Independent Expert Committee (IEC)

Opinions on Recommendations for Mitigation

March 7, 2018

The following are written opinions provided by the members of the Independent Expert Committee with regards to the recommendation that they support for the mitigation of options for the mitigation of methylmercury impacts. I asked each of them, including those who supported the majority opinion, to summarize the justification behind their recommendation in 400 words or less. The opinions submitted have been reformatted for the purpose of this document but have not been edited.

Ken Reimer
Chair, Independent Expert Advisory Committee

Minority Opinion:
Dr. Maureen Baikie
Option 1: No further action for mitigation

I am in favour of option 1- no further action for mitigation. Changes in peak exposure related to Option 3 (Scenario B) and Option 4 (Scenario A) were explored based on a model used in a peer reviewed journal article but which has inherent limitations and inputs subject to differing opinions among scientists. Note that the unintended consequences (side-effects) of the soil removal options are currently not well characterized (1,2). Ryan Calder made several points about changes in exposure based on the model's output: the results for peak exposure show that overall, relatively few individuals (<5%) exceed the Health Canada pTDI now or in the future including women ages 16-49; median exposures will likely continue to be below regulatory guidelines; for the 95th population percentile exposures, the exposure risks are somewhat mitigated by Scenario B particularly for women age 16 to 49 who will be pushed below the EPA RfD (3, 4). I note that the EPA RfD is lower than the Health Canada pTDI for this group. Based on this modelling of changes in exposures and the comparison with Health Canada guidance values, it is my view that the objective of protecting both human health in the affected communities and the continuation of the current lifestyle of harvesting and consuming country foods post reservoir flooding at Muskrat Falls can be achieved by the recommendations in the Monitoring and Management Recommendations documents (5,6) without soil clearance. These recommendations include community engagement in the monitoring program and the development of dietary advice tailored to each community as necessary based on the principles of risk communication and public health programming. (6, 7). My decision has taken into account perception by community members of the current and future risks related to methylmercury and country food and the effect on mental health and lifestyle (7). I also acknowledge the school of thought that any reduction in exposure to methylmercury carries increased risk (according to the no lower threshold for health effects viewpoint) without a commensurate increase in benefit (4). I am of the view that we should be guided by Health Canada guidance values as they are the Canadian standard, are used widely by researchers and public health officials in Canada and there are no plans to change them in the foreseeable future.

1. Jansen, W., September 27, 2017. Effects of forestry practices and similar soil disturbances on environmental mercury concentrations. Memo submitted to IEC.
2. Independent Expert Advisory Committee Recommendations Mitigation. Draft dated March 1, 2018
3. Calder, R., February 28, 2018. Methylmercury exposure forecasts among Lake Melville Inuit under hypothetical scenarios for soil removal at Muskrat Falls and using certain updated and alternative model parameter inputs. Memo submitted to IEC.
4. Calder, R., March 01, 2018. Methylmercury Risk Analysis at Muskrat Falls. Alternative model inputs and remediation scenarios. Slide deck for IEC webinar.
5. Independent Expert Advisory Committee Recommendations Monitoring. Draft dated March 02, 2018
6. Independent Expert Advisory Committee Recommendations Management. Draft dated March 02, 2018
7. Baikie, M., February 25, 2018. Methylmercury and Muskrat Falls: A Public Heath Perspective. Report to the Independent Expert Advisory Committee.

Minority Opinion:
Jim McCarthy
Option 1: No further action for mitigation

My recommendation vote has considered the weight of data derived from modelled effects predictions from mitigations deemed feasible (e.g., Scenarios A and B) and the uncertainties/assumptions associated with these, additional experiments completed by Harvard University, and other presentations/papers/information requested by the IEC. Based on the results submitted and reviewed, the mitigation scenarios identified are determined to be ineffective and of little benefit to minimizing potential exposure and risk to public health. When compared to the no further mitigation scenario, there is no effective reduction in the estimated percent fraction of the human population exceeding Health Canada's limits (slides 7-9 Calder March1) nor to the decrease in fish mercury levels (slide 39 Harris Feb 26/18); all mitigation scenarios modelled were within the confidence limits of the no mitigation scenario. There is also evidence based on additional experiments completed by Harvard (Kirk presentation Jan 27/18) that organic soil removal will not eliminate methylation and therefore flux of methylmercury into the water column. This uncertainty is similar to other studies of proposed mitigations which produced the opposite anticipated effect (Mailman and Bodaly 2005; 2006).
In addition, the models used to estimate baseline as well as post-flood effects have not appropriately incorporated fish species abundances and use of the lower Churchill River or Lake Melville habitat and therefore have not adequately predicted baseline or post-flood changes (McCarthy presentation/submission Feb 15 and revised species habitat use table with existing data and traditional knowledge from the Committee). This in addition to the assumptions of the models increases the uncertainty of further mitigation effectiveness.

Mailman, M. and R.A. Bodaly. 2005. Total mercury, methyl mercury, and carbon in fresh and burned plants and soil in Northwestern Ontario. Environmental Pollution 138: 161-166.
Mailman, M. and R.A. Bodaly. 2006. The burning question: Does burning before flooding lower methylmercury production and bioaccumulation? Science of the Total Environment 368: 407-417.

Minority Opinion:
David Lean
Option 1: No further action for mitigation

It is noted that greater than 50% of the future reservoir area has been cleared of trees which has reduced some of the organic carbon and possibly reduced future methylmercury production.

When upland soils are flooded, some methyl and inorganic mercury is released but the amount and timing of the peak relates to key features that related to the time required for an amount of water equivalent to the volume of the reservoir to be released (water renewal time) which in the case of Muskrat Falls is only 10 days compared with much longer times (months) for the reservoirs in Quebec and even Churchill Falls. In addition, the depth, drawdown, steepness of the banks, the small area flooded and the higher pH will result in very little methyl mercury release and future methyl mercury levels will depend on upstream sources independent of any mitigation in the reservoir itself. The expense of removing soil and capping wetlands would be better spent in compensation for the people whose lives are disrupted not because of any methyl mercury increase in their food but because a reservoir was built on their land. A comprehensive public information exercise (contrary to some of the alarmist recent press designed to manipulate the public) should reassure that local people that the fish are currently very low in mercury and any increase will not result in levels where health is compromised.

Minority Opinion:
Wolfgang Jansen
Option 4: Capping of Wetlands

My decision to vote for Option 4 – Capping of Wetlands is based on the following considerations:

1) Characteristics of the Muskrat Falls (MF) reservoir in terms of mercury (Hg) methylation potential

Most of the characteristics of the MF reservoir indicate a small potential for sustained increases in mercury (Hg) methylation post-flooding. This is reflected in the predictions by two models that estimate maximum post-flooding concentrations of methylmercury (MeHg) in water at 0.11 ng/L and 0.19 ng/L (IEAC Recommendations: Mitigation, Table 1). The peak values are expected to last only weeks, and a one-year average concentration calculated by one of the modes of 0.067 ng/L is likely more representative when predicting Hg levels in biota relevant to human consumption.

2) Human exposure to methylmercury due to the Project

Current Hg concentrations in all fish species in the MF Project area are very low (McCarthy, J, February 2, 2018). While concentrations may increase due to the Project (Harris, February 26, 2018; Calder et al. 2016), concentrations in those species most relevant to mercury exposure of local resource users likely will not. Fish species used as country food by members of communities on Lake Melviille/Goose Bay mainly comprise salmon, Rock Cod, Brook Trout, and smelt. There exists no or only a weak pathway linking these fish species (and young seals) to Project-derived increases in Hg (Stewart Michelin, pers. comm.; McCarthy, February 2, 2018). Thus, it is not obvious what food sources could be responsible for the predicted substantial increases in MeHg exposure of resource users (Calder et al. 2016). This view is supported by the IEC presentations of four human health experts, that indicate to me that the vast majority of resource users will be able (and should be encouraged) to maintain their traditional life-style and dietary habits of frequent country food consumption without taking a risk of harming their health.

3) Benefits and risks of mitigation measures

Reductions in the amount of MeHg produced as a result of the Project are beneficial as, particularly when combined with dietary advice on the benefits and risks of fish consumption, it may improve mainly the mental health of members in the affected communities. I am concerned that pre-Project mitigation options involving the large scale removal of soils in the reservoir area will have side effects that may partially or fully offset the expected decrease in the amount of MeHg produced. Soil disturbance on a much smaller scale than proposed in options 2,3, and 5 has been shown to increase soil methylation potential and MeHg concentration in fish (Jansen, September 27, 2017). There are just too many unknowns in how exactly the soil clearing operation will be done to have confidence in a desired outcome. Unwanted side-effects are much less likely to occur for option 4. Flooded wetlands, particularly peat, can be a major, long-lasting source of MeHg release (Jansen, February 28, 2018), which is not accounted for in both models mentioned above. The overall reduction in MeHg production for option 4 may be relatively small at first, but its effect may increase in importance over time.

Majority Opinion:
Stewart Michelin
Option 5: Combination of Options 3 (targeted removal of soils and vegetation) and Option 4 (capping of wetlands)

I went fishing with my daughters and friends this past weekend and caught several nice brook trout which we had for supper.
I would like to continue this. So Scenario # 1 is not an option for me.

Scenario # 2 removing all the soil would do more harm than good

Scenario # 3 capping only addresses part of the problem

Scenario # 4 only addresses part of the problem

Scenario # 5 is the best option for reducing the amount of mercury produced by all accounts. We cant be 100% sure about what will happen to people in Lake Melville, but the Harvard and Nalcor models both say that if we cap the wetlands and remove the soil, the methylmercury in the reservoir will go down by 23%.

Majority Opinion:
Etienne Pone
Option 5: Combination of Options 3 (targeted removal of soils and vegetation) and Option 4 (capping of wetlands)

This opinion was expressed verbally in lieu of a written submission, and is summarized as follows (by M. Biasutti-Brown):

I understand that if soil is removed, there won't be any more carbon. There is carbon in the topsoil. If it is removed, everything will be ok then.

Majority Opinion:
Jane Kirk
Option 5: Combination of Options 3 (targeted removal of soils and vegetation) and Option 4 (capping of wetlands)

Based on the scientific evidence that the IEAC has reviewed, including the published, peer reviewed Calder et al. 2016 study, there is a well-established positive, linear relationship between concentrations of organic carbon in flooded soils and vegetation and the rate of mercury methylation. Thus removal of soil organic carbon prior to flooding should decrease methylmercury production in the Muskrat Falls reservoir. The IEAC also reviewed the scientific literature regarding the flooding of wetlands, which demonstrates that wetlands are disproportionately large contributors to methylmercury production for long durations (see Jansen, memo of March 1, 2018). Regarding the impacts of the Muskrat Fall reservoir on exposure to methylmercury, Calder et al. 2016 predicted that following flooding of the Muskrat Falls reservoir, median MeHg exposures will at least double for the majority of the downstream Inuit population with projected increases greatest in the community of Rigolet, where the median exposure increase is projected to be almost three times baseline values. Further, as presented to the IEAC by Weihe as well as in several peer circulated to the IEAC (Grandjean and Landrigan, 2014, Lancet Neurology; Weihe et al., 2015, Arctic Monitoring and Assessment Programme, Ha et al., 2016, Environmental Research), a variety of studies have used improved scientific methods to demonstrate progressively lower thresholds for methylmercury effects, including neurological deficits at the current Health Canada and USEPA guidelines. The IEAC also reviewed predictions for methylmercury production under Scenarios A and B carried out by Calder and Harris; both Calder and Harris's finding agreed that Scenario B would decrease methylmercury production by 15-23%. Further, Calder predicted that under Scenario B, methylmercury exposures would be reduced, especially in sensitive or vulnerable populations. For example, the fraction of women of childbearing age who will be over the Health Canada guidelines for methylmercury exposure will be reduced from > 5% to about 5%. Based on this scientific evidence, as well as the risk of unwanted side effects from Option 2/full soil removal, such as enhanced erosion, Option 5 (targeted soil removal and wetland capping) is the best available pre-flooding mitigation strategy available to decrease methylmercury exposure to the people living along the shores of Lake Melville.

Majority Opinion:
David Wolfrey
Option 5: Combination of Options 3 (targeted removal of soils and vegetation) and Option 4 (capping of wetlands)

The following written opinion was provided by David Wolfrey on Friday March 2. At that time, his decision was in support of Option 2: Full clearing of soils and vegetation. During subsequent telephone conversations, David decided to support the majority recommendation of Option 5.

I don't know if I read it I know that if you flood land and flood more and more land you going to create more MeHg that is why I went with number 2 for me that would be the least MeHg going out but I could be wrong seems like it anyway.

Another thing is that for the people I represent Nunatsiavut I know they expected for me to do what is best for the people and that is what I though was the best.

Majority Opinion:
Trevor Bell
Option 5: Combination of Options 3 (targeted removal of soils and vegetation) and Option 4 (capping of wetlands)

Following the specific mandate of the IEAC *to assess and recommend options for mitigation* of methylmercury impacts, and its specific guidance *to use the best available peer reviewed science and Indigenous knowledge*, the IEC has received solicited and unsolicited expert opinions on the only peer-reviewed science that permits an assessment of mitigation of MeHg impacts in the Muskrat Falls reservoir (the Calder et al. 2016 model)[1]. As the referenced documents illustrate, the Calder model is fully supported by published peer-reviewed science and Indigenous knowledge in its operating assumptions and processes, definitions of parameter space, and robustness of output, including when adjustments were made for new field data from the study area[2]. Model outputs were generated by Calder to simulate a range of mitigation options proposed by the IEC, for which SNC Lavalin demonstrated engineering feasibility although acknowledging the challenge of some options given the proponents pre-determined timeline[3]. A series of targeted mitigation options (labelled options 3, 4 and 5 in the IEC report) to reduce undesired impacts of mitigation while maximizing benefits was informed by peer-reviewed science and validated by the Calder model[4]. The necessity for mitigation in reducing future MeHg exposure risk in affected populations is unequivocally demonstrated by modelling results that show a decline in the number of those persons most sensitive to MeHg exposure (those that consume country food) relative to both current Canadian safe intake guidelines and progressively lower thresholds for MeHg effects established by peer-reviewed studies on diverse populations worldwide[5].
On the basis of this peer-reviewed science and Indigenous knowledge, I unambiguously support both the evidence-based recommendation for Mitigation and for the choice of Mitigation Option #5.

Footnotes to reference documents contained in the IEC Mitigation Recommendation report

1. Calder, R. et al, 2016. Future Impacts of Hydroelectric Power Development on Methylmercury Exposures of Canadian Indigenous Communities. Environmental Science and Technology. 8 pages.
2. Azimuth Consulting Group Partnership, February 25, 2018; Calder December 07, 2017; December 19, 2017; January 31, 2018; February 19, 2018; March 01, 2018; Harris, R., February 21, 2018; Hesslein, R, February 12, 2018; Jansen, W., February 17, 2018; February 28, 2018; Kirk, J.K., February 28, 2018.
3. Calder February 13, 2018; February 22, 2018; February 28, 2018; SNC Lavalin, December 21, 2017; February 26, 2018; Independent Expert Committee, January 23, 2018; January 16, 2018; McCarthy, J., February 2, 2018; February 15, 2018; February 17, 2018; Nalcor Energy, January 31, 2018.
4. Table 1 in IEC Recommendations Report March 06, 2018; Calder, R., February 28, 2018; March 01, 2018;
5. Chan, Laurie H.M., February 15, 2018; Ollson, C. March 1, 2018; Weihe, P. February 19, 2018; See also papers in circulated through IEC Dropbox: 2014 review by Grandjean and Landrigan, published in Lancet Neurology; 2015 review by Weihe et al. in the Arctic Monitoring and Assessment Program chapter on Mercury; 2016 review by Ha et al in Environmental Research.