As presented to the Science Advisory Board on 6/7/2021.
Prepared by Dr. Frannie Nilsen, Environmental Toxicologist, DEQ.

Most commonly occurring PFAS in NC~						
PFAS Compound	PFAS Group	Media	Available Data			Regulated or Guidance in Other States?
			Bioactivity by Group	Toxicity		
				Non- Mammalian	Mammalian	
PFOS	Sulfonic Acids	DW, SW, Serum, Air	Yes[1]	Yes[2–4]	Yes[4–6]	Many[7]
PFBS		DW, SW	Yes[1]	Yes[8–10]	Yes[5]	MI, MN,
PFHxS		DW, Serum	Yes[1]	Yes[2,3]	Yes[11]	Many[7]
PFOA	Carboxylic Acids	DW, SW, Serum, Air	Yes[1]	Yes[2–4,12,13]	Yes [4,5,14,15]	Many[7]
PFBA		DW, SW, Air	Yes[1]	Yes[12,13,16]	Yes[5]	MN^
PFPeA		DW, SW, Air	Yes[1]	Yes[12]	Yes[5,15]	None^
PFHxA		DW, SW, Serum	Yes[1]	Yes[3,12,16]	Yes[5,15]	MI
PFHpA[$]		DW, SW, Serum	Yes[1]	Yes[2,12]	Yes[15]	VT
PFDA		Serum	Yes[1]	Yes[12]	Yes[5]	MA
PFMOPrA[$#]		Air	Yes[1]	No	Yes[17]	None
PFMOBA[$#]		Air	Yes[1]	No	Yes[17]	None
HFPO-DA (GenX)[$]	Ether Carboxylic Acids	DW, SW, GW, Air	Yes[1,18]	*	Yes [5,14,19]	MI, OH
PFMOAA[$]		DW, SW, GW, Air	Yes[1,18,20]	No	Yes[17,21]	None
PMPA[$#]		DW, SW	Yes[1,18,20]	No	No	None
PEPA[$#]		DW, SW	Yes[1,18,20]	No	No	None
PFO2HxA[$]		DW, GW, Air	Yes[1,18,20]	No	No	None
PFO3OA[$]		DW, SW, Air	Yes[1,18,20]	Yes[22]	No	None
PFO4DA[$]		DW, GW, Serum, Air	Yes[1,18,20]	Yes[22]	*	None
PFO5DA[$]		Air, Serum	Yes[1,18,20]	*	*	None
HydroEVE		Serum	Yes[1,18,20]	*	*	None
Nafion By-prod1[$]	Ether Sulfonic Acids	Air	Yes[1,20]	No	No	None
Nafion by-prod 2[$]		Surface Water, Serum	Yes[1,20]	*	Yes[23]	None

GW denotes Ground Water; SW denotes Surface Water; DW denotes Drinking Water. Bioactivity denotes *in vitro*, next-gen, or computational means of determining biochemical effects.

[1,20] – all PF ethers together; [18]- suggested for all PFECAs based on GenX; [5]- some based on read-across; [^]-Italy; *-forthcoming systematic reviews[24,25]; [#]-Chemours isomer pairs; [$]- Chemours Consent Order PFAS; ~-based on Dec 7, 2020 presentations and related publications.

References

1. Houck, K. A. *et al.* Bioactivity Profiling of Per-and Polyfluoroalkyl Substances (PFAS) Identifies Potential Toxicity Pathways Related to Molecular Structure. *Toxicology* 152789 (2021).
2. Menger, F., Pohl, J., Ahrens, L., Carlsson, G. & Örn, S. Behavioural effects and bioconcentration of per-and polyfluoroalkyl substances (PFASs) in zebrafish (Danio rerio) embryos. *Chemosphere* **245**, 125573 (2020).
3. Gaballah, S. *et al.* Evaluation of developmental toxicity, developmental neurotoxicity, and tissue dose in zebrafish exposed to GenX and other PFAS. *Environ. Health Perspect.* **128**, 047005 (2020).
4. Hekster, F. M., Laane, R. W. & De Voogt, P. Environmental and toxicity effects of perfluoroalkylated substances. *Rev. Environ. Contam. Toxicol.* 99–121 (2003).
5. Bil, W. *et al.* Risk assessment of per-and polyfluoroalkyl substance mixtures: A relative potency factor approach. *Environ. Toxicol. Chem.* **40**, 859–870 (2021).
6. Pedersen, K. E. *et al.* Brain region-specific perfluoroalkylated sulfonate (PFSA) and carboxylic acid (PFCA) accumulation and neurochemical biomarker responses in east Greenland polar bears (Ursus maritimus). *Environ. Res.* **138**, 22–31 (2015).
7. Kindschuh, J. & Lee, T. State-by-State Regulation of PFAS Substances in Drinking Water. *Bryan Cave Leighton Paisner* https://www.bclplaw.com/en-US/insights/state-by-state-regulation-of-pfas-substances-in-drinking-water.html (2021).
8. Chen, L. *et al.* Accumulation of perfluorobutane sulfonate (PFBS) and impairment of visual function in the eyes of marine medaka after a life-cycle exposure. *Aquat. Toxicol.* **201**, 1–10 (2018).
9. Ulhaq, M., Örn, S., Carlsson, G., Morrison, D. A. & Norrgren, L. Locomotor behavior in zebrafish (Danio rerio) larvae exposed to perfluoroalkyl acids. *Aquat. Toxicol.* **144**, 332–340 (2013).
10. Foguth, R., Sepúlveda, M. S. & Cannon, J. Per-and Polyfluoroalkyl Substances (PFAS) Neurotoxicity in Sentinel and Non-Traditional Laboratory Model Systems: Potential Utility in Predicting Adverse Outcomes in Human Health. *Toxics* **8**, 42 (2020).
11. Viberg, H., Lee, I. & Eriksson, P. Adult dose-dependent behavioral and cognitive disturbances after a single neonatal PFHxS dose. *Toxicology* **304**, 185–191 (2013).
12. Hoke, R. A., Bouchelle, L. D., Ferrell, B. D. & Buck, R. C. Comparative acute freshwater hazard assessment and preliminary PNEC development for eight fluorinated acids. *Chemosphere* **87**, 725–733 (2012).
13. Valsecchi, S. *et al.* Deriving environmental quality standards for perfluorooctanoic acid (PFOA) and related short chain perfluorinated alkyl acids. *J. Hazard. Mater.* **323**, 84–98 (2017).
14. Blake, B. E. *et al.* Evaluation of maternal, embryo, and placental effects in CD-1 mice following gestational exposure to perfluorooctanoic acid (PFOA) or hexafluoropropylene oxide dimer acid (HFPO-DA or GenX). *Environ. Health Perspect.* **128**, 027006 (2020).
15. Han, J.-S. *et al.* Subacute dermal toxicity of perfluoroalkyl carboxylic acids: comparison with different carbon-chain lengths in human skin equivalents and systemic effects of perfluoroheptanoic acid in Sprague Dawley rats. *Arch. Toxicol.* **94**, 523–539 (2020).
16. Mahapatra, C. T. *et al.* Comparative in vitro toxicity assessment of perfluorinated carboxylic acids. *J. Appl. Toxicol.* **37**, 699–708 (2017).

17. Woodlief, T., Vance, S., Hu, Q. & DeWitt, J. Immunotoxicity of Per-and Polyfluoroalkyl Substances: Insights into Short-Chain PFAS Exposure. *Toxics* **9**, 100 (2021).
18. Gebreab, K. Y. *et al.* Comparative toxicometabolomics of perfluorooctanoic acid (PFOA) and next-generation perfluoroalkyl substances. *Environ. Pollut.* **265**, 114928 (2020).
19. Conley, J. M. *et al.* Adverse maternal, fetal, and postnatal effects of hexafluoropropylene oxide dimer acid (GenX) from oral gestational exposure in Sprague-Dawley rats. *Environ. Health Perspect.* **127**, 037008 (2019).
20. Cheng, W. & Ng, C. A. Using machine learning to classify bioactivity for 3486 per-and polyfluoroalkyl substances (PFASs) from the OECD list. *Environ. Sci. Technol.* **53**, 13970–13980 (2019).
21. Vance, S. 30-Day Immunotoxicity Study of PFMOAA in C57BL/6 Mice. (2019).
22. Wang, J. *et al.* Perfluoropolyether carboxylic acids (novel alternatives to PFOA) impair zebrafish posterior swim bladder development via thyroid hormone disruption. *Environ. Int.* **134**, 105317 (2020).
23. Lang, J. R. *et al.* Toxicity of Balb-c mice exposed to recently identified 1, 1, 2, 2-tetrafluoro-2-[1, 1, 1, 2, 3, 3-hexafluoro-3-(1, 1, 2, 2-tetrafluoroethoxy) propan-2-yl] oxyethane-1-sulfonic acid (PFESA-BP2). *Toxicology* **441**, 152529 (2020).
24. Pelch, K. E., Reade, A., Wolffe, T. A. & Kwiatkowski, C. F. PFAS health effects database: Protocol for a systematic evidence map. *Environ. Int.* **130**, 104851 (2019).
25. Vendl, C. *et al.* Profiling Research on PFAS in Wildlife: Protocol of a Systematic Evidence Map and Bibliometric Analysis. (2021).