Groundwater IMAC Summary Document
Division of Water Resources

Hexafluoropropylene Oxide Dimer Acid (HFPO-DA; GenX) (CASRN: 13252-13-6)

Recommended Groundwater IMAC

Groundwater standards are to be the "lesser of" the criteria in 15A NCAC 02L .0202(d)(1-6):

(1) Systemic threshold concentration
(2) Concentration that corresponds to an incremental lifetime cancer risk of $1x10^{-6}$
(3) Taste threshold limit value
(4) Odor threshold limit value
(5) Maximum contaminant level
(6) National secondary drinking water standard

The recommended groundwater IMAC for **HFPO-DA** is **10 ng/L** based on the federal drinking water maximum contaminant level.

Data used for Groundwater IMAC

The following references, in order of preference, are used in establishing concentrations of substances which correspond to the criteria in 15A NCAC 02L .0202(d):

(1) U.S. EPA Integrated Risk Information System
(2) U.S. EPA Office of Drinking Water Health Advisories
(3) Other health risk assessment data published by the U.S. EPA
(4) Other relevant, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

U.S. EPA's Office of Water published a Human Health Toxicity Assessment for HFPO-DA which established an oral reference dose (RfD) of 0.000003 mg/kg-day based on liver effects (constellation of lesions including cytoplasmic alteration, hepatocellular single-cell and focal necrosis, and hepatocellular apoptosis) reported in an oral reproductive and developmental toxicity study with exposure of 53-64 days in mice (DuPont, 2010 as referenced in U.S. EPA, 2021). The RfD was derived by dividing the point of departure of 0.01 mg/kg-day by an uncertainty factor of 3,000 (10 for variation in sensitivity among the human population, 3 for interspecies extrapolation, 10 for extrapolation from subchronic to a chronic exposure duration uncertainty factor, and 3 for database deficiencies) (U.S. EPA, 2021). A systemic threshold concentration of 0.02 µg/L (20 ng/L or parts per trillion) can be calculated using the oral reference dose for HFPO-DA in accordance with 15A NCAC 02L .0202(d)(1).

U.S. EPA has not classified HFPO-DA for carcinogenicity. A cancer potency factor is not available. Therefore, a human exposure concentration associated with an incremental lifetime cancer risk estimate of 1×10^{-6} cannot be calculated according to the requirements of 15A NCAC 02L .0202(d)(2).

U.S. EPA established a maximum contaminant level (MCL) of 10 ng/L or ppt for HFPO-DA in April 2024 (U.S. EPA, 2024).

Health Effects Summary

Adverse effects were identified in rodents receiving oral doses of HFPO-DA. The adverse effects were exhibited in the liver, during embryonic developmental, and to the hematological, and immune systems (U.S. EPA, 2021).

Uses and Occurrence

HFPO-DA has been manufactured as a replacement polymer processing aid compound for PFOA since 2009, and is used in similar consumer products as PFOA, including food packaging, paints, cleaning products, non-stick coatings, outdoor fabrics, and firefighting foam (U.S. EPA, 2021). HFPO-DA occurs in North Carolina's groundwater and other environmental media (DEQ, 2021).

References

- **U.S. EPA. (2021).** Human Health Toxicity Values for Hexafluoropropylene Oxide (HFPO) Dimer Acid and Its Ammonium Salt (CASRN 13252-13-6 and CASRN 62037-80-3) Also Known as "GenX Chemicals". U.S. Environmental Protection Agency, Office of Water (4304T), Health and Ecological Criteria Division. EPA Document Number: 822R-21-010
- **U.S. EPA. (2024).** Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation. https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas
- **DuPont. (2010)** An Oral (Gavage) Reproduction/Developmental Toxicity Screening Study of H-28548 in Mice link (as referenced in U.S. EPA, 2021)
- **DEQ. (2021)**. PFAS in NC presentation to the NC Secretaries' Science Advisory Board on August 2, 2021. Presentation (nc.gov)

North Carolina Groundwater IMAC

Hexafluoropropylene oxide dimer acid (HFPO-DA) CASRN 13252-13-6

North Carolina Ground Water (GW) IMAC = 0.01 µg/L

GW IMAC based on noncancer endpoint

GWQS = [(RfD x WT x RSC) / WI] * 1000

RfD = reference dose[1]	3.0E-06	mg/kg/day	
WT = average adult human body weight[2]	70	kg	
RSC= relative source contribution	0.2	unitless value	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard with noncancer endpoint	**0.021**	**µg/L (ppb)**	**21 ng/L (ppt)**

GW IMAC based on cancer endpoint

GWQS = [(RL x WT) / (q1* x WI)] * 1000

RL = risk level	1.0E-06		
WT = average adult human body weight[2]	70	kg	
q1* = carcinogenic potency factor (slope factor)	NA	$(mg/kg/day)^{-1}$	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using cancer endpoint	**NA**	**µg/L (ppb)**	

GW IMACs based on published values

Taste Threshold	**NA**	**µg/L**	
Odor Threshold	**NA**	**µg/L**	
Maximum Contaminant Level (MCL)[4]	**0.01**	**µg/L**	**10 ng/L (ppt)**
Secondary Drinking Water Standard (SMCL)	**NA**	**µg/L**	

References

[1] US EPA Human Health Toxicity Values for Hexafluoropropylene Oxide (HFPO) Dimer Acid and Its Ammonium Salt (CASRN 13252-13-6 and CASRN 62037-80-3) Also Known as "GenX Chemicals". EPA Document Number: 822R-21-010.

[2] Average adult body weight from 15A NCAC 02L .0202 (effective date April 1, 2022).

[3] Average water consumption from 15A NCAC 02L .0202 (effective date April 1, 2022).

[4] U.S. EPA. (2024). Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation.

ppb= parts per billion
ppt= parts per trillion
NA = Not available
RSC = 0.1 for nonorganics, 0.2 for organics

Groundwater IMAC Summary Document
Division of Water Resources

Perfluorobutane Sulfonic Acid (PFBS) (CASRN: 375-73-5)

Recommended Groundwater IMAC

Groundwater standards are to be the "lesser of" the criteria in 15A NCAC 02L .0202(d)(1-6):

(1) Systemic threshold concentration
(2) Concentration that corresponds to an incremental lifetime cancer risk of $1x10^{-6}$
(3) Taste threshold limit value
(4) Odor threshold limit value
(5) Maximum contaminant level
(6) National secondary drinking water standard

The recommended groundwater IMAC for **PFBS** is **2,000 ng/L** based on the calculated noncancer systemic threshold concentration.

Data used for Groundwater IMAC

The following references, in order of preference, are used in establishing concentrations of substances which correspond to the criteria in 15A NCAC 02L .0202(d):

(1) U.S. EPA Integrated Risk Information System
(2) U.S. EPA Office of Drinking Water Health Advisories
(3) Other health risk assessment data published by the U.S. EPA
(4) Other relevant, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

U.S. EPA's Office of Research and Development published a Human Health Toxicity Assessment for PFBS which established an oral reference dose (RfD) of 0.0003 mg/kg-day based on decreased serum total T4 in newborn mice (Feng et al., 2017, as referenced in U.S. EPA, 2021). The RfD was derived by dividing the point of departure of 0.095 mg/kg-day by an uncertainty factor of 300 (10 for variation in sensitivity among the human population, 3 for interspecies extrapolation, 1 for extrapolation of developmental effects, and 10 for database deficiencies) (U.S. EPA, 2021). A systemic threshold concentration of 2 µg/L (2,000 ng/L or parts per trillion) can be calculated using the oral reference dose for PFBS in accordance with 15A NCAC 02L .0202(d)(1).

U.S. EPA has not classified PFBS for carcinogenicity. A cancer potency factor is not available. Therefore, a human exposure concentration associated with an incremental lifetime cancer risk estimate of 1×10^{-6} cannot be calculated according to the requirements of 15A NCAC 02L .0202(d)(2).

U.S. EPA established a National Primary Drinking Water Regulation (NPDWR) for PFAS mixtures containing at least two or more of PFHxS, PFNA, HFPO-DA, and PFBS using a unitless Hazard Index in April 2024 (U.S. EPA, 2024). No individual maximum contaminant level has been established for PFBS.

Health Effects Summary

Adverse effects were identified in rodents receiving oral doses of PFBS. The adverse effects exhibited were decreases in thyroid hormones, developmental delays, and reproductive effects (U.S. EPA, 2021).

Uses and Occurrence

PFBS is a replacement for PFOS and are used primarily in the manufacture of paints, cleaning agents, and water- and stain-repellent products and coatings (U.S. EPA, 2021). PFBS occurs in North Carolina's groundwater and other environmental media (DEQ, 2021).

References

- **U.S. EPA. (2021).** Human Health Toxicity Values for Perfluorobutane Sulfonic Acid (CASRN 375-73-5) and Related Compound Potassium Perfluorobutane Sulfonate (CASRN 29420-49-3). Office of Research and Development (ORD) Center for Public Health and Environmental Assessment (CPHEA). EPA Document Number: EPA/600/R-20/345F
- **U.S. EPA. (2024).** Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation.
- **Feng** X, Cao X, Zhao S, Wang X, Hua X, Chen L, Chen L. **(2017)** Exposure of Pregnant Mice to Perfluorobutanesulfonate Causes Hypothyroxinemia and Developmental Abnormalities in Female Offspring, *Tox. Sci.*, 155, 409–419, https://doi.org/10.1093/toxsci/kfw219 (as referenced in U.S. EPA, 2021)
- **DEQ. (2021)**. PFAS in NC presentation to the NC Secretaries' Science Advisory Board on August 2, 2021. Presentation (nc.gov)

North Carolina Groundwater IMAC

Perfluorobutane sulfonic acid (PFBS) CASRN 375-73-5

North Carolina Ground Water (GW) IMAC = 2 µg/L*

GW IMAC based on noncancer endpoint

GWQS = [(RfD x WT x RSC) / WI] * 1000

RfD = reference dose[1]	3.0E-04	mg/kg/day	
WT = average adult human body weight[2]	70	kg	
RSC= relative source contribution	0.2	unitless value	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using noncancer endpoint	**2.1**	**µg/L (ppb)**	**2100 ng/L (ppt)**

GW IMAC based on cancer endpoint

GWQS = [(RL x WT) / (q1* x WI)] * 1000

RL = risk level	1.0E-06	
WT = average adult human body weight[2]	70	kg
q1* = carcinogenic potency factor (slope factor)	NA	$(mg/kg/day)^{-1}$
WI = average daily adult human water intake[3]	2	L/day
1000 = conversion factor	1000	µg/mg
Calculated GW Standard using cancer endpoint	**NA**	**µg/L (ppb)**

GW IMACs based on published values

Taste Threshold	**NA**	**µg/L**
Odor Threshold	**NA**	**µg/L**
Maximum Contaminant Level (MCL)[4]	**NA**	**µg/L**
Secondary Drinking Water Standard (SMCL)	**NA**	**µg/L**

References

[1] U.S. EPA. (2021). Human Health Toxicity Values for Perfluorobutane Sulfonic Acid (CASRN 375-73-5) and Related Compound Potassium Perfluorobutane Sulfonate (CASRN 29420-49-3). U.S. Environmental Protection Agency, Office of Research and Development (ORD) Center for Public Health and Environmental Assessment (CPHEA).

[2] Average adult body weight from 15A NCAC 02L .0202 (effective date April 1, 2022).

[3] Average water consumption from 15A NCAC 02L .0202 (effective date April 1, 2022).

[4] U.S. EPA established a unitless Hazard Index approach to regulate for mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS. No individual MCL has been established for PFBS; U.S. EPA. (2024). Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation.

*Rounded using conventions from EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (Office of Water, EPA 822-B-00-004, October 2000)

ppb= parts per billion
ppt= parts per trillion
NA = Not available
RSC = 0.1 for nonorganics, 0.2 for organics

Groundwater IMAC Summary Document
Division of Water Resources

Perfluorobutanoic Acid (PFBA) (CASRN: 375-22-4)

Recommended Groundwater IMAC

Groundwater standards are to be the "lesser of" the criteria in 15A NCAC 02L .0202(d)(1-6):

(1) Systemic threshold concentration
(2) Concentration that corresponds to an incremental lifetime cancer risk of $1x10^{-6}$
(3) Taste threshold limit value
(4) Odor threshold limit value
(5) Maximum contaminant level
(6) National secondary drinking water standard

The recommended groundwater IMAC for **PFBA** is **7,000 ng/L** based on the calculated noncancer systemic threshold concentration.

Data used for Groundwater IMAC

The following references, in order of preference, are used in establishing concentrations of substances which correspond to the criteria in 15A NCAC 02L .0202(d):

(1) U.S. EPA Integrated Risk Information System
(2) U.S. EPA Office of Drinking Water Health Advisories
(3) Other health risk assessment data published by the U.S. EPA
(4) Other relevant, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

U.S. EPA's Integrated Risk Information System (IRIS) established an oral reference dose (RfD) of 0.001 mg/kg-day for PFBA based on increased liver hypertrophy and decreased total T4 (a hormone used to detect thyroid issues) reported in a 28-day and 90-day oral exposure study in rats (Buttenhoff et al., 2012, as referenced in U.S. EPA, 2022). The RfD was derived by dividing the point of departure of 1.27 mg/kg-day by an uncertainty factor of 1000 (10 for variation in sensitivity among the human population, 3 for interspecies extrapolation, 10 for extrapolation of a subchronic effect level to a chronic effect level, and 3 for database deficiencies) (U.S. EPA, 2022). A systemic threshold concentration of 7 µg/L (7,000 ng/L or parts per trillion) can be calculated using the oral reference dose for PFBA in accordance with 15A NCAC 02L .0202(d)(1).

U.S. EPA has not classified PFBA for carcinogenicity. A cancer potency factor is not available. Therefore, a human exposure concentration associated with an incremental lifetime cancer risk estimate of 1×10^{-6} cannot be calculated according to the requirements of 15A NCAC 02L .0202(d)(2).

Health Effects Summary

Adverse effects were identified in rodents receiving oral doses of PFBA. The adverse effects were exhibited in the decrease if T4 in the thyroid, an increase in weight of the liver, and developmental effects which were expressed as the loss of viable offspring and postnatal developmental milestones. These effects indicate that PFBA exposure is likely to cause thyroid, hepatic, and developmental toxicity in humans (US EPA, 2022).

Uses and Occurrence

PFBA is a breakdown product of other PFAS used in stain-resistant fabrics, paper food packaging, and carpets. PFBA was also used for manufacturing photographic film. The 3M Company was once a major manufacturer of PFBA and products containing PFBA, but production was phased out in 1998 (Minnesota Dept of Health, 2022). PFBA occurs in North Carolina's groundwater and other environmental media (DEQ, 2021).

References

- **U.S. EPA. (2022).** Integrated Risk Information System (IRIS) Toxicological Review of Perfluorobutanoic Acid (PFBA, CASRN 37522-4) and Related Salts. Office of Research and Development. EPA/635/R-22/277Fa. PFBA IRIS
- **Butenhoff** JL, Bjork JA, Chang SC, Ehresman DJ, Parker GA, Das K, Lau C, Lieder PH, van Otterdijk FM, Wallace KB. **(2012).** Toxicological evaluation of ammonium perfluorobutyrate in rats: twenty-eight-day and ninety-day oral gavage studies. Reprod Toxicol.;33(4):513-530. PubMed (nih.gov) (as referenced in U.S. EPA, 2022)
- **Minnesota Dept of Health. (2022).** Perfluorobutanoic acid (PFBA) and Water. PFBA Info Sheet (state.mn.us)
- **DEQ. (2021)**. PFAS in NC presentation to the NC Secretaries' Science Advisory Board on August 2, 2021. Presentation (nc.gov)

North Carolina Groundwater IMAC

Perfluorobutanoic Acid (PFBA) CASRN 375-22-4

North Carolina Ground Water (GW) IMAC = 7 µg/L*

GW IMAC based on noncancer endpoint

GWQS = [(RfD x WT x RSC) / WI] * 1000

RfD = reference dose[1]	1.0E-03	mg/kg/day	
WT = average adult human body weight[2]	70	kg	
RSC= relative source contribution	0.2	unitless value	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using noncancer endpoint	**7**	**µg/L (ppb)**	**7000 ng/L (ppt)**

GW IMAC based on cancer endpoint

GWQS = [(RL x WT) / (q1* x WI)] * 1000

RL = risk level	1.0E-06	
WT = average adult human body weight[2]	70	kg
q1* = carcinogenic potency factor (slope factor)	NA	$(mg/kg/day)^{-1}$
WI = average daily adult human water intake[3]	2	L/day
1000 = conversion factor	1000	µg/mg
Calculated GW Standard using cancer endpoint	**NA**	**µg/L (ppb)**

GW IMACs based on published values

Taste Threshold	**NA**	**µg/L**
Odor Threshold	**NA**	**µg/L**
Maximum Contaminant Level (MCL)	**NA**	**µg/L**
Secondary Drinking Water Standard (SMCL)	**NA**	**µg/L**

References

[1] **U.S. EPA. (2022). Integrated Risk Information System (IRIS) Toxicological Review of Perfluorobutanoic Acid (PFBA, CASRN 37522-4) and Related Salts. Office of Research and Development. EPA/635/R-22/277Fa.**

[2] **Average adult body weight from 15A NCAC 02L .0202 (effective date April 1, 2022).**

[3] **Average water consumption from 15A NCAC 02L .0202 (effective date April 1, 2022).**

***Rounded using conventions from EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (Office of Water, EPA 822-B-00-004, October 2000)**

ppb= parts per billion
ppt= parts per trillion
NA = Not available
RSC = 0.1 for nonorganics, 0.2 for organics

Groundwater IMAC Summary Document
Division of Water Resources

Perfluorohexane sulfonic acid (PFHxS) (CASRN: 355-46-4)

Recommended Groundwater IMAC

Groundwater standards are to be the "lesser of" the criteria in 15A NCAC 02L .0202(d)(1-6):

(1) Systemic threshold concentration
(2) Concentration that corresponds to an incremental lifetime cancer risk of $1x10^{-6}$
(3) Taste threshold limit value
(4) Odor threshold limit value
(5) Maximum contaminant level
(6) National secondary drinking water standard

The recommended groundwater IMAC for **PFHxS** is **10 ng/L** based on the calculated noncancer systemic threshold concentration and the federal drinking water maximum contaminant level.

Data used for Groundwater IMAC

The following references, in order of preference, are used in establishing concentrations of substances which correspond to the criteria in 15A NCAC 02L .0202(d):

(1) U.S. EPA Integrated Risk Information System
(2) U.S. EPA Office of Drinking Water Health Advisories
(3) Other health risk assessment data published by the U.S. EPA
(4) Other relevant, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

U.S. Center for Disease Control and Prevention's Agency for Toxic Substance Disease Registry (ATSDR) established an intermediate-duration oral minimal risk level (MRL) of 0.00002 mg/kg-day for PFHxS based on thyroid follicular epithelial hypertrophy/hyperplasia in rats (Buttenhoff et al., 2009, as referenced in ATSDR, 2021). The MRL was derived by dividing the point of departure of 0.0047 mg/kg-day by an uncertainty factor of 300 (10 for variation in sensitivity among the human population, 3 for interspecies extrapolation, and 10 for database deficiencies) (ATSDR, 2021). The EPA's Office of Drinking Water used the ATSDR MRL with an additional uncertainty factor of 10 to account for the extrapolation of subchronic to chronic exposure duration to calculate the RfD of 0.000002 mg/kg-day published in the Maximum Contaminant Level Goals assessment (U.S. EPA, 2024a). A systemic threshold concentration of 0.01 µg/L (10 ng/L or parts per trillion) can be calculated using the oral reference dose for PFHxS in accordance with 15A NCAC 02L .0202(d)(1).

U.S. EPA has not classified PFHxS for carcinogenicity. A cancer potency factor is not available, and a concentration associated with an incremental lifetime cancer risk estimate of 1×10^{-6} cannot be calculated in accordance with 15A NCAC 02L .0202(d)(2).

U.S. EPA established a maximum contaminant level (MCL) of 10 ng/L or ppt for PFHxS in April 2024 (U.S. EPA, 2024b).

Health Effects Summary

Adverse health effects were identified in rodents receiving oral doses of PFHxS. The adverse effects were exhibited by hypertrophy/hyperplasia on the thyroid follicular epithelial region, as well as decreased litter size, and changes to both the immune system and the liver (ATSDR, 2021).

Uses and Occurrence

PFHxS is used as a surfactant and protective coating in applications such as aqueous firefighting foams, textile coating, metal plating and in polishing agents (ATSDR, 2021). PFHxS occurs in North Carolina's groundwater and other environmental media (DEQ, 2021).

References

- **Butenhoff** JL, Chang SC, Ehresman DJ, York RG. Evaluation of potential reproductive and developmental toxicity of potassium perfluorohexanesulfonate in Sprague Dawley rats. Reprod Toxicol**. (2009)** 27(3-4):331-341. doi:10.1016/j.reprotox.2009.01.004.(as referenced in ATSDR, 2021)
- **ATSDR. (2021).** Toxicological Profile for Perfluoroalkyls. https://www.atsdr.cdc.gov/ToxProfiles/tp200.pdf
- **U.S. EPA. (2024a).** Maximum Contaminant Level Goals (MCLGs) for Three Individual Per- and Polyfluoroalkyl Substances (PFAS) and a Mixture of Four PFAS. Office of Water. EPA Document Number: EPA-815-R-24-004
- **U.S. EPA. (2024b).** Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation. https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas
- **DEQ. (2021)**. PFAS in NC presentation to the NC Secretaries' Science Advisory Board on August 2, 2021. Presentation (nc.gov)

North Carolina Groundwater IMAC

Perfluorohexane sulfonate (PFHxS) CASRN 355-46-4

North Carolina Ground Water (GW) IMAC = 0.01 µg/L*

GW IMAC based on noncancer endpoint

GWQS = [(RfD x WT x RSC) / WI] * 1000

RfD = reference dose[1]	2.0E-06	mg/kg/day	
WT = average adult human body weight[2]	70	kg	
RSC= relative source contribution	0.2	unitless value	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using noncancer endpoint	**0.01**	**µg/L (ppb)**	**14 ng/L (ppt)**

GW IMAC based on cancer endpoint

GWQS = [(RL x WT) / (q1* x WI)] * 1000

RL = risk level	1.0E-06		
WT = average adult human body weight[2]	70	kg	
q1* = carcinogenic potency factor (slope factor)	NA	$(mg/kg/day)^{-1}$	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using cancer endpoint	**NA**	**µg/L (ppb)**	

GW IMACs based on published values

Taste Threshold	**NA**	**µg/L**	
Odor Threshold	**NA**	**µg/L**	
Maximum Contaminant Level (MCL)[4]	**0.01**	**µg/L**	**10 ng/L (ppt)**
Secondary Drinking Water Standard (SMCL)	**NA**	**µg/L**	

References

[1] Agency for Toxic Substances and Disease Registry (ATSDR). 2021. Toxicological profile for Perfluoroalkyls. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. DOI: 10.15620/cdc:59198

[2] Average adult body weight from 15A NCAC 02L .0202 (effective date April 1, 2022).

[3] Average water consumption from 15A NCAC 02L .0202 (effective date April 1, 2022).

[4] U.S. EPA. (2024). Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation.

*Rounded using conventions from EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (Office of Water, EPA 822-B-00-004, October 2000)

ppb= parts per billion
ppt= parts per trillion
NA = Not available
RSC = 0.1 for nonorganics, 0.2 for organics

Groundwater IMAC Summary Document
Division of Water Resources

Perfluorohexanoic Acid (PFHxA) (CASRN: 307-24-4)

Recommended Groundwater IMAC

Groundwater standards are to be the "lesser of" the criteria in 15A NCAC 02L .0202(d)(1-6):

(1) Systemic threshold concentration
(2) Concentration that corresponds to an incremental lifetime cancer risk of $1x10^{-6}$
(3) Taste threshold limit value
(4) Odor threshold limit value
(5) Maximum contaminant level
(6) National secondary drinking water standard

The recommended groundwater IMAC for **PFHxA** is **4,000 ng/L** based on the calculated noncancer systemic threshold concentration.

Data used for Groundwater IMAC

The following references, in order of preference, are used in establishing concentrations of substances which correspond to the criteria in 15A NCAC 02L .0202(d):

(1) U.S. EPA Integrated Risk Information System
(2) U.S. EPA Office of Drinking Water Health Advisories
(3) Other health risk assessment data published by the U.S. EPA
(4) Other relevant, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

U.S. EPA's Integrated Risk Information System (IRIS) established an oral reference dose (RfD) of 0.0005 mg/kg-day for PFHxA based on developmental effects observed in a gestational 126-day oral exposure study in rodents (Loveless et al., 2009, as referenced in U.S. EPA, 2023). The RfD was derived by dividing the point of departure of 0.048 mg/kg-day by an uncertainty factor of 100 (10 for variation in sensitivity among the human population, 3 for interspecies extrapolation, and 3 for database deficiencies) (U.S. EPA, 2023). A systemic threshold concentration of 4 µg/L (4,000 ng/L or parts per trillion) can be calculated using the oral reference dose for PFHxA in accordance with 15A NCAC 02L .0202(d)(1).

U.S. EPA has not classified PFHxA for carcinogenicity. The cancer potency factor is not available. Therefore, a human exposure concentration associated with an incremental lifetime cancer risk estimate of 1×10^{-6} cannot be calculated according to the requirements of 15A NCAC 02L .0202(d)(2).

Health Effects Summary

Adverse effects have been identified in rodents receiving oral doses of PFHxA. The adverse effects were exhibited by decreased body weight in offspring, and deleterious impacts to the hepatic and hematopoietic systems (U.S. EPA, 2023). PFHxA likely causes hepatic, developmental, hematopoietic, and endocrine effects in humans given sufficient exposure conditions (U.S. EPA, 2023). Animals receiving oral doses of PFHxA exhibited adverse hepatic, hematopoietic, and developmental effects (U.S. EPA, 2023).

Uses and Occurrence

PFHxA is used as a surfactant and protective coating in various applications such as: aqueous firefighting foams, textile coating, metal plating, polishing agents, water-resistant coatings, non-stick cookware, stain-resistant fabrics and carpets, and food packaging materials (U.S. EPA, 2023). PFHxA occurs in North Carolina's groundwater and other environmental media (DEQ 2021).

References

- **U.S. EPA. (2023).** Integrated Risk Information System (IRIS) Toxicological Review of Perfluorohexanoic Acid (PFHxA) and Related Salts. National Center for Environmental Assessment, Office of Research and Development. PFHxA IRIS
- **Loveless** SE, Slezak B, Serex T, Lewis J, Mukerji P, O'Connor JC, Doner EM, Frame SR, Korzeniowski SH, Buck RC. **(2009).** Toxicological evaluation of sodium perfluorohexanoate.Toxicology; 264;32-44 (as referenced in U.S. EPA, 2023)
- **DEQ. (2021)**. PFAS in NC presentation to the NC Secretaries' Science Advisory Board on August 2, 2021. Presentation (nc.gov)

North Carolina Groundwater IMAC

Perfluorohexanoic Acid (PFHxA) CASRN 307-24-4

North Carolina Ground Water (GW) IMAC = 4 µg/L*

GW IMAC based on noncancer endpoint

GWQS = [(RfD x WT x RSC) / WI] * 1000

RfD = reference dose[1]	5.0E-04	mg/kg/day	
WT = average adult human body weight[2]	70	kg	
RSC= relative source contribution	0.2	unitless value	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using noncancer endpoint	**3.5**	**µg/L (ppb)**	**3500 ng/L (ppt)**

GW IMAC based on cancer endpoint

GWQS = [(RL x WT) / (q1* x WI)] * 1000

RL = risk level	1.0E-06	
WT = average adult human body weight[2]	70	kg
q1* = carcinogenic potency factor (slope factor)	NA	$(mg/kg/day)^{-1}$
WI = average daily adult human water intake[3]	2	L/day
1000 = conversion factor	1000	µg/mg
Calculated GW Standard using cancer endpoint	**NA**	**µg/L (ppb)**

GW IMACs based on published values

Taste Threshold	**NA**	**µg/L**
Odor Threshold	**NA**	**µg/L**
Maximum Contaminant Level (MCL)	**NA**	**µg/L**
Secondary Drinking Water Standard (SMCL)	**NA**	**µg/L**

References

[1] U.S. EPA. (2023). Integrated Risk Information System (IRIS) Toxicological Review of Perfluorohexanoic Acid (PFHxA) and Related Salts. National Center for Environmental Assessment, Office of Research and Development.

[2] Average adult body weight from 15A NCAC 02L .0202 (effective date April 1, 2022).

[3] Average water consumption from 15A NCAC 02L .0202 (effective date April 1, 2022).

*Rounded using conventions from EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (Office of Water, EPA 822-B-00-004, October 2000)

ppb= parts per billion
ppt= parts per trillion
NA = Not available
RSC = 0.1 for nonorganics, 0.2 for organics

Groundwater IMAC Summary Document
Division of Water Resources

Perfluorononanoic acid (PFNA) (CASRN: 375-95-1)

Recommended Groundwater IMAC

Groundwater standards are to be the "lesser of" the criteria in 15A NCAC 02L .0202(d)(1-6):

(1) Systemic threshold concentration
(2) Concentration that corresponds to an incremental lifetime cancer risk of 1x10-6
(3) Taste threshold limit value
(4) Odor threshold limit value
(5) Maximum contaminant level
(6) National secondary drinking water standard

The recommended groundwater IMAC for **PFNA** is **10 ng/L** based on the federal drinking water maximum contaminant level.

Data used for Groundwater IMAC

The following references, in order of preference, are used in establishing concentrations of substances which correspond to the criteria in 15A NCAC 02L .0202(d):

(1) U.S. EPA Integrated Risk Information System
(2) U.S. EPA Office of Drinking Water Health Advisories
(3) Other health risk assessment data published by the U.S. EPA
(4) Other relevant, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

U.S. Center for Disease Control and Prevention's Agency for Toxic Substance Disease Registry (ATSDR) established an intermediate-duration oral minimal risk level (MRL) of 0.000003 mg/kg-day for PFNA based on decreased body weight and developmental delays in mice administered an oral dose of PFNA during gestational days 1-17 (Das et al., 2015, as referenced in ATSDR, 2021). The MRL was derived by dividing the point of departure of 0.001 mg/kg-day by an uncertainty factor of 300 (10 for variation in sensitivity among the human population, 3 for interspecies extrapolation, and 10 for database deficiencies) (ATSDR, 2021). The EPA's Office of Drinking Water used the ATSDR MRL as the RfD published in the Maximum Contaminant Level Goals assessment (U.S. EPA, 2024a). A systemic threshold concentration of 0.02 µg/L (20 ng/L or parts per trillion) can be calculated using the oral reference dose for PFNA in accordance with 15A NCAC 02L .0202(d)(1).

U.S. EPA has not classified PFNA for carcinogenicity. A cancer potency factor is not available. Therefore, a human exposure concentration associated with an incremental lifetime cancer risk estimate of 1×10^{-6} cannot be calculated according to the requirements of 15A NCAC 02L .0202(d)(2).

U.S. EPA established a maximum contaminant level (MCL) of 10 ng/L or ppt for PFNA in April 2024 (U.S. EPA, 2024b).

Health Effects Summary

Adverse effects were identified in rodents receiving oral doses of PFNA. The adverse effects were exhibited by decreased body weight and developmental delays in offspring, as well as hepatic lesions (ATSDR, 2021).

Uses and Occurrence

PFNA is used similarly to PFOA and is used in similar products, including food packaging, paints, cleaning products, and non-stick coatings (ATSDR, 2021). PFNA occurs in North Carolina's groundwater and other environmental media (DEQ, 2021).

References

- **Das** KP, Grey BE, Rosen MB, Wood CR, Tatum-Gibbs KR, Zehr RD, Strynar MJ, Lindstrom AB, Lau C. Developmental toxicity of perfluorononanoic acid in mice. Repro Toxicol. **(2015)**, 51, 133-144. https://doi.org/10.1016/j.reprotox.2014.12.012. (as referenced in ATSDR, 2021)
- **ATSDR. (2021).** Toxicological Profile for Perfluoroalkyls. https://www.atsdr.cdc.gov/ToxProfiles/tp200.pdf
- **U.S. EPA. (2024a).** Maximum Contaminant Level Goals (MCLGs) for Three Individual Per- and Polyfluoroalkyl Substances (PFAS) and a Mixture of Four PFAS. U.S. Environmental Protection Agency, Office of Water (4304T), Office of Science and Technology, Health and Ecological Criteria Division. EPA Document Number: EPA-815-R-24-004
- **U.S. EPA. (2024b).** Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation.
- **DEQ. (2021)**. PFAS in NC presentation to the NC Secretaries' Science Advisory Board on August 2, 2021. Presentation (nc.gov)

North Carolina Groundwater IMAC

Perfluorononanoic acid (PFNA) CASRN 375-95-1

North Carolina Ground Water (GW) IMAC = 0.01 µg/L

GW IMAC based on noncancer endpoint

GWQS = [(RfD x WT x RSC) / WI] * 1000

RfD = reference dose[1]	3.0E-06	mg/kg/day	
WT = average adult human body weight[2]	70	kg	
RSC= relative source contribution	0.2	unitless value	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using noncancer endpoint	**0.021**	**µg/L (ppb)**	**21 ng/L (ppt)**

GW IMAC based on cancer endpoint

GWQS = [(RL x WT) / (q1* x WI)] * 1000

RL = risk level	1.0E-06		
WT = average adult human body weight[2]	70	kg	
q1* = carcinogenic potency factor (slope factor)	NA	$(mg/kg/day)^{-1}$	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using cancer endpoint	**NA**	**µg/L (ppb)**	

GW IMACs based on published values

Taste Threshold	**NA**	**µg/L**	
Odor Threshold	**NA**	**µg/L**	
Maximum Contaminant Level (MCL)[4]	**0.01**	**µg/L**	**10 ng/L (ppt)**
Secondary Drinking Water Standard (SMCL)	**NA**	**µg/L**	

References

[1] Agency for Toxic Substances and Disease Registry (ATSDR). 2021. Toxicological profile for Perfluoroalkyls. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. DOI: 10.15620/cdc:59198

[2] Average adult body weight from 15A NCAC 02L .0202 (effective date April 1, 2022).

[3] Average water consumption from 15A NCAC 02L .0202 (effective date April 1, 2022).

[4] U.S. EPA. (2024). Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation.

ppb= parts per billion
ppt= parts per trillion
NA = Not available
RSC = 0.1 for nonorganics, 0.2 for organics

Groundwater IMAC Summary Document
Division of Water Resources

Perfluorooctane Sulfonic Acid (PFOS) (CASRN: 1763-23-1)

Recommended Groundwater IMAC

Groundwater standards are to be the "lesser of" the criteria in 15A NCAC 02L .0202(d)(1-6):

(1) Systemic threshold concentration
(2) Concentration that corresponds to an incremental lifetime cancer risk of 1x10-6
(3) Taste threshold limit value
(4) Odor threshold limit value
(5) Maximum contaminant level
(6) National secondary drinking water standard

The recommended groundwater IMAC for **PFOS** is **0.7 ng/L** based on the calculated noncancer systemic threshold concentration.

Data used for Groundwater IMAC

The following references, in order of preference, are used in establishing concentrations of substances which correspond to the criteria in 15A NCAC 02L .0202(d):

(1) U.S. EPA Integrated Risk Information System
(2) U.S. EPA Office of Drinking Water Health Advisories
(3) Other health risk assessment data published by the U.S. EPA
(4) Other relevant, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

U.S. EPA's Office of Water established an oral reference dose (RfD) of 0.0000001 mg/kg-day for PFOS based on the developmental and cardiovascular endpoints of low birth weight and increased total cholesterol seen in epidemiological studies (U.S. EPA, 2024a). The RfD was derived by dividing the point of departure of 0.0000012 mg/kg-day by an uncertainty factor of 10 (10 for interspecies extrapolation) (U.S. EPA, 2024a). A systemic threshold concentration of 0.7 ng/L or parts per trillion (ppt) can be calculated using the oral reference dose for PFOS in accordance with 15A NCAC 02L .0202(d)(1).

U.S. EPA has classified PFOS for carcinogenicity as "likely to be carcinogenic to humans" and produced a cancer potency factor (CPF) of 39.5 mg/kg-day based on hepatocellular adenomas and carcinomas in female rats (U.S. EPA, 2024a). Therefore, a human exposure concentration associated with an incremental lifetime cancer risk estimate of 1×10^{-6} can be calculated according to the requirements 15A NCAC 02L .0202(d)(2) and results in a groundwater standard of 0.9 ng/L or ppt.

U.S. EPA established a maximum contaminant level (MCL) of 4 ng/L or ppt for PFOS in April 2024 (EPA, 2024b).

Health Effects Summary

Adverse health effects were identified in rodents receiving oral doses of PFOS. The rodents exposed to PFOS exhibited adverse cardiovascular, and developmental effects (U.S. EPA, 2024a). The adverse human health effects associated with low, oral environmental exposures to PFOS are derived from epidemiology studies. The adverse health effects identified in humans are increased cholesterol and increased hepatic proteins (U.S. EPA, 2024a).

Uses and Occurrence

PFOS was the key ingredient in stain repellents, fire-fighting foams, surfactants used in electroplating, cleaning products, metal surfaces, and carpet treatments (U.S. EPA, 2024a). PFOS occurs in North Carolina's surface water and other environmental media (DEQ, 2021).

References

- **U.S. EPA. (2024a).** Human Health Toxicity Assessment for Perfluorooctane Sulfonic Acid (PFOS) and Related Salts.U.S. Environmental Protection Agency Office of Water. EPA Document Number: 815R24007. PFOS Toxicity Assessment
- **U.S. EPA. (2024b).** Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation. https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas
- **DEQ. (2021)**. PFAS in NC presentation to the NC Secretaries' Science Advisory Board on August 2, 2021. Presentation (nc.gov)

North Carolina Groundwater IMAC

Perfluorooctanesulfonic acid (PFOS) CASRN 1763-23-1

North Carolina Ground Water (GW) IMAC = 0.7 ng/L*

GW IMAC based on noncancer endpoint

GWQS = [(RfD x WT x RSC) / WI] * 1000

RfD = reference dose[1]	1.0E-07	mg/kg/day	
WT = average adult human body weight[2]	70	kg	
RSC= relative source contribution	0.2	unitless value	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using noncancer endpoint	**0.00070**	**µg/L (ppb)**	**0.7 ng/L (ppt)**

GW IMAC based on cancer endpoint

GWQS = [(RL x WT) / (q1* x WI)] * 1000

RL = risk level	1.0E-06		
WT = average adult human body weight[2]	70	kg	
q1* = carcinogenic potency factor (slope factor)[1]	39.5	$(mg/kg/day)^{-1}$	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using cancer endpoint	**0.0008861**	**µg/L (ppb)**	**0.89 ng/L (ppt)**

GW IMACs based on published values

Taste Threshold	**NA**	**µg/L**	
Odor Threshold	**NA**	**µg/L**	
Maximum Contaminant Level (MCL)[4]	**0.004**	**µg/L**	**4 ng/L (ppt)**
Secondary Drinking Water Standard (SMCL)	**NA**	**µg/L**	

References

[1] U.S. EPA. (2024). Human Health Toxicity Assessment for Perfluorooctane Sulfonic Acid (PFOS) and Related Salts. Office of Water. EPA Document Number: 815R24007. https://www.epa.gov/system/files/documents/2024-04/main_final-toxicity-assessment-for-pfos_2024-04-09-refs-formatted_508c.pdf

[2] Average adult body weight from 15A NCAC 02L .0202 (effective date April 1, 2022).

[3] Average water consumption from 15A NCAC 02L .0202 (effective date April 1, 2022).

[4] U.S. EPA. (2024). Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation. https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas

*Rounded using conventions from EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (Office of Water, EPA 822-B-00-004, October 2000)

ppb= parts per billion

ppt= parts per trillion

NA = Not available

RSC = 0.1 for nonorganics, 0.2 for organics

Groundwater IMAC Summary Document
Division of Water Resources

Perfluorooctanoic Acid (PFOA) (CASRN: 335-67-1)

Recommended Groundwater IMAC

Groundwater standards are to be the "lesser of" the criteria in 15A NCAC 02L .0202(d)(1-6):

(1) Systemic threshold concentration
(2) Concentration that corresponds to an incremental lifetime cancer risk of $1x10^{-6}$
(3) Taste threshold limit value
(4) Odor threshold limit value
(5) Maximum contaminant level
(6) National secondary drinking water standard

The recommended groundwater IMAC for **PFOA** is **0.001 ng/L** based on its chronic drinking water concentration corresponding to an incremental lifetime cancer risk of 1×10^{-6}.

Data used for Groundwater IMAC

The following references, in order of preference, are used in establishing concentrations of substances which correspond to the criteria in 15A NCAC 02L .0202(d):

(1) U.S. EPA Integrated Risk Information System
(2) U.S. EPA Office of Drinking Water Health Advisories
(3) Other health risk assessment data published by the U.S. EPA
(4) Other relevant, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

U.S. EPA's Office of Water established an oral reference dose (RfD) of 0.00000003 mg/kg-day for PFOA based on endpoints of decreased anti-tetanus and anti-diphtheria antibody concentrations in human children, low birth weight in human infants, and increased total cholesterol in human adults seen in epidemiological studies (U.S. EPA, 2024a). The RfD was derived by dividing the point of departure of 0.000000275 mg/kg-day by an uncertainty factor of 10 (10 for interspecies extrapolation) (U.S. EPA, 2024a). A systemic threshold concentration of 0.2 ng/L or parts per trillion (ppt) can be calculated using the oral reference dose for PFOA in accordance with 15A NCAC 02L .0202(d)(1).

U.S. EPA has classified PFOA for carcinogenicity as "likely to be carcinogenic to humans" and produced a cancer potency factor (CPF) of 0.0293 ng/kg-day based on renal cell carcinomas in human males seen in an epidemiological study (U.S. EPA, 2024a). Therefore, a human exposure concentration associated with an incremental lifetime cancer risk estimate of 1×10^{-6} can be calculated according to the requirements of 15A NCAC 02L .0202(d)(2) and results in a groundwater standard of 0.001 ng/L or ppt.

U.S. EPA established a maximum contaminant level (MCL) of 4 ng/L or ppt for PFOA in April 2024 (U.S. EPA, 2024b).

Health Effects Summary

Adverse health effects were identified in rodents receiving oral doses of PFOA. The rodents exposed to PFOA exhibited adverse immune, cardiovascular, hepatic, and developmental effects (U.S. EPA, 2024a). The adverse human health effects associated with low, oral environmental exposures to PFOA are derived from epidemiology studies. The adverse health effects identified in humans are increased cholesterol and increased hepatic proteins (U.S. EPA, 2024a).

Uses and Occurrence

PFOA is used in stain-resistant carpet, water-repellent clothes, paper and cardboard packaging, ski wax, foams used to fight fires, and non-stick cookware and has been manufactured as a polymer processing aid up until 2009 (U.S. EPA, 2024a). PFOA occurs in North Carolina's surface water and other environmental media (DEQ, 2021).

References

- **U.S. EPA. (2024a).** Human Health Toxicity Assessment for Perfluorooctanoic Acid (PFOA) and Related Salts, U.S. Environmental Protection Agency. Office of Water. EPA Document Number: 815R24006. PFOA Toxicity Assessment
- **U.S. EPA. (2024b).** Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation. https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas
- **DEQ. (2021)**. PFAS in NC presentation to the NC Secretaries' Science Advisory Board on August 2, 2021. Presentation (nc.gov)

North Carolina Groundwater IMAC

Perfluorooctanoic acid (PFOA) CASRN 335-67-1

North Carolina Ground Water (GW) IMAC = 0.001 ng/L*

GW IMAC based on noncancer endpoint

GWQS = [(RfD x WT x RSC) / WI] * 1000

RfD = reference dose[1]	3.0E-08	mg/kg/day	
WT = average adult human body weight[2]	70	kg	
RSC= relative source contribution	0.2	unitless value	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	1000	µg/mg	
Calculated GW Standard using noncancer endpoint	**0.00021**	**µg/L (ppb)**	**0.21 ng/L (ppt)**

GW IMAC based on cancer endpoint

GWQS = [(RL x WT) / (q1* x WI)] * 1000

RL = risk level	1.0E-06		
WT = average adult human body weight[2]	70	kg	
q1* = carcinogenic potency factor (slope factor)[1]	0.0293	$(ng/kg/day)^{-1}$	
WI = average daily adult human water intake[3]	2	L/day	
1000 = conversion factor	0.001	µg/ng	
Calculated GW Standard using cancer endpoint	**0.0000012**	**µg/L (ppb)**	**0.0012 ng/L (ppt)**

GW IMACs based on published values

Taste Threshold	**NA**	**µg/L**	
Odor Threshold	**NA**	**µg/L**	
Maximum Contaminant Level (MCL)[4]	**0.004**	**µg/L**	**4 ng/L (ppt)**
Secondary Drinking Water Standard (SMCL)	**NA**	**µg/L**	

References

[1] U.S. EPA. (2024). Human Health Toxicity Assessment for Perfluorooctanoic Acid (PFOA) and Related Salts, U.S. Environmental Protection Agency. Office of Water. EPA Document Number: 815R24006.

[2] Average adult body weight from 15A NCAC 02L .0202 (effective date April 1, 2022).

[3] Average water consumption from 15A NCAC 02L .0202 (effective date April 1, 2022).

[4] U.S. EPA. (2024). Per- and Polyfluoroalkyl Substances (PFAS) Final PFAS National Primary Drinking Water Regulation.

*Rounded using conventions from EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (Office of Water, EPA 822-B-00-004, October 2000)

ppb= parts per billion
ppt= parts per trillion
NA = Not available
RSC = 0.1 for nonorganics, 0.2 for organics