCA has developed site-specific water quality criteria (WQC) for application in Bde Maka Ska as the basis for remediation and other efforts to reduce PFOS and associated per and polyfluoroalkyl substance (PFAS) contamination.

The MPCA must protect all surface waters so that they are safe for people recreating, eating fish affected by contamination, and used as source waters for drinking (designated for domestic consumption) as described in Minn. R. chs. 7050 and 7052 (Lake Superior Basin).[3] In collaboration with the Interagency Fish Contaminant Monitoring Program, the MPCA has documented high concentrations of perfluorooctane sulfonate (PFOS) in multiple species of fish. This WQC is based on the information found in *Water Quality Standard Technical Support Document: Human Health Protective Water Quality Criteria for Perfluorooctane Sulfonate (PFOS)* (available at https://www.pca.state.mn.us/water/site-specific-criteria).

Criteria information:

The WQC are chronic criteria (CC) (see Minn. R. 7050.0217 to 7050.0219). PFOS is a developmental toxicant, so the CC reflect this aspect of its toxicological profile. There are three CC_{DEV} that provide the basis for regulatory action under Minnesota's WQS methods and rules:

- A fish-tissue based $CC_{FT\text{-}DEV}$ applicable in all Class 2 surface waters.
- Water column-based $CC_{DFR\text{-}DEV}$ applicable in surface waters classified as Classes 1/2A and 1/2Bd.
- Water column-based $CC_{FR\text{-}DEV}$ applicable in surface waters classified as Classes 2B or Class 2D wetlands.

The applicable site-specific WQC are found in Table B-3. For more information, see; MPCA, 2020 *Water Quality Standard Technical Support Document: Human Health Protective Water Quality Criteria for Perfluorooctane Sulfonate (PFOS).* Online, https://www.pca.state.mn.us/water/site-specific-criteria.

[3] *The MPCA's Water Quality Standard rules also address impacts to aquatic life and fish-eating wildlife. Those evaluations are not covered in this WQC based only on human health.*

Table B-3: PFOS water quality criteria for the protection of surface water and fish consumers

PFOS (CAS numbers)	**Site-specific water quality criteria: *Chronic Criteria* (*CC*)**			***Health Risk Index Endpoints*** **(Additive risk)**
	Class 1/2A or Class 1/2Bd– drinking water, fish and recreational exposure ($CC_{DFR\text{-}DEV}$) (Applied as a 30-day average)	**Class 2B/2D[#]** – fish and recreational exposure ($CC_{FR\text{-}DEV}$) (Applied as a 30-day average)	**Class 2 fish-tissue (fillet)** ($CC_{FT\text{-}DEV}$) (Applied as the 90th percentile of 5 or more fish per water body)	
PFOS (45298-90-6: anion 1763-23-1: acid 29081-56-9: ammonium salt 70225-14-8: diethanolamine salt 2795-39-3: potassium salt 29457-72-5: lithium salt)	0.05 ng/L (Information only)	0.05 ng/L (Applicable to Bde Maka Ska)	0.37 ng/g (Applicable to Bde Maka Ska)	Developmental, Adrenal (Endocrine), Hepatic (Liver) System, Immune System, Thyroid (Endocrine)

Description of CC:

$CC_{DFR\text{-}DEV}$: Applied in Class 1/2A and Class 1/2Bd surface waters (D: Domestic Consumption, drinking water/food processing, F: Fish consumption, and R: Recreational exposure); used for a pollutant with acute, short-term, or subchronic developmental ("less-than-chronic") toxicity and higher early-life exposure rates (developmental toxicity as a Health Risk Index Endpoint)

$CC_{FR\text{-}DEV}$: Applied in Class 2B surface waters (F: Fish consumption and R: Recreational exposure); used for a pollutant with acute, short-term, or subchronic ("less-than-chronic") toxicity, higher early-life exposure rates, or developmental toxicity as a Health Risk Index Endpoint.

[#]PFOS CC that includes drinking water or domestic consumption protection ($CC_{DFR\text{-}DEV}$) is the same concentration as the $CC_{FR\text{-}DEV}$, which is also more stringent than the MDH HBV of 15 ng/L, and protective of any downstream drinking water uses.

$CC_{FT\text{-}DEV}$: Applied for Bioaccumulative Chemicals of Concern (BCC) in fish (fillet/muscle) for all Class 2 waters (FT: fish-tissue); used for a pollutant with acute, short-term, or subchronic ("less-than-chronic") toxicity, higher early-life exposure rates, or developmental toxicity as a Health Risk Index Endpoint.

Application of the CC in regards to comparing to water and fish monitoring data should follow Minn. R. chs. 7050 and 7052 *Human Health-based Water Quality Standards Technical Support Document* (Final June 2017) (MPCA 2017), available online at https://www.pca.state.mn.us/sites/default/files/wq-s6-12a.pdf.

Appendix B4. Application of perfluorooctane sulfonate water quality criteria to specific water bodies: Mississippi River, Pool 2 (Dakota, Ramsey, and Washington Counties)

Water body (MPCA WID): Mississippi River, Pool 2 [07010206-814, Ford Dam (L&D 1) to Hastings Dam (L&D 2)], excluding Mississippi River Mile 820 to Hastings Dam (see Human Health Protective Water Quality Criteria for PFAS in Mississippi River, Miles 820 to 812 (wq-s6-69f) for criteria in the excluded section of Pool 2)

Water body use class: 2B

Pollutant: Perfluorooctane Sulfonate (PFOS)

Beneficial uses/use classes: Aquatic consumption

Reason for application: The MPCA has developed site-specific water quality criteria (WQC) for application in a portion of Pool 2 of the Mississippi River, as the basis for remediation and other efforts to reduce PFOS and associated per and polyfluoroalkyl substance (PFAS) contamination.

The MPCA must protect all surface waters so that they are safe for people recreating, eating fish affected by contamination, and used as source waters for drinking (designated for domestic consumption) as described in Minn. R. chs. 7050 and 7052 (Lake Superior Basin).[4] In collaboration with the Interagency Fish Contaminant Monitoring Program, the MPCA has documented high concentrations of perfluorooctane sulfonate (PFOS) in multiple species of fish. This WQC is based on the information found in *Water Quality Standard Technical Support Document: Human Health Protective Water Quality Criteria for Perfluorooctane Sulfonate (PFOS)*(available at https://www.pca.state.mn.us/water/site-specific-criteria).

Criteria information:

The WQC are chronic criteria (CC) (see Minn. R. 7050.0217 to 7050.0219). PFOS is a developmental toxicant, so the CC reflect this aspect of its toxicological profile. There are three CC_{DEV} that provide the basis for regulatory action under Minnesota's WQS methods and rules:

- A fish-tissue based $CC_{FT\text{-}DEV}$ applicable in all Class 2 surface waters.
- Water column-based $CC_{DFR\text{-}DEV}$ applicable in surface waters classified as Classes 1/2A and 1/2Bd.
- Water column-based $CC_{FR\text{-}DEV}$ applicable in surface waters classified as Classes 2B or Class 2D wetlands.

The applicable site-specific WQC are found in Table B-4. For more information, see; MPCA, 2020 *Water Quality Standard Technical Support Document: Human Health Protective Water Quality Criteria for Perfluorooctane Sulfonate (PFOS).* Online, https://www.pca.state.mn.us/water/site-specific-criteria.

[4] *The MPCA's Water Quality Standard rules also address impacts to aquatic life and fish-eating wildlife. Those evaluations are not covered in this WQC based only on human health.*

Table B-4: PFOS water quality criteria for the protection of surface water and fish consumers.

PFOS (CAS numbers)	**Site-specific water quality criteria: *Chronic Criteria* (*CC*)**			***Health Risk Index Endpoints*** **(Additive risk)**
	Class 1/2A or Class 1/2Bd– drinking water, fish and recreational exposure ($CC_{DFR\text{-}DEV}$) (Applied as a 30-day average)	**Class 2B/2D[#]** – fish and recreational exposure ($CC_{FR\text{-}DEV}$) (Applied as a 30-day average)	**Class 2 fish-tissue (fillet)** ($CC_{FT\text{-}DEV}$) (Applied as the 90th percentile of 5 or more fish per water body)	
PFOS (45298-90-6: anion 1763-23-1: acid 29081-56-9: ammonium salt 70225-14-8: diethanolamine salt 2795-39-3: potassium salt 29457-72-5: lithium salt)	0.05 ng/L (Information only)	0.05 ng/L (Applicable to Mississippi River, Pool 2)	0.37 ng/g (Applicable to Mississippi River, Pool 2)	Developmental, Adrenal (Endocrine), Hepatic (Liver) System, Immune System, Thyroid (Endocrine)

Description of CC:

$CC_{DFR\text{-}DEV}$: Applied in Class 1/2A and Class 1/2Bd surface waters (D: Domestic Consumption, drinking water/food processing, F: Fish consumption, and R: Recreational exposure); used for a pollutant with acute, short-term, or subchronic developmental ("less-than-chronic") toxicity and higher early-life exposure rates (developmental toxicity as a Health Risk Index Endpoint)

$CC_{FR\text{-}DEV}$: Applied in Class 2B surface waters (F: Fish consumption and R: Recreational exposure); used for a pollutant with acute, short-term, or subchronic ("less-than-chronic") toxicity, higher early-life exposure rates, or developmental toxicity as a Health Risk Index Endpoint.

[#]PFOS CC that includes drinking water or domestic consumption protection ($CC_{DFR\text{-}DEV}$) is the same concentration as the $CC_{FR\text{-}DEV}$, which is also more stringent than the MDH HBV of 15 ng/L, and protective of any downstream drinking water uses.

$CC_{FT\text{-}DEV}$: Applied for Bioaccumulative Chemicals of Concern (BCC) in fish (fillet/muscle) for all Class 2 waters (FT: fish-tissue); used for a pollutant with acute, short-term, or subchronic ("less-than-chronic") toxicity, higher early-life exposure rates, or developmental toxicity as a Health Risk Index Endpoint.

Application of the CC in regards to comparing to water and fish monitoring data should follow Minn. R. chs. 7050 and 7052 *Human Health-based Water Quality Standards Technical Support Document* (Final June 2017) (MPCA 2017), available online at https://www.pca.state.mn.us/sites/default/files/wq-s6-12a.pdf.