

Coastal Environmental Baseline Program: Baseline Mercury Levels in Frobisher Bay Fish and Invertebrates

1. Organization Information	
1.1 Legal Name (Organization's registered corporate name) and Address of the Organization	
<p>Organization's registered corporate name: University of Waterloo</p> <p>Complete Address: Department of Biology, University of Waterloo, 200 University Ave. West, Waterloo, ON, N2L 3G1</p>	
1.2 Project Team Lead <i>Name, Title, Full Address, Phone #, email address</i>	1.3 Media Relations Contact (for the purpose of press releases, announcements, etc.) <i>Name, Title, Full Address, Phone #, email address</i>
<p>Name: M. Power & H. Swanson</p> <p>Position title: Professors</p> <p>Organization Name: Dept. of Biology, University of Waterloo</p> <p>Organization Address: 200 University Ave. West, Waterloo, ON, N2L 3G1</p> <p>Phone Number: 519-888-4567</p> <p>Power (x32595) Swanson (x37387)</p> <p>Email: m3power@uwaterloo.ca</p> <p style="text-align: center;">heidi.swanson@uwaterloo.ca</p>	<p>Name: Katharine Tuerke</p> <p>Position title: Communication Officer</p> <p>Organization Name: Faculty of Science, University of Waterloo</p> <p>Organization Address: 200 University Ave. West, Waterloo, ON, N2L 3G1</p> <p>Phone Number: 519-888-4567 (x39173)</p> <p>Email: katharine.tuerke@uwaterloo.ca</p>
1.4 Organization Type Select one: <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Canadian post-secondary academic institution <input type="checkbox"/> Canadian non-governmental organization <input type="checkbox"/> Indigenous organizations or groups <input type="checkbox"/> Canadian provincial, territorial, and municipal government 	

- ☐ Business and industry, including business and industry associations
- ☐ Community group
- ☐ Foreign Government
- ☐ Foreign Organization
- ☐ Foreign University
- ☐ Port Authority
- ☐ Other: *Specify*

2. Project Team

2.1 Provide for each team member of the proposed project the information as per the table below starting with the project leader (if more than three members, provide the same information for each additional member on a separate page)

Name: Michael. Power Position title: Professor Organization Name: Dept. of Biology, University of Waterloo Organization Address: 200 University Ave. West, Waterloo, ON, N2L 3G1 Phone Number: 519-888-4567 x32595 Email: m3power@uwaterloo.ca	Name: Heidi Swanson Position title: Professor Organization Name: Dept. of Biology, University of Waterloo Organization Address: 200 University Ave. West, Waterloo, ON, N2L 3G1 Phone Number: 519-888-4567 x37387 Email: heidi.swanson@uwaterloo.ca	<i>Name, Title, Full Address, Phone #, email address</i>
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2.2 Name Fisheries and Oceans Canada personnel consulted in developing the proposed project

Name: Ashley Stasko Position title: Arctic Aquatic Biologist Region: Central and Arctic Phone Number: 204-983-5252 Email: ashley.stasko@dfo-mpo.gc.ca	Name: Chris Lewis Position title: Aquatic Science Biologist Region: Northern Operations Phone: 867-979-8002	<i>Name, Title, Full Address, Phone #, email address</i>
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	Email: Christopher.Lewis@dfo-mpo.gc.ca	
3. The Project		
3.1 Project Title		
Coastal Environmental Baseline Program: Baseline Mercury Levels in Frobisher Bay fish and invertebrates		
3.2 Project start and end dates (SEE SECTION 2 OF THE ANNEX)		
Project start date (dd/mm/yyyy)	Project end date (dd/mm/yyyy)	
01/05/2019	31/03/2022	
3.3 Project location		
Identify the <u>PRINCIPAL</u> province/territory where the project activities will take place.		
Nunavut (within the Baseline pilot area of Iqaluit)		
3.4 Project relevance to Fisheries and Ocean Canada Program Areas		
Select the <u>PRINCIPAL program area</u> relevant to the proposal (Only ONE program area should be selected) among those listed below		
<u>Fisheries</u>		
<input type="checkbox"/> Aquatic Animal Health Science		
<input type="checkbox"/> Biotechnology and Genomics		
<input type="checkbox"/> Aquaculture Science		
<input type="checkbox"/> Fisheries Science		
<u>Aquatic Ecosystems</u>		
<input checked="" type="checkbox"/> Ecosystems Assessment		
<input type="checkbox"/> Oceans and Climate Change Science		
<input type="checkbox"/> Oceanography		
<input type="checkbox"/> Aquatic Invasive Species Science		
<input type="checkbox"/> Species at Risk Science		
<u>Marine Navigation</u>		
<input type="checkbox"/> Hydrography		

Explain the relevance of the proposed project to the **program area that was selected**.

This project will enable the collection of coastal environmental baseline data, specifically that related to mercury in local biota, to aid in characterizing the current state of the ecosystem in Frobisher Bay. The project will also contribute to the capacity building of key parties in and around Iqaluit to collect environmental data as part of the implementation of the Oceans Protection Plan. Results will not only provide an open source of data that can be used to characterize Frobisher Bay marine ecosystem, but may also support evidence-based decision making (such as assessments for marine spatial planning around conservation, cumulative effects, etc.).

3.5 Project Description (max. 800 words¹)

This project will involve sampling and analysis of target components and features, including benthic invertebrates and fishes, of the local coastal ecosystem of Frobisher Bay. Data collection is designed to inform and characterize the current status of contaminants, namely mercury, in species in an understudied northern coastal ecosystem. This project is expected to strengthen Canada's capacity for oceans science and contribute to oceans scientific data collection in coastal areas of existing or potential commercial and subsistence interest. This project will also build technical and scientific capacity of key parties and other coastal organizations.

This project will specifically measure concentrations of total mercury (THg) and methyl mercury (MeHg) in bivalves (e.g. clams up to 30), other benthic invertebrates (e.g., starfish, decapod crustaceans, barnacles up to 30 for ~4 species), Arctic cod (up to 100), and other forage fish species (e.g., fourhorned and Arctic sculpin, up to 100 total), and anadromous Sylvia Grinnell Arctic Char (up to 200, including historical samples). Mercury (Hg) contamination is a continuing threat to the health of Arctic ecosystems and inhabitants who rely on country foods. Measuring THg, MeHg, and food web biomarkers in anadromous Arctic Char, key prey, as well as other components of the lower food web will identify pathways of dietary Hg exposure to anadromous Arctic Char. Further insight will be gained by comparing the feeding and contaminant dynamics of anadromous Arctic Char to truly marine fishes (e.g., Arctic Cod and marine sculpins). Finally, descriptions of baseline conditions will provide standards against which future changes may be assessed.

3.6 Project Objectives and Anticipated Benefits (*in point form*)

The objectives and anticipated benefits of this project are designed to:

- Build capacity of graduate students, and Iqaluit Hunter and Trapper Association to characterize ecosystem and oceanographic processes in Frobisher Bay
- Support evidence-based management decisions and conservation of marine ecosystems
- Improve the ability to detect changes in the environment over time
- Strengthen Canada's capacity for oceans science
- Increase confidence in data collection methods and procedures

In addition to providing data to assess Hg-related consumption risks, the project will seek to provide a mechanistic understanding of how the feeding behaviours of predatory fishes affect their contaminant loads, and will test the hypothesis that greater use of pelagic marine resources (i.e. reliance on foodchains driven by

¹ DFO reserves the right to request additional information on the project

zooplankton) leads to higher THg and MeHg concentrations. This will lead to a better understanding of which pathways of dietary Hg exposure have the greatest risks of THg exposure.

3.7 Project Expected Results *(qualitative, quantitative or both)*

The expected results of this project are:

- Establish technical and scientific capacity for key parties to collect data in coastal ecosystems (qualitative)
- Improved understanding of existing environmental ecosystem conditions, namely levels of THg in key fish species resident in Frobisher Bay (qualitative and quantitative)
- Improved ability to detect temporal ecosystem changes in as a result of changing climates and/or increased human use of the bay (quantitative)
- Advance the use of open data by ensuring that resulting data, which is not subject to privacy specifications, are uploaded and available via a designated online repository
- Development and delivery of a plain-language (with translated posters) summary of research findings

3.8 Project Workplan *(Describe the main project activities, timelines and milestones)*

Timelines	Activities	Milestones
May - June 2019	Project Planning and Implementation (including Data Collection Preparation)	<ul style="list-style-type: none"> • Select and analyze samples from 2018 surveys • Finalize survey methods, survey schedule and site selection for field season 2019 • Graduate student begins program/project work
July - September 2019	Data Collection and Data Entry	<ul style="list-style-type: none"> • Conduct data collection surveys • Progress Report (qualitative) at 6 month mark of Project
October - December 2019	Data Collection, Data Entry and Data Analysis	<ul style="list-style-type: none"> • Sample processing • Data Entry, Validation and Analysis
January - March 2020	Program completion (Year 1) and evaluation/ Project planning for Year 2	<ul style="list-style-type: none"> • Ensure all samples are processed, analyzed, and stored/disposed of properly • Ensure all data is entered into online database • Submit Summary Report for Year 1

		<ul style="list-style-type: none"> • Program evaluation and planning for field season 2020
April - June 2020	Project Planning and Implementation (including Data Collection Preparation)	<ul style="list-style-type: none"> • Finalize survey methods, survey schedule and site selection for field activities in 2020
July - September 2020	Data Collection and Data Entry	<ul style="list-style-type: none"> • Conduct any make-up data collection activities (as identified by data gap analysis)
October - December 2020	Data Collection, Data Entry and Data Analysis	<ul style="list-style-type: none"> • Sample processing • Data Entry, Validation and Analysis
January - March 2021	Program completion (Year 2) and evaluation/ Project planning for Year 3	<ul style="list-style-type: none"> • Ensure all samples are processed, analyzed and stored/disposed of properly • Undertake data analysis for Year 2 • Ensure all data is entered into online database • Submit Summary Report for Year 2
April 2021 – March 2022	Final data analysis, completion of deliverables	<ul style="list-style-type: none"> • Final analysis and preparation of student thesis • Final report • Translation of final deliverables • Graduate student thesis submission • Presentation of results to key partners

3.9 Project Methodology *(Outline the project methodology with appropriate discussion of uncertainties)*

Methods for sampling this project's specified target components and features, i.e., species for later contaminant analysis, will generally be based on the best available practices (e.g. Vander velden et al. 2013. Sci. Total Env. 444:531 that similarly worked in coastal marine environments of Baffin Island) to ensure standardized, replicable results. However, since community-based support will be requested for field collections, sampling methods will also be based on consultation with the community to adequately incorporate the interests and views of both those

parties and the Project Authority. The MSc student will be available to assist in sample collections, thereby facilitating reciprocal knowledge transfer between the student and the community. The MSc student will learn fishing techniques, history, and condition of the subsistence fishery from community members. Community members will gain experience in sampling for trophic biomarkers and contaminants. Curriculum materials and translated handouts (developed by Swanson for previous projects) regarding contaminants in the Arctic and community-driven contaminant survey will also be made available. For workshops, meetings, and training opportunities, the a plain-language (with translated posters) summary of research progress will be developed for distribution in Iqaluit.

Published, peer-reviewed collection and analysis techniques (e.g. Power et al. 2002, J. Appl. Ecol. 39:819; Swanson et al. 2011, CJFAS 68:2002; van der Velden et al. 2013. Sci. Total Env. 444:531) will be used for mercury and stable isotope analysis (e.g. Guiguer et al. 2002. J. Fish Biol. 60:348; Swanson et al. 2015. Ecology 96:318). Stable isotope ratios of $\delta^{15}\text{N}$, $\delta^{13}\text{C}$ and $\delta^{34}\text{S}$ measured in consumer tissues (up to 150 Arctic Char, 100 Sculpin spp., will be used to infer trophic level, the relative extent of pelagic feeding, and use of marine versus freshwater resources, respectively. Stable isotope ratios will be measured using an elemental analyser coupled to a mass spectrometer at the certified Waterloo Environmental Isotopes Laboratory (University of Waterloo). Total Hg concentrations will be measured at the University of Waterloo on a Milestone Direct Mercury Analyzer, DMA-80, via thermal decomposition and atomic absorption spectroscopy as described in U.S. EPA method 7473. Concentrations of MeHg will be measured at the ISO-accredited Biotron Analytical Services Laboratory at Western University using U.S. EPA method 1630. All methods will follow QA/QC protocols as established by the National Contaminants Program.

3.10 Project Data Management

(a) Describe how data resulting from the project will be managed and made accessible to the public.
Data will be managed through an external data provider agreed upon by both Project Authority and DFO, and data will be made accessible via publications, reports and resulting datasets will made available in an external open data forum.

(b) Indicate whether or not the organization intends to share the data with DFO (data might be needed by DFO to monitor the progress of the project) ☒ Yes ☐ No