

Understanding of distribution and sources of polybrominated diphenyl ethers in the north and east of Great Slave Lake and coastal regions

Xing Song¹, Bing Chen^{1*}, Hongjie Wang¹, Alan Alex², Bruce Hanna³, Dayue Shang⁴, Wayne Langenhan², Darryl Bohnet², Vic Mercredi², Jessica Hurtubise⁵, Shawn Mckay⁶, Tas-Tsi Catholique⁷, Baiyu Zhang¹

1. Faculty of Engineering and Applied Science, Memorial University of Newfoundland, St. John's, NL, Canada, A1B 3X5. [*bchen@mun.ca](mailto:bchen@mun.ca);

2. North Slave Métis Alliance, 32 Melville Drive, Yellowknife, NT, Canada. 3. Advisor, Regional Science Programs, Environment and Climate Change, Government of Northwest Territories.

4. Pacific and Yukon Laboratory for Environmental Testing, Pacific Environmental Science Centre, Environmental and Climate Change Canada. 5. Vice President of Business Development, Pisces Research Project Management, NT, Canada

6. Environment Coordinator, Fort Resolution Metis Government. Fort Resolution, NT, Canada. 7. Manager, Wildlife, Lands and Environment Department, Lutsel K'e Dene First Nation, NT, Canada.

INTRODUCTION

Polybrominated diphenyl ethers (PBDEs):

- Persistent, bio-accumulative, and toxic chemical products
- widely used in household, commercial and industrial activities
- severe negative impacts on community health and ecological systems (The international Joint Commission, 2016; Sun et al., 2022)

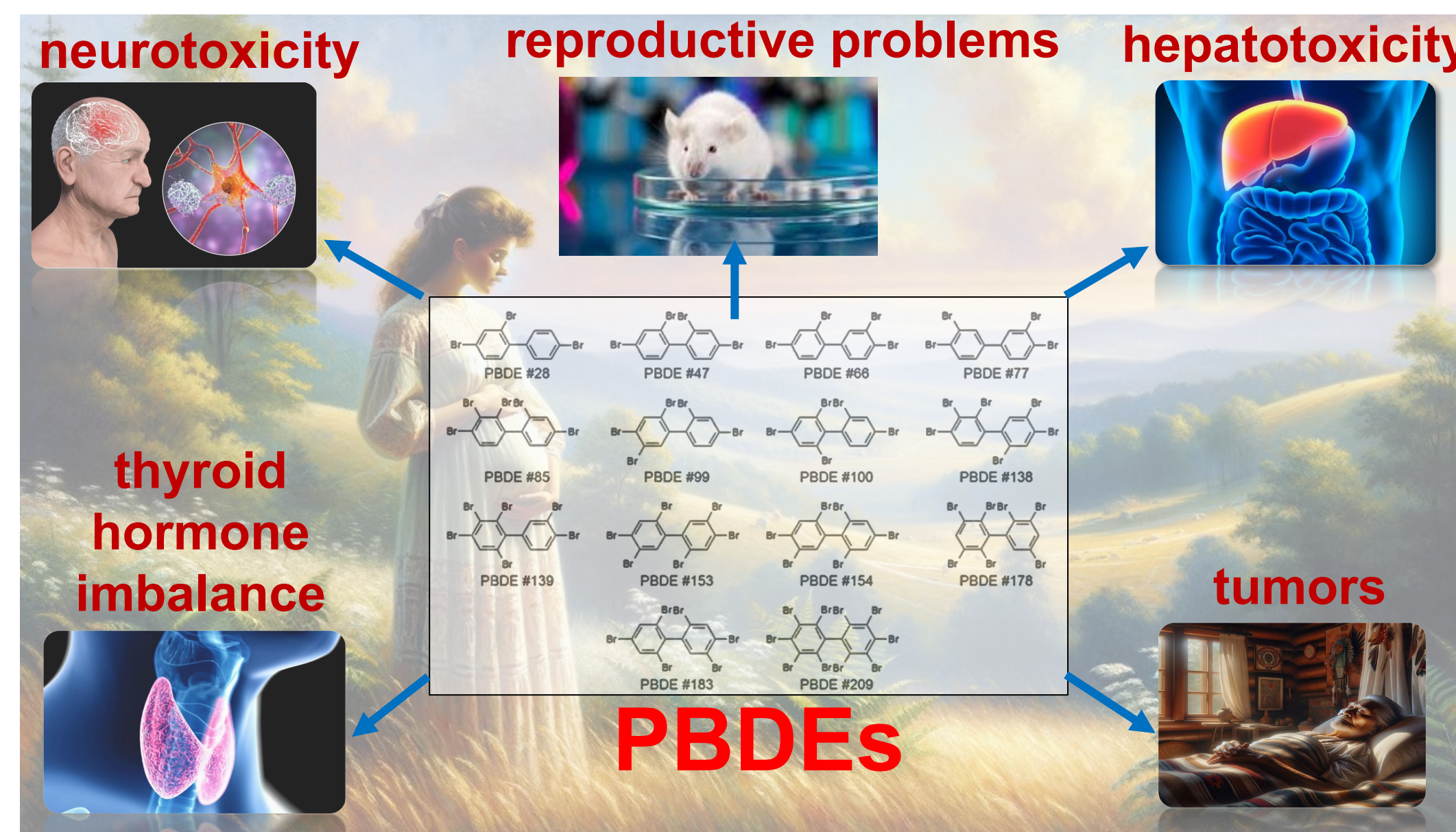


Figure 1. PBDE Congeners and Their Health Risks

METHODOLOGY

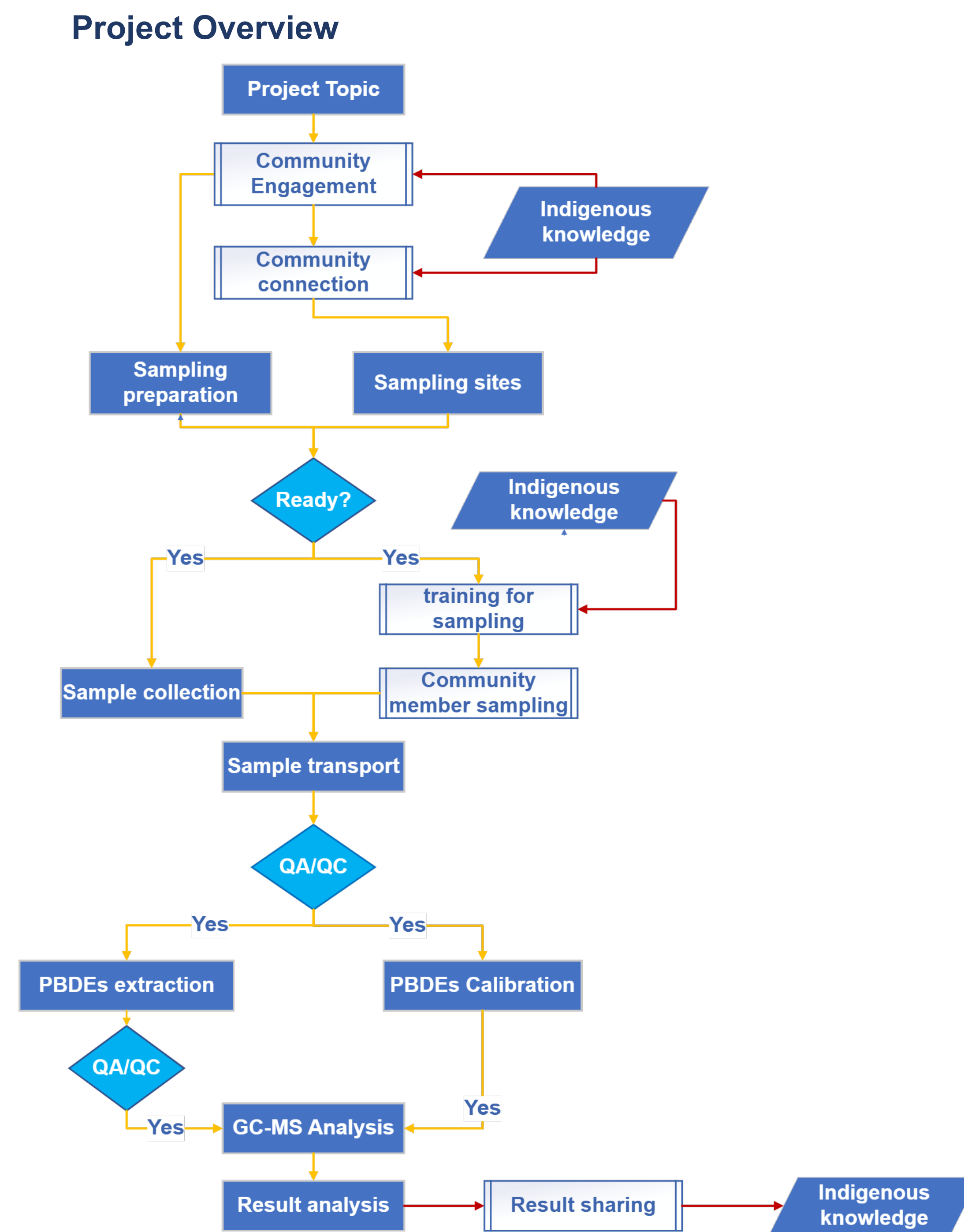


Figure 3 Project workflow

Sampling activities in 2023



Figure 4 Sampling site

Lab work and data analysis – ongoing as of January 2024

PBDEs extraction: ASE method (Wang et al. 2020; Xu et al., 2023)

PBDEs GC-MS/MS analysis (Santini et al., 2024)



Figure 5. PBDEs analysis using GC-MS/MS

RESULTS (as of January 2024)

- **Variable PBDE Levels:** Found PBDEs concentrations ranging from 0.5 to 90 ng/L across local waters, highlighting significant variability.
- **Exceeding Guidelines:** Detected BDE-47 and BDE-100 surpass national quality standards, requiring targeted action.
 - Detected average **BDE-47: 34.7 ng/L**; (144%)
Federal Environmental Quality Guidelines: **24 ng/L**.
 - Detected average **BDE-100: 2.96 ng/L**; (12800%)
Federal Environmental Quality Guidelines: **0.023 ng/L**.
- **Widespread Detection:** PBDEs were found in 30 of 34 water samples, indicating prevalent pollution.
- **Pending Analysis (as of January 2024):** Soil water samples and 20+ water samples are still being extracted and analyzed for PBDEs, with final results yet to clarify the full extent.

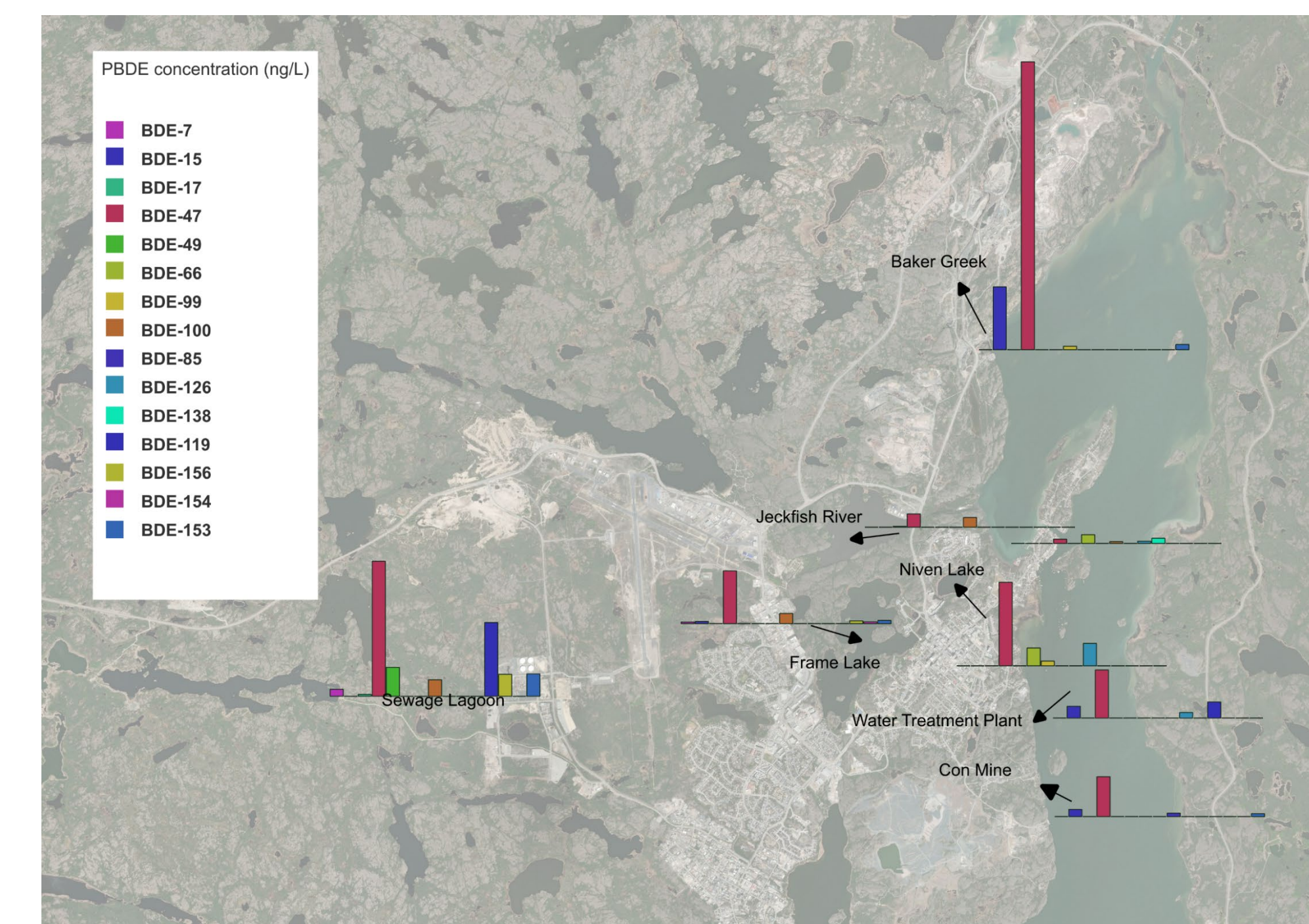


Figure 6 PBDEs distribution in Yellowknife

Capacity Building

- **Community Engagement Success:** Integrated Indigenous knowledge with active community participation.
- **Indigenous Knowledge Utilization:** Applied Indigenous insights for targeted, effective sampling.
- **Community Member Training:** Enhanced local capacity with environmental training.
- **Collaboration and Partnership Achievements:** Fostered long-term environmental protection partnerships.



Figure 7 Field sampling and training in 2023



Figure 7 Field sampling and training in 2023

SUMMARY

Current Summary Highlights:

- **PBDEs Insights:** Mapped PBDEs concentrations, identifying areas above safety thresholds.
- **Community Training:** Boosted local engagement through environmental sampling training.
- **Partnership:** Established a vital partnership with NSMA and associated communities surrounding the Great Slave Lake, boosting research and collaboration.

Future Steps:

- **Finalize Analysis:** To complete PBDEs level examination (remaining water, biota, and soil samples)
- **Call for Extended Monitoring:** Advocate for the necessity of long-term monitoring programs for a broader range of **emerging pollutants** to safeguard environmental and public health.

ACKNOWLEDGMENTS

With heartfelt gratitude, we extend our thanks to:

- The Northern Contaminants Program (NCP) for the financial support.
- LauraJane Michel in Lutsel K'e Dene First Nation for her traditional knowledge and guidance on sampling in Lutsel K'e.
- The landfills and solid waste management teams of the communities: Yellowknife, Enterprise, Hay River, Fort Resolution, and Fort Providence, for their generous support and assistance in sampling.

REFERENCES:

- The International Joint Commission, 2016. Polybrominated Diphenyl Ethers (PBDEs) in the Great Lakes Basin. Cat. No.:978-0-660-06807-7.
- Sun, H., Li, Y., Wang, P., Yang, R., Pei, Z., Zhang, Q., & Jiang, G. (2022). First report on hydroxylated and methoxylated polybrominated diphenyl ethers in terrestrial environment from the Arctic and Antarctica. Journal of Hazardous Materials, 424, 127644.
- Santini, S., Bains, M., Martellini, T., Bissoli, M., Galli, M., Concato, M., ... & Cincinelli, A. (2024). Novel ultrasound assisted extraction and d-SPE clean-up for the analysis of multiple legacy and emerging organic contaminants in edible fish. Food Chemistry, 138582.
- Król, S., Zabiegała, B., & Namieśnik, J. (2012). PBDEs in environmental samples: sampling and analysis. Talanta, 93, 1-17.
- Xu, S., Wang, J., Deng, D., Sun, Y., Wang, X., & Zhang, Z. (2023). A pretreatment method combined matrix solid-phase dispersion with dispersive liquid-liquid micro-extraction for polybrominated diphenyl ethers in vegetables through quantitation of gas chromatography-tandem mass spectrometry (GC-MS). RSC advances, 13(23), 15772-15782.

Problems and research gap:

- Great Slave Lake Pollution: Elevated PBDEs, lacking climate-linked monitoring.
- Needs focused study on sources, impacts in Great Slave Lake area.
- Our Significance: To protect ecosystems, health in Great Slave Lake through targeted PBDE research.



Figure 2. Possible PBDEs transport pathways

OBJECTIVES

- **Monitor PBDEs Pollution:** Track and document PBDE pollution trends in Great Slave Lake.
- **Measure PBDEs Levels:** Conduct detailed sampling to map PBDE distribution and concentration.
- **Train Indigenous Samplers:** Educate community members on environmental sampling, enhancing local monitoring capabilities.
- **Use Insights for Management:** Utilize findings to refine PBDEs management strategies for community well-being and environmental sustainability.