

Information Note
Department of Environment and Conservation

Title: Overview of the Provincial Government's involvement on Mercury and Associated Downstream Impacts in Relation to the Lower Churchill Project

Issue: To provide context on the Provincial Government's involvement thus far on mercury and associated downstream impacts in relation to the Lower Churchill Project.

Background and Current Status:

Project Overview:

- On March 15, 2012, Nalcor's Lower Churchill Generation Project was released from Environmental Assessment after a comprehensive independent panel review process.
- The Project was released subject to an extensive list of terms and conditions that required Nalcor to submit a variety of environmental protection plans, environmental effects monitoring plans, socio-economic benefits plan and the establishment of a community liaison committee, etc.
- Nalcor, in consultation with government departments, has received approval for the vast majority of the Environmental Assessment release conditions with the exception of:
 - Wetland / Riparian Compensation Plans
 - Human Health Risk Assessment Plan / Environmental Effects Monitoring Plan
- All regulatory approvals and Environmental Assessment release conditions are subject to aboriginal consultation prior to approval and issuance (30 days minimum consultation).
- Some key recommendations in the Panel report related to the mercury issue are:
 - Rec. #4.5 - Full clearing of the Muskrat Falls reservoir
Response: the Government of Newfoundland and Labrador agrees with the principle of maximizing the utilization of the forest resource. With limited opportunities to use the resource, and the likely insignificant reductions in mercury levels associated with full versus partial clearing, the Government supports partial harvesting of the flood zone. If an economic opportunity to use the resource materializes, consideration will be given to harvesting additional fibre.
 - Rec. #6.5 - Pilot study for methylmercury mitigation through soil removal
Response: the Government of Newfoundland and Labrador notes this recommendation is directed to Natural Resources Canada and Nalcor.
 - Rec. #13.9 - Possible requirement for consumption advisories in Goose Bay or Lake Melville
Response: the Government of Newfoundland and Labrador accepts the intent of this recommendation. If consumption advisories are required as a result of the downstream mercury assessment, then Nalcor should consult with downstream resource users on further mitigation measures, including the potential for compensation.
 - Rec. #15.5 - Lower Churchill Project Monitoring and Community Liaison Committee
Response: the Government of Newfoundland and Labrador accepts the intent of this recommendation to establish an Environmental Monitoring and Community Liaison Committee. As identified in the Governments' response to recommendation 15.1, a committee will be established by Nalcor to provide feedback and advice to the Proponent and Government on the effects of the Project. The Government is committed to ensuring consultation with affected Aboriginal groups, communities,

- and relevant stakeholders to address public concerns and communicate monitoring results.
- The Panel concluded that there will be significant adverse effects on:
 - Fish habitat and fish assemblage;
 - Riparian habitat;
 - Fishing and seal hunting in Lake Melville; and
 - One of the key findings of the panel review was regarding the issue of methylmercury accumulation in the reservoir due to flooding and the possibility of bio-accumulation in country foods (in particular fish and seals) in Lake Melville. The Nunatsiavut Government was particularly concerned with this issue claiming it may impact on their treaty fishing rights.
 - In July 2013, the Department of Environment and Conservation issued a permit to “Alter a Body of Water” to allow for the construction of a dam, powerhouse and other related infrastructure for the generation facility at Muskrat Falls. The Nunatsiavut Government applied to the courts to squash the permit claiming the province failed to consult and accommodate the Nunatsiavut Government with respect to the impacts of methylmercury accumulation in the water and henceforth on their treaty fishing rights.
 - On January 12, 2015, the Trial Division dismissed the application by the Nunatsiavut Government in favor of the province citing the matter was dealt with during the Environmental Assessment review process where the Nunatsiavut Government was fully engaged.

Mercury Information:

- Mercury (Hg) is a metal element found naturally in the environment.
- Traces of mercury are present in most foods, dental amalgams, and certain vaccines.
- Mercury is also present in the global atmosphere where it can be deposited either wet or dry on all water or land surfaces. It can also accumulate in the organic matter of forest litter and soils, and can migrate into the subsoil (and groundwater) or can be washed into lakes and streams.
- Low levels of mercury can be found in fish in pristine environments.
- Methylmercury is an organic chemical compound formed from inorganic mercury by anaerobic organisms in aquatic systems.
- Naturally occurring inorganic mercury is taken up by aquatic bacteria in oxygen depleted (anaerobic) environments and transformed to methylmercury by the process of methylation (see Figure 1, attached).
- Methylmercury is the most toxic form of mercury in the environment.
- When flooding occurs, mercury present in the submerged forest floor and vegetation is mobilized. The presence of organic matter (in the form of newly submerged vegetation) in combination with anaerobic conditions can stimulate microbial growth and lead to elevated methylmercury levels.
- Methylmercury production is supported by increased decomposition in flooded areas, resulting in more activity by microbes that methylate and more efficient ecosystem conversion of inorganic mercury into methylmercury.
- Methylmercury is taken up by fish and other aquatic species and not excreted but instead bio-accumulates in the tissue and can cause adverse human health effects which can result in consumption advisories.
- As per information from Health Canada: “...methylmercury is absorbed through the digestive tract and distributed throughout the body. It readily enters the brain, where it may

remain for a long period of time. In a pregnant woman, it can also cross the placenta into the fetus, building up in the fetal brain and other tissues. Methylmercury can also be passed to the infant through breast milk. A child's developing nervous system is particularly sensitive to methylmercury. Depending on the level of exposure, the effects can include a decrease in I.Q., delays in walking and talking, lack of coordination, blindness and seizures. In adults, extreme exposure can lead to health effects such as personality changes, tremors, changes in vision, deafness, loss of muscle coordination and sensation, memory loss, intellectual impairment, and even death.”

- Mercury in fish from the Churchill River system in Labrador has been studied for over thirty years since the creation of the Smallwood Reservoir. Mercury levels in most species in the Churchill River were elevated immediately following impoundment and have since declined as have the levels in several estuarine species.
- Species studied in the Churchill River system (from reservoir to estuary) were as follows: lake whitefish, brook trout, white sucker, longnose sucker, lake trout, northern pike, rainbow smelt, tomcod, and sea trout.
- To date, there are only three fish consumption advisories on the Churchill River System (Smallwood Reservoir, Lobstick Forebay, and Churchill River between the tailrace and the outflow of Lake Winokapau) for lake trout and northern pike species.

Monitoring Commitments:

- Nalcor has invested in downstream aquatic baseline augmentation and monitoring programs for fish and seal health in the river and downstream to Lake Melville. These baseline efforts will continue until the reservoir is created.
- All monitoring plans will be described in the Fish Habitat and Compensation Plan and Aquatic Environmental Effects Monitoring Plan. This process is regulated by Fisheries and Oceans Canada and approved through a *Fisheries Act* authorization.
- Nalcor has submitted a Human Health Risk Assessment Plan/ Environmental Effects Monitoring Plan for review. The purpose of the Human Health Risk Assessment Plan is to outline the key tasks and activities that will occur as part of Nalcor's commitments and requirements in relation to conducting a final baseline pre-inundation Human Health Risk Assessment that focuses on human exposures and risks to mercury (Hg) and methylmercury (MeHg) in key country food items. The Human Health Risk Assessment Plan is intended to serve as a general framework or process document for the key components of the baseline Human Health Risk Assessment program, which includes a dietary survey (DS) and a human biomonitoring program, in addition to the Human Health Risk Assessment study itself.
- In addition to Nalcor's monitoring, the Water Resources Management Division is monitoring water on a real-time basis (Lake Melville – water quantity; English Point – water quantity/quality). Grab samples for full suite of physical and chemical parameters (including total mercury) are collected approximately four times per year (in the open water season) at both stations. To date total mercury results are below detection limit.
- The Nunatsiavut Government is concerned with bioaccumulation of methylmercury in traditional food sources (fish and seal).
- They are partnering with scientists from Memorial University, Harvard and ArcticNet to monitor the water quality in Lake Melville for potential changes during the Muskrat Falls hydroelectric project.
- The Harvard study entitled “Freshwater Discharges Drive High Levels of Methylmercury in Arctic Marine Biota” was recently released in fall 2015.

Analysis:

- A technical meeting was held in 2012 that was attended by senior officials from the Nunatsiavut Government and the Department of Environment and Conservation. This meeting discussed the planned research study by Harvard.
- Two Ministerial level meetings were held on January 9, 2013 to discuss potential funding for Lake Melville research and monitoring program. The first meeting was between Honourable Tom Hedderson (then Minister of Environment and Conservation) and Honourable Darryl Shiwak followed by a second meeting between Honourable Tom Marshall (then Minister of Natural Resources) and Honourable Darryl Shiwak. A follow-up letter, dated March 1, 2013, from Honourable Tom Marshall to Honourable Darryl Shiwak, indicated that there was no funding available to assist the Nunatsiavut Government with its research and monitoring program.
- A meeting was held on October 30, 2015 to discuss Harvard research findings from the paper entitled “Freshwater Discharges Drive High Levels of Methylmercury in Arctic Marine Biota”. This meeting was attended by senior officials from Labrador and Aboriginal Affairs, the Department of Environment and Conservation and the Nunatsiavut Government. At this meeting, the senior officials from the Nunatsiavut Government provided a presentation that focused on the downstream aspects of the development and the outcomes of the Harvard research study. The Nunatsiavut Government requested the following (since reiterated in a letter from Minister Shiwak to the Deputy Minister of Environment and Conservation, who has requested a meeting with the Minister of Environment and Conservation post-election) to reduce impacts of methylmercury contamination in Lake Melville on Inuit health and rights:
 - **Fully clear the future Muskrat Falls reservoir** area of wood, brush and vegetation before flooding to reduce methylmercury inputs downstream into Inuit territory, consistent with recommendation 4.5 of the Joint Review Panel.
 - **Negotiate an Impact Management Agreement** with the Nunatsiavut Government before Muskrat Falls flooding and subsequent damaging downstream impacts occur, consistent with recommendation 13.9 of the Joint Review Panel.
 - **Establish an independent Expert Advisory Committee** of recognized academic experts to advise on the design of and audit, a rigorous, credible, and predictive monitoring program for downstream impacts of Muskrat Falls on the environment and health, using the best available knowledge (science and traditional).
 - **Grant Inuit joint decision-making authority over downstream environmental monitoring and management** of the Lower Churchill project.
- Provincial officials communicated that they are still in the process of reviewing findings of the study. There were no specific comments provided by the Province on the study itself. Additionally, it was communicated that they appreciate receiving the presentation and, as previously committed, will fully and fairly review any material provided by the Nunatsiavut Government in relation to downstream impacts
- The research in the Harvard study contributed valuable information on mercury to the scientific community.
- Water, sediment, and plankton samples were taken throughout Lake Melville at varying depths from freshwater regions to the outer Labrador Sea.
- It was determined that concentrations of methylmercury are extremely low throughout the cold, saline deep waters of Lake Melville. Methylmercury concentrations in the upper few meters of the water are enriched from riverine inputs (e.g., settlement near the riverbanks) as opposed to deeper water. Total mercury concentrations are increased by spring snowmelt

when concentrations in rivers and the surface waters of the estuary are significantly higher than in the fall.

- Mercury concentrations were expressed as pM (picomolar) and fM (femtomolar) in the paper. These units are much smaller than the achievable detection limit, generally in micrograms, by an industry approved analytical method and therefore becomes a topic of scientific debate.
- The guidelines for inorganic mercury and methylmercury in water are as follows:

CCME Water Quality Guidelines Protection of Aquatic Life:

| | Mercury (Hg) Inorganic CCME Guideline (µg/L) |
|-------------------|--|
| Freshwater | 0.026 |
| Marine | 0.016 |
| | Methyl Mercury (MeHg) Organic CCME Guideline (µg/L) |
| Freshwater | 0.004 |

Health Canada Canadian Drinking Water Quality Guidelines:

| | Mercury (Hg) Inorganic CDWQ Guideline (µg/L) |
|-----------------------|---|
| Drinking Water | 1.0 |

- There were no alarming results from this study. The reported numbers in comparison to the CCME guidelines (more stringent than the drinking water guidelines) are insignificant. The reported data is almost zero when converted to established guideline units.
- Soil flooding experiments indicate that near term changes expected from reservoir creation will increase methylmercury inputs to the estuary by 25 to 200%, overwhelming climate driven changes over the next decade. The orders of magnitude were not discussed, nor were any guidelines for comparison purposes. In the paper, data is presented in percentage, a form which amplifies the results visually.
- The study does not provide clear indications as to the potential impacts associated with mercury that the reservoir flooding above Muskrat Falls will have on downstream users.
- The Aquatic Environmental Effects Monitoring Plan – Baseline Conditions Report was finalized in July 2015.
- As indicated in the report *“sampling of mercury in fish and ringed seal tissue was also conducted. Mercury in ringed seals was recently added to the baseline sampling and the database is not yet large enough to assess the natural variability; collection is ongoing. There are several years of baseline mercury data for fishes in the lower Churchill River. Mercury analysis conducted in 2014 continued to show a decreasing trend in mercury concentrations in all sampling areas (i.e. above and below Muskrat Falls, Goose Bay, and Lake Melville), with the majority of the samples collected being below detection limits (0.05 mg/kg)”*.
- Based on the review of the report, there are a couple of points to highlight from the above noted study:
 - The mercury levels in fish in Goose Bay and Lake Melville are very low, and in many cases range near the limits of detection for mercury in fish tissue.
 - The older ringed seals are carrying relatively greater mercury burdens than fish. Mercury concentrations in the livers of older animals have been consistently high and above the recommended Health Canada guideline (0.5 ppm).

- Any impact on the downstream environment and potential risk to the local population will require the attention of federal agencies (i.e. Department of Fisheries and Oceans; Health Canada; Environment Canada; etc.) to take appropriate risk management measures.
- A revised Human Health Risk Assessment Plan / Environmental Effects Monitoring Plan was submitted by Nalcor on March 17, 2015 and is currently under review. Comments by the Nunatsiavut Government were requested by July 12, 2015 (30 days) and have been received.
- The Plan was reviewed by Health Canada and Department of Health and Community Services with no concerns expressed on the latest version.
- The Nunatsiavut Government had commented on the prior version and indicated the Plan does not contain sufficient detail to enable a technical review. Nalcor has included a Table of Concordance in reply to the Nunatsiavut Government.
- The Environmental Assessment Division is reviewing the Human Health Risk Assessment Plan/ Environmental Effects Monitoring Plan for compliance with the Undertaking Order.
- Nalcor has indicated the Dietary Survey and Human Bio-monitoring Report would be finalized on November 2015 and sent to government agencies to review. The final Human Health Risk Assessment report will not be available for several months.
- The Nunatsiavut Government is conducting their own Human Health research in Lake Melville and potential impacts to their communities.
- Nalcor and the Nunatsiavut Government have both started collecting data including dietary surveys and human bio-monitoring – collection of hair samples. The Human Health Environmental Effects Monitoring Plan however is still under review (as per the Aboriginal Consultation Guidelines for Regulatory Approval Applications provided to the Nunatsiavut Government on May 30, 2012).

Action Being Taken:

- Regulatory agencies will continue to oversee the monitoring of methylmercury and impacts of the Lower Churchill Project on the downstream environment.
- Any impact on the downstream environment and potential risk to the local population will require the attention of federal agencies (i.e. Department of Fisheries and Oceans; Health Canada; Environment Canada; etc.) to take appropriate risk management measures.

Prepared/approved by: P.Carter / M.McComiskey / R.Paterson / B.Cleary Director EA /
H.Khan Director WRMD / M. Goebel, ADM

November 24, 2015

Annex:

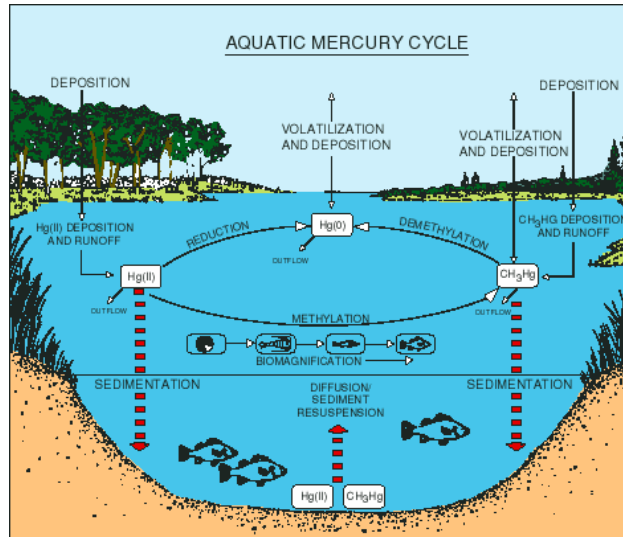


Figure 1: The mercury cycle: Various forms of mercury are converted from one form to the next (USGS, 2008).

The guidelines related to total mercury and methylmercury in fish tissue are as follows:

| Health Canada - Canadian Standards (Maximum Levels) for Various Chemical Contaminants in Foods | | | |
|---|----------------|--------------------|---|
| Mercury | Total | 0.5 ppm | In the edible portion of all retail fish except escolar, orange roughy, marlin, fresh and frozen tuna, shark, and swordfish |
| | | 1 ppm | Edible portion of escolar, orange roughy, marlin, fresh and frozen tuna, shark, and swordfish |
| Health Canada - Provisional Tolerable Daily Intake (pTDI) | | | |
| | | <i>Adults</i> | <i>Childbearing Age and <12years</i> |
| Methyl Mercury | Organic | 0.47ug/kg bw/day** | 0.2ug/kg bw/day** |

* ISQG = Interim sediment quality guidelines, PEL = Probable Effect Level

**bw/day = body weight/day