KNOWLEDGE POLITICS IN ENVIRONMENTAL IMPACT ASSESSMENT

by

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submitted by Hannah Barnard-Chumik in partial fulfillment of the requirements for

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Abstract

Environmental impact assessment (EIA) faces significant criticism with respect to its scientific approach and oft disjointed legislation. Although appeals for more rigorous science and legally binding obligations for decision-makers are warranted, it is also crucial to acknowledge that regulatory science is situated in specific social, institutional, and political contexts. Therefore, in addition to science and legislation, relevant social processes influence the way in which knowledge is gathered, legitimized, and interpreted, thus affecting regulatory decisions. However, there remains an important empirical gap in understanding how these processes affect knowledge construction in an EIA context. In Chapter 2 of this thesis, I use Situated Analysis to explore the knowledge politics around methylmercury contamination that emerged throughout the EIA of the controversial Muskrat Falls portion of the Lower Churchill Hydroelectric Generation Project, situated in Labrador, Canada. I focus on debates about knowledge related to downstream methylmercury impacts, human health, and mitigation measures to reduce the production of and exposure to methylmercury. I find that there are distinct knowledge orders that interact and collide, generating knowledge conflicts about framing of the policy problem, norms of knowledge construction, and reasoning about the policy problem. Using illustrative examples from the Muskrat Falls case study, this work highlights and categorizes knowledge conflicts that may emerge over the course of a controversial environmental regulatory decision. I also argue that power intersects with EIA in a way that privileges some knowledge orders over others. Privileged knowledge orders are often aligned with particular conceptualizations of human health, the environment, and natural resources. In Chapter 3, I propose an educational activity based on the Muskrat Falls case study that enables post-secondary students to explore how

Structured Decision-Making (SDM), a framework for environmental policy decisions that emphasizes objectives and values, may address knowledge conflicts and competing knowledge orders in an EIA context. More broadly, my findings echo calls for a more pluralistic approach to EIA that acknowledges existing power structures in the regulatory context. I also discuss the implications of these findings for the next iterations of EIA legislation and policy.

Lay Summary

Hydroelectric megaprojects are often met with intense controversy, with proponents citing the benefits, such as renewable energy, and critics citing concerns, such as high costs and adverse impacts on the environment, local people, and Indigenous rights. Environmental impact assessment (EIA) evaluates the risks and benefits of such projects with the aim of informing decision-making. EIA faces significant criticisms of scientific and legislative shortcomings. However, social scientists argue that social processes, like institutions and politics, largely influence how projects are studied. In this thesis, I perform a case study analysis of the Muskrat Falls Hydroelectric Project in Labrador, Canada, focusing on debates about human health impacts. I find that there were conflicts about how scientific research was conducted and how the evidence was interpreted. I argue that power structures influence the way that research is executed by scientists and interpreted by decision-makers. My findings contribute to improving EIA process in Canada.

Preface

Chapter 2 was written as a standalone manuscript. Therefore, there may be some repetition throughout the thesis with respect to this section. For the piece, I conducted the interviews, performed the data analysis, made the tables and figures, and wrote the original draft of the manuscript. Natalie Cappe, an undergraduate student at UBC under the supervision of Dr. Amanda Giang, researched the timeline of events for the case study. Dr. Amanda Giang supervised the work and edited the manuscript. Dr. Amanda Giang and I both contributed to the conceptualization of the research program and methodology.

Research protocols, interview instruments, and consent procedures for Chapter 2 were approved by the UBC Behavioural Research Ethics Board, as per certificate H19-00229, and by the Nunatsiavut Government Research Advisory Committee.

Chapter 3 was also written as a standalone piece. I facilitated the experiential learning activity in undergraduate and graduate classrooms, wrote the game documents, and designed the surveys. Dr. Amanda Giang supervised the work. Dr. Amanda Giang, Dr. Jiaying Zhao, and I contributed to the conceptualization of the activity.

Research protocols, surveys, game documents and consent procedures for Chapter 3 were approved by the UBC Behavioural Research Ethics Board, as per certificate H19-02440.

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List of Abbreviations

EIA – Environmental Impact Assessment

IA – Impact Assessment

IAA – impact Assessment Act

JRP – Joint Review Panel

SDM – Structured Decision-Making

Acknowledgements

I would like to acknowledge that this case study takes place on Labrador Inuit Lands, Labrador Innu Lands, and within the Traditional Territory of the NunatuKavut Inuit. I would also like to acknowledge that this case study work was conceptualized and implemented on the traditional, ancestral, and unceded territory of the Musqueam, Tsleil-Waututh, and Squamish Nations.

I offer my enduring gratitude to the faculty, staff and my fellow students at UBC. In particular, I would like to thank the staff, students, and faculty at IRES. I have learned so much from you, and you inspire me to dream big.

I would also like to thank Dr. Amanda Giang for her dedication to my work, for fostering my intellectual growth, for giving me incredible opportunities, and most importantly, for leading with kindness. I am grateful that you took a chance on me.

I owe a special thanks to my parents, whose emotional and financial support throughout the years have gotten me to where I am today.

Dedication

I would like to dedicate this thesis to two women who have had a great impact on my life. The first is my aunt Carol McElroy, who passed away while I was finishing this piece. Thank-you for teaching me resilience and to pursue the things that you love. I would also like to dedicate this thesis my grandmother, Jean Barnard, who has always been a great supporter of mine. I hope that I have made both of you proud.

Chapter 1: Introduction

1.1 Science, Policy, and Power

Environmental decision-making is inherently complex, often because there is rarely a single "best" decision without problematic consequences. These complexities can stem from the fundamental complexity of coupled human and natural systems, which make predicting the consequences of a given decision difficult because there is often a great deal of scientific uncertainty associated with such predictions (Berkes, Colding, and Folke 2003). However, in pluralist societies, there are also multiple ways of knowing and understanding the world, which can result in differences in preferences, values, and stakes in environmental policymaking. Therefore, what constitutes the "best" decision for one group may not be for another. These factors further complicate the presentation and interpretation of the science that informs such decision-making. Due to these complexities, scientific controversies can emerge in policymaking.

Governments, policymakers, and scientists often respond to such controversies with appeals for more research and evidence-based policymaking (Mason-Renton et al. 2018). However, social scientists argue that these kinds of responses often fall short because they assume that science itself is impartial and will provide an evident alternative for decision-makers, when complex judgements about policy are arguably the result of social processes in which competing knowledge claims and scientific uncertainties are assessed and legitimized based on values and normative concerns (Miller 2008; Öberg and Mason-Renton 2018; Mason-Renton et al. 2018). Therefore, some argue that scientific controversies in the policy realm ought to be addressed

through participatory processes that balance stakeholder values and scientific research (Gregory 2012; Öberg and Mason-Renton 2018).

As a result, participatory processes in environmental governance have gained traction in recent years (Turnhout et al. 2020). In many cases, however, these processes have not yet achieved their stated outcomes and have been associated with reinforcing, rather than solving, governance problems (Turnhout, Van Bommel, and Aarts 2010). Some scholars suggest that this is due to a lack of attention to power in the regulatory arena, with the depoliticization of such processes reinforcing power inequalities between elite and non-elite actors in the regulatory context, thus limiting the potential of participatory processes to contribute to positive societal transformation (Turnhout et al. 2020). Instead, these scholars suggest a "repoliticization" of participatory processes that acknowledges unequal power relations and politics, and that emphasizes pluralism and debates about knowledge.

1.2 Overview of Environmental Impact Assessment

Environmental Impact Assessment is a venue in which emergent debates about science, knowledge, and policy occur amongst the public and policymakers. In its most basic form, Environmental Impact Assessment (EIA) is a legislated process that provides decision-makers with the information required to weigh the benefits and risks of a proposed development project, policy, or other undertaking and determine whether is in the public interest (Government of Canada 2019). In Canada, an assessment may be triggered when there is a proposed project or undertaking containing a component falling under federal and/or provincial legislative jurisdiction that may have an adverse environmental impact. Figure 1.2.1 depicts an abbreviated overview of the EIA process with a review panel. If the responsible government agency

determines that there may be substantial public concerns associated with the potential impacts of the undertaking, the EIA may be referred to a review panel of independent experts whose expertise may consist of local knowledge, the social sciences, the natural sciences, or environmental law and policy. The review panel holds public hearings in affected communities, reviews the potential impacts of the project, and drafts a report with recommendations to inform the decision-making of the responsible minister. Otherwise, the EIA may be conducted by the Impact Assessment Agency of Canada.

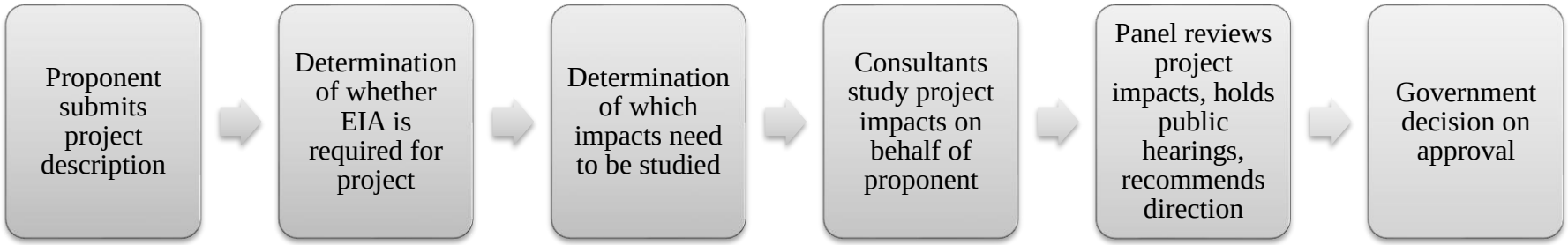

Figure 1.2.1 Abbreviated overview of EIA process

The major components of EIAs include predicting socio-ecological effects of the undertaking, public engagement, determination of significant adverse effects of the project or undertaking and whether these effects are justified in the circumstances (Stacey 2015). It is often described as procedural in nature because decision-makers are not required to achieve a specific desired outcome. However, scholars often argue that EIA is also substantive in that it provides a public arena for emergent debates about utilization of natural resources, relationships to nature, perceptions of environmental risks, and future environmental planning (Stacey 2015; Gibson, Doelle, and Sinclair 2016; Doelle 2014). Indeed, EIA can serve as a venue in which the government attempts to promote sustainable development, consult with Indigenous peoples, and interrogate more deeply the various ways in which various actors come to understand their environment.

EIA was first formally introduced in Canada over 40 years ago, with the introduction of the federal Environmental Assessment and Review Process in 1973 (Gibson, Doelle, and Sinclair 2016; Noble 2013). The Canadian Environmental Assessment Act replaced this legislation in 1992, with the aim of strengthening EIA in Canada. The Harper government's iteration of EIA, the 2012 Canadian Environmental Assessment Act, was viewed by many environmental law scholars as a step back in environmental protection (Stacey 2015; Gibson, Doelle, and Sinclair 2016). At the time of the conceptualization of this thesis in 2018, the Trudeau government was in the process of reforming EIA and had completed an expert review of the process which included public engagement (Expert Panel for the Review of Environmental Assessment Processes 2017). The new legislation, the Impact Assessment Act, came into force in 2019. The provinces, territories, and some land claim agreements also have their own versions of EIA legislation that apply to undertakings that fall under these jurisdictions (Noble 2013).

1.3 Critiques and Challenges of Environmental Impact Assessment

Environmental Impact Assessment faces considerable critiques with respect to its ability to meet multiple standards. These include scientific shortcomings, such as limited temporal and geographical scope of the study area, less rigorous methodological standards than the academic literature, limited study of cumulative impacts on the environment by assessing one undertaking at a time, and significant data gaps that limit informed decision-making (Behn and Bakker 2019; Hackett, Liu, and Noble 2018a; Singh et al. 2020). Criticism also extends to not meeting legislative and consultation standards set out by legislation and academic scholars, including gaps in governance, legislation that constrains the kinds of impacts that can be studied in an EIA context, a lack of oversight of work conducted by proponents on the part of responsible government bodies, and exclusion of Indigenous voices from studying, evaluating, and understanding impacts (Behn and Bakker 2019; Booth and Skelton 2011; Stacey 2015). Such criticisms have led to numerous calls to improve the EIA process, including more inclusive and pluralistic approaches to debates about project impacts, integration of cultural valuation of ecosystems using various metrics and tools, increased transparency in decision-making, and novel frameworks for the EIA process (Behn and Bakker 2019; Calder et al. 2020; Doelle 2014; Gibson, Doelle, and Sinclair 2016; Satz et al. 2013).

1.3.1 Human Health Impacts in Environmental Impact Assessment

In addition to general shortcomings of the EIA process, one area of particularly problematic neglect is the study of human health impacts. Human health impacts are seldom at centre stage of discussions about EIA reform, which tend to focus more heavily on non-human dimensions of sustainability and environmental impacts (Gibson, Doelle, and Sinclair 2016). Indeed, the EIA literature indicates a lack of consistent and comprehensive evaluation of human health impacts in Canada (Peterson, E. & Kosatsky 2016a; Hackett, Liu, and Noble 2018a; Singh et al. 2020; Expert Panel 2016). Although health impacts are discussed in the guiding documents for EIA, requirements for their consideration under the law are limited (Mendell 2010). For instance, consideration of the human health impacts of a project or policy beyond a risk assessment for products is not required. Furthermore, the evaluation of human health impacts can be limited to biophysical indicators rather than more holistic measures like social determinants of health. As a result, there is considerable variation in which health impacts are explicitly considered in EIAs. For instance, one study evaluating the health impacts of hydroelectric projects in the same watershed found considerable differences among the types of impacts that were included in the EIAs (Hackett, Liu, and Noble 2018b).

Previous research addressing health impacts in EIA were limited in scope by solely providing a broad overview of how health is included in the assessment process. Indeed, past studies mostly focus on the inclusion of health determinants in EIA across jurisdictions or case studies, focusing on the outcome of the process rather than the process itself (Hackett, Liu, and Noble 2018b; Expert Panel 2016; McCallum, Ollson, and Stefanovic 2018; Singh et al. 2020). There has not been an in-depth descriptive analysis with the aim of understanding the process

and results of the ways in which health impacts are assessed. Additionally, other studies have not emphasized health concerns from the point of view of the public. As a result, there is not a good understanding of how human health impacts are assessed in practice, how decisions regarding such impacts are justified, and whether the process adequately addresses the concerns of the public.

1.4 Knowledge Politics and Civic Epistemologies

Although the many critiques of Environmental Impact Assessment are warranted, they mostly focus on legislative and scientific deficiencies. The Science and Technology Studies (STS) literature argues that science-based policy decisions are also intertwined with social and political processes (Jasanoff 1987; 1991; Miller 2008). In critiques of EIA and discussions about improving the process, it is therefore also crucial to acknowledge that regulatory science is situated in specific social, institutional, cultural, and political contexts. Science and legislation do not necessarily compel a regulatory decision, especially in the face of uncertainty or ambiguity (Jasanoff 1991). Rather, policymakers draw on established social and institutional processes to legitimize their decisions, such as norms of knowledge construction, standards of evidence, and modes of reasoning (Jasanoff 1991; Miller 2008).

EIA, itself situated within certain social and institutional contexts, therefore provides a venue for emergent debates about knowledge and knowledge politics amongst the public and policymakers. The civic epistemologies framework, drawn from STS, analyzes knowledge construction in the political sphere, exploring how knowledge is constructed and applied in policy implementation (Miller 2008). The concept of civic epistemologies refers to the social and institutional practices through which policy-relevant knowledge is publicly constructed,

deliberated, reviewed, and validated. Civic epistemologies are grounded in deliberative democracy and represent ways of knowing and reasoning about policy problems that are embedded within distinct political and institutional orders, known as knowledge orders. These knowledge orders exist within a given civic epistemology and consist of particular epistemic frameworks and associated social and institutional arrangements that produce and apply knowledge. Although it is known that knowledge plays an important role in shaping politics, and vice versa (Epstein 1996; Ezrahi 1990), there remains an empirical gap in understanding how knowledge systems and orders compete in public arenas like EIA (Miller 2008).

1.5 Muskrat Falls Case Study

This thesis addresses the aforementioned empirical gap through a case study analysis of the Muskrat Falls Project, located in Labrador, Canada, that explores knowledge politics in an EIA process. During the Project implementation phase in 2016, there were knowledge conflicts regarding the potential increases in exposure to methylmercury and the subsequent health impacts, particularly for downstream Indigenous communities consuming country foods (Barry, White, and Goodyear 2016). These concerns sparked protests and hunger strikes, significant media attention, and the establishment of various expert panels. The project therefore illustrates how contradictory and competing knowledge can lead to controversial decision-making outcomes in EIA.

Qualitative case study analysis enables the understanding of how a complex process, such as EIA, works in practice (Yin 2014a). This study will enable the exploration of EIA in the socio-cultural-economic-environmental context of its occurrence, and therefore whether the current EIA process is succeeding in assessing environmental health impacts. By providing an

in-depth, process-oriented description of the EIA in the context of health impacts, we can understand whether there is a difference between what is prescribed in EA and what the process looks like in practice. Furthermore, qualitative analysis of the Muskrat Falls case is informative because it represents a concrete manifestation of the assessment of health impacts in the EA process. It is also a representation of a common occurrence in Canadian EAs, that of hydroelectric siting decisions (Hackett, Liu, and Noble 2018b). Finally, the high-profile case received significant media attention, offering a wealth of empirical data.

1.6 Objective and Research Questions

This thesis seeks to interrogate the role of knowledge in Environmental Impact Assessment with the aim of informing future EIA policy and legislation. I seek to build on previous literature of knowledge politics and complicate the current EIA reform paradigm of better science and legislation through a case study analysis of the Muskrat Falls Hydroelectric Project. More specifically, I evaluate the following research questions:

1. What is the nature of the knowledge conflicts that emerged during the Muskrat Falls Hydroelectric Project EIA?
2. How did knowledge politics concerning methylmercury and human health impacts influence the process and outcome of the Muskrat Falls Hydroelectric Project EIA?
3. How can knowledge conflicts in EIA be characterized and communicated?

1.7 Structure of Thesis

Following the introduction, this thesis is divided into three subsequent chapters. Chapter 2 details the case study analysis of the methylmercury and human health knowledge disputes

relevant to the Muskrat Falls Project. The aim of Chapter 2 is to address the first two research questions. Chapter 3 aims to address the third question using the findings of Chapter 2 to propose an educational activity for post-secondary students based on these knowledge disputes. The aim of the educational activity is to provide an experiential opportunity for participants to explore knowledge politics in EIA. Chapter 4 concludes the thesis, discussing the limitations of the work, future research directions, and the implications of these findings for Canada's EIA process.

Chapter 2: Knowledge Politics in Environmental Impact Assessment: A Case Study of the Muskrat Falls Hydroelectric Project

2.1 Introduction

Environmental impact assessment (EIA) evaluates the risks and benefits of development projects with the aim of informing environmental governance. Hydroelectric dams are one example of such projects, which have increased in number in recent years (Zarfl et al. 2014). These projects are often met with intense controversy, with proponents citing the benefits, such as renewable energy, and critics citing concerns, such as high costs and adverse impacts on socio-ecological systems and Indigenous rights (Behn and Bakker 2019). In its most basic form, EIA is a process which studies and predicts the effects of projects, informing decision-making about whether an undertaking should take place. However, it is not merely procedural in nature, but also substantive, by providing a public arena for debates about relationships to nature and perceptions of environmental risks (Stacey 2015). In Canada, the major components of EIAs include predicting socio-ecological effects, public engagement, determination of significant adverse effects of the project and whether these effects are justified (Stacey 2015).

EIA faces considerable critiques with respect to its ability to meet various standards. These include scientific shortcomings, such as limited scope and rigor, inadequate treatment of cumulative impacts on the environment, fragmented methodologies and insufficient data, and narrow interpretations of human health impacts (Behn and Bakker 2019; Hackett, Liu, and Noble 2018a; Singh et al. 2020). Criticism also extends to gaps in governance, legislation that reduces

the scope and rigor of assessments, lack of oversight, and exclusion of Indigenous voices from understanding project impacts (Behn and Bakker 2019; Booth and Skelton 2011; Stacey 2015). Such criticisms have led to numerous calls to improve the EIA process, including more inclusive and pluralistic approaches to debates about project impacts, increased transparency in decision-making, and novel frameworks for environmental review (Behn and Bakker 2019; Calder et al. 2020; Doelle 2014; Gibson, Doelle, and Sinclair 2016).

Although these critiques are warranted, they mostly focus on legislative and scientific deficiencies. The Science and Technology Studies (STS) literature argues that science-based policy decisions are also intertwined with social and political processes (Jasanoff 1987; 1991; Miller 2008). In critiques of EIA and discussions about improving the process, it is therefore also crucial to acknowledge that regulatory science is situated in specific social, institutional, cultural, and political contexts. Science and legislation do not necessarily compel a regulatory decision, especially in the face of uncertainty or ambiguity (Jasanoff 1991). Rather, policymakers draw on established social and institutional processes to legitimize their decisions, such as norms of knowledge construction, standards of evidence, and modes of reasoning (Jasanoff 1991; Miller 2008).

EIA, itself situated within certain social and institutional contexts, therefore provides a venue for emergent debates about knowledge and knowledge politics amongst the public and policymakers. The civic epistemologies framework, drawn from STS, analyzes knowledge construction in the political sphere, exploring how knowledge is constructed and applied in policy implementation (Jasanoff 2005; Miller 2008). The concept of civic epistemologies refers to the social and institutional practices through which policy-relevant knowledge is publicly constructed, deliberated, reviewed, and validated. Civic epistemologies are grounded in

deliberative democracy and represent ways of knowing and reasoning about policy problems that are embedded within distinct political and institutional orders, known as knowledge orders. These knowledge orders exist within a given civic epistemology and consist of particular epistemic frameworks and associated social and institutional arrangements that produce and apply knowledge. Although it is known that knowledge plays an important role in shaping politics, and vice versa (Epstein 1996; Ezrahi 1990), there remains an empirical gap in understanding how knowledge systems and orders compete in public arenas like EIA (Miller 2008).

This chapter addresses this gap through a case study analysis of the Muskrat Falls Project, located in Labrador, Canada, that explores knowledge politics in an EIA process. The Project was originally proposed in the 1980's, but the EIA process was not set in motion until 2006 as part of a larger hydroelectric megaproject, the Lower Churchill Generation Project, by Nalcor Energy, Newfoundland and Labrador's energy utility (Nalcor Energy 2009; Samson 2018). Concerns over the economic rationale for the Project, Indigenous rights, and environmental and human health impacts dominated the discourse surrounding the Project. Despite objections brought forth during the Project's extensive and lengthy process of environmental review, the Project was ultimately sanctioned in 2012 by the Government of Newfoundland and Labrador (Daly 2012). This article focuses on debates about knowledge related to the human health impacts of the Project and proposed mitigation measures within a process of environmental review. Disputes about human health impacts were related to the Project's potential effects on the downstream bioaccumulation of methylmercury in locally harvested aquatic species, known as country foods. Prominent disagreements also centred around clearing of the dam reservoir area prior to flooding as an effective mitigation measure to reduce

the production of methylmercury. Despite recommendations for a full reservoir clearing by a Joint Review Panel (Joint Review Panel 2011), recommendations for targeted soil removal and wetland capping by an Independent Expert Advisory Committee (IEAC) (IEAC 2018b), acceptance of the recommendation of wetland capping by the Government of Newfoundland and Labrador, and significant political pressure from land protectors, the reservoir was flooded in 2019 without these physical mitigation measures (LeBlanc 2020b).

The case study analysis shows that there was significant disagreement related to knowledge construction of downstream methylmercury impacts in the Muskrat Falls EIA. Actors brought forth different and conflicting framings of the methylmercury policy problem, norms of knowledge construction, and ways of reasoning. These debates illustrate the existence of distinct knowledge orders. Within a regulatory process like EIA, knowledge orders come into contact and collide, resulting in disputes about knowledge. Power intersects with knowledge orders in a way that privileges some over others. The privileged knowledge orders are often ones that perpetuate what many see as the Canadian government's enduring view of its environment: as existing solely for natural resource extraction (Behn and Bakker 2019; Stacey 2015). These empirical findings echo calls for a more pluralistic approach to EIA that acknowledges power structures in environmental regulation.

2.2 Methodology

This work used Situated Analysis to explore knowledge politics in the Muskrat Falls case study. Situated Analysis is a qualitative methodology rooted in Grounded Theory, one of the most popular approaches to qualitative inquiry in the social sciences and humanities (Clarke and Charmaz 2014). Situational Analysis extends beyond Grounded Theory by incorporating

contemporary and poststructuralist concerns, such as power analyses and reflexivity of the researcher. Additionally, by applying a social constructivist lens, Situational Analysis encourages the analyst to examine the multiple perspectives and the processes present in social life through a relational framework.

The analytic focus in Situated Analysis is the situation of inquiry (Clarke, Friese, and Washburn 2015). In this work, the issue of methylmercury impacts and reservoir clearing was the situation of inquiry. To construct the timeline of relevant events and explore the knowledge debates that emerged in the methylmercury and reservoir clearing issue, this study relied on primary data sources, including policy documents, official statements, reports produced throughout the EA process, and semi-structured interviews with 13 key informants (see Appendix A for interview instrument). These informants were involved in the case, participated in the knowledge disputes in the environmental assessment process, or were additional subjected matter experts. This work also used secondary sources, such as newspaper articles, to establish a timeline of events. Interviews were recorded and transcribed with transcription software, followed by qualitative content analysis of transcribed interviews and documents using NVivo software (QSR International 1999).

2.2.1 Positionality Statement

I am an interdisciplinary scholar interested in environmental health, as well as a Master's student at the Institute for Resources, Environment and Sustainability at the University of British Columbia in Vancouver, Canada.

The goal of this work is not to weigh in on the knowledge conflicts that emerged during the case study. Rather, the purpose of this work is to document, describe, and analyze such

conflicts with the aim of addressing challenges to knowledge construction in an EIA context. I therefore approached the case study chapter from a social constructivist perspective, in which EIA is situated in certain social and institutional contexts and serves as a venue for knowledge construction through interactions between decision-makers, scientists, and traditional and local knowledge holders.

I view myself as an outsider with respect to this research project because I was not directly involved in the Muskrat Falls Project case study. Additionally, I did not have any previous relationships with the research participants prior to starting my thesis work.

2.3 Case Study Description

2.3.1 Project Context and Timeline

Industrial development and resource extraction are tied to much of Newfoundland and Labrador's political culture, owing to its historical struggle to achieve its own identity within Canada and desire to attain a "have" rather than "have not" status (Bannister 2012). Much of this "have" status hinged upon resource extraction from Labrador, which was placed under the purview of the Dominion of Newfoundland by the British colonial government after over one hundred years of boundary disputes with the adjacent province of Québec (Hiller 1997; Interview 1). Knowledge holders in the area recall a visit from the province's first Premier, Joey Smallwood, wherein he expressed the desire to utilize Labrador's "energy warehouse" and develop the area (Interview 1). Many Labradorians express that there is a history of resource exploitation of Labrador on the part of the Newfoundland government in which Labrador is denied the benefits of such development (Interview 1; Interview 2).

The Lower Churchill Project, of which Muskrat Falls is a part, was originally sited and assessed in the 1980's, following the completion of the Upper Churchill Falls hydroelectric facility in the 1970's (Daly 2012; Samson 2018) (Figure 2.3.1). The Upper Churchill Project was deemed a political failure due to an energy contract that asymmetrically benefited Québec (Bannister 2012). The Muskrat Falls Project therefore presented an opportunity for political redemption; the ultimate symbol of "have" status. Indeed, several Premiers of Newfoundland and Labrador have heralded the Project as a representation of the province's modernization and independence (Samson 2018), becoming intertwined with the province's sub-nationalist rhetoric in the early 2000's (Bannister 2012).

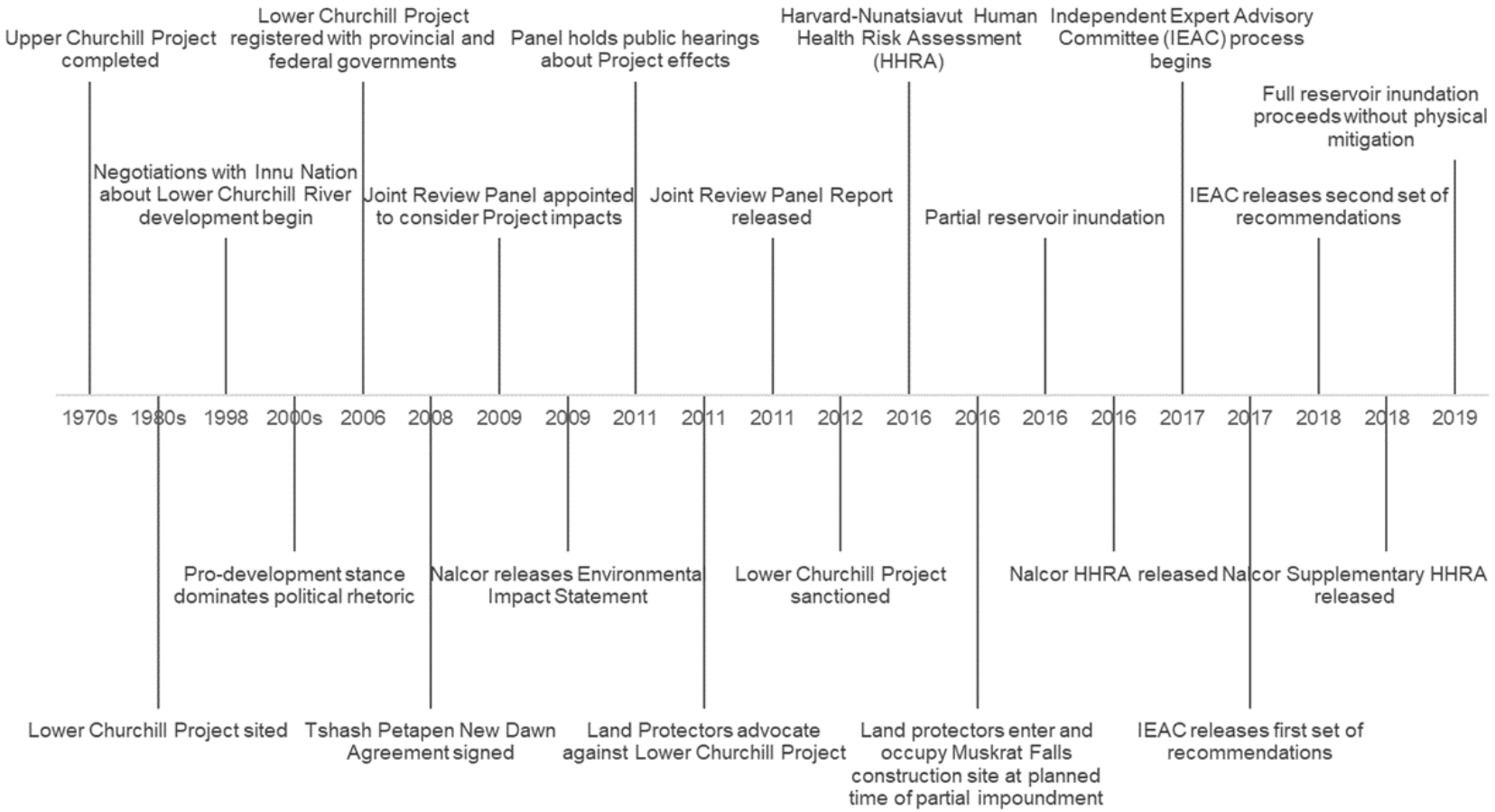

Figure 2.3.1 Timeline of events related to the Muskrat Falls Hydroelectric Project analyzed in Chapter 2

The Project's infrastructure is situated within Innu Nation's Labrador Innu Lands and Labrador Innu Settlement Area and the Traditional Territory of the NunatuKavut Inuit ("Our Rights Recognition" 2019; "The Tshash Petapen Agreement New Dawn Agreement" 2008) (Figure 2.3.2). It is also upstream of various communities and the Labrador Inuit Lands, which is governed by the Nunatsiavut Government, an Inuit regional government (Durkalec and Sheldon 2016). Consultations about the potential development of hydroelectric dams on the Lower Churchill River between the Government of Newfoundland and Labrador and Innu Nation started in 1998 (LeBlanc 2020b) and culminated in the signing of the Tshash Petapen New Dawn Agreement between Innu Nation, Nalcor, and the Government of Newfoundland and Labrador in 2008, which ties together Innu land claims, terms for Innu participation in development projects like Muskrat Falls, and redress for the harms of the Upper Churchill Project (Samson 2018). The NunatuKavut Community Council and the Nunatsiavut Government were not engaged to a similar extent (LeBlanc 2020b; 2020a).

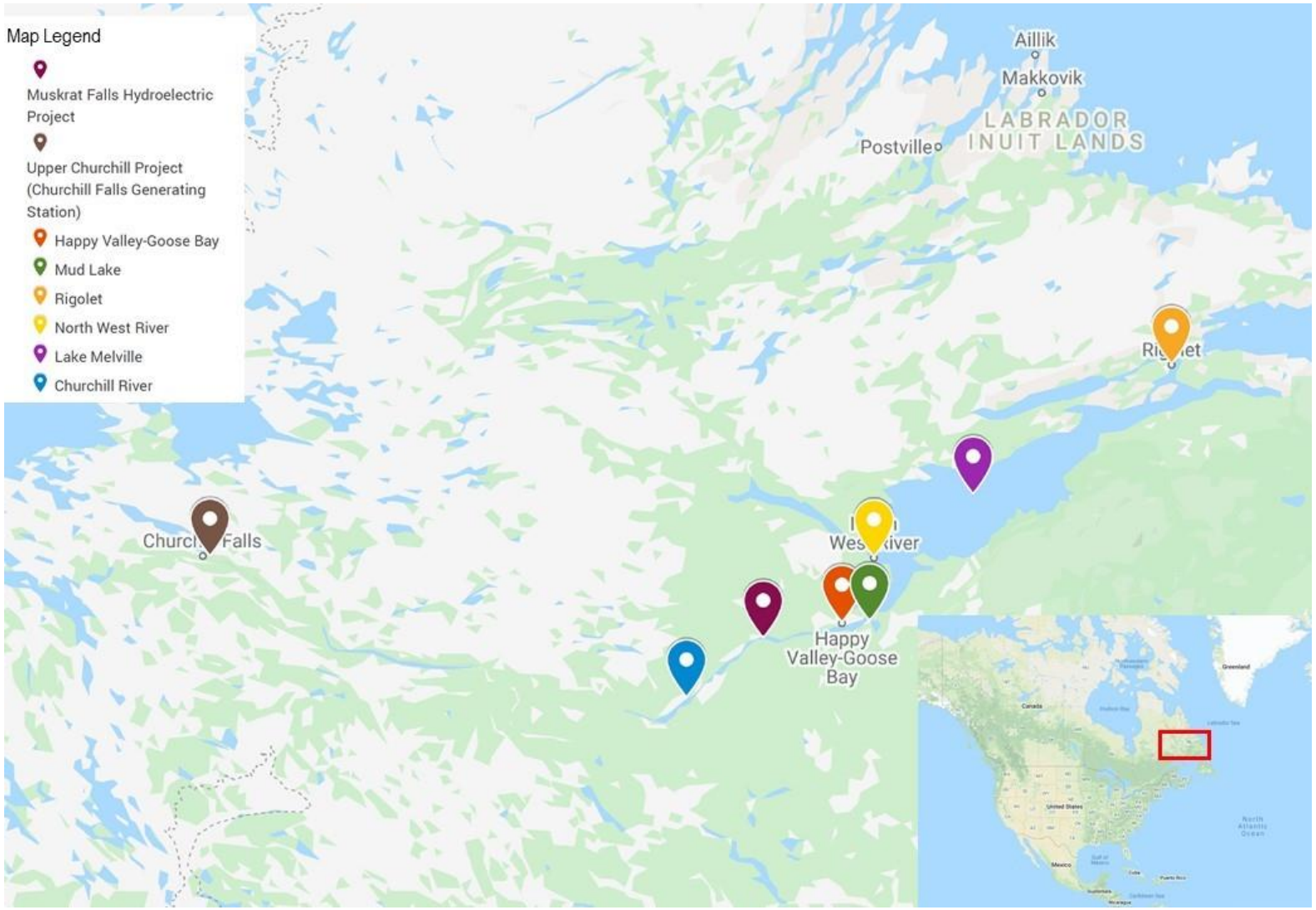

Figure 2.3.2 Map of Muskrat Falls Project area. Map data from © Google Maps INEGI

The Project underwent an extensive and lengthy review process (Interview 10; Interview 11), with many knowledge construction-related activities occurring post-sanction. The Project was registered with the provincial and federal governments in 2006 (LeBlanc 2020a), then referred to a Joint Review Panel composed of five members appointed by federal and provincial Ministers in 2009 (Joint Review Panel 2011). The Panel was mandated to consider whether the Project would cause significant adverse socio-economic and environmental effects and make recommendations to the provincial and federal governments. The Panel process included reviewing information provided by Nalcor, Newfoundland and Labrador's energy utility, various experts, and a 30-day public hearing that took place in 2011 in which interested parties shared their positions, interests, and concerns. The Panel released its report that same year, which noted a lack of baseline information about the area downstream of the Project and the many potential significant adverse effects on the environment, Indigenous culture and land-use (Interview 10). Despite these concerns, the Project was formally sanctioned in 2012 (CBC News 2012b).

There were several downstream community members who expressed concerns about the Project. The Labrador Land Protectors, a grassroots group of Indigenous and settler land protectors, have been advocating against aspects of the Muskrat Falls project since 2011 (Heaney 2020). Resistance movements culminated in 2016, around the time of the planned partial impoundment of the reservoir, when those self-identifying as the Labrador Land Protectors entered and occupied the dam's construction site. In an eleventh-hour meeting with Indigenous leaders brought on by the occupation of the Project site, the Government of Newfoundland and Labrador agreed to establish the Independent Expert Advisory Committee (IEAC) to review evidence and knowledge about the human health impacts of the Project on Indigenous and downstream populations and make recommendations to the Government of Newfoundland and

Labrador (LeBlanc 2020a). The IEAC was composed of a Chair, an oversight committee, and an expert committee ("Independent Expert Advisory Committee: Muskrat Falls Project" 2017). The oversight committee included voting representatives of the affected downstream communities, the Nunatsiavut Government, Innu Nation, the NunatuKavut Community Council, and non-voting representatives of the provincial and federal governments and Nalcor. It also included an expert committee, composed of six Western scientific and three Indigenous knowledge experts. Two sets of recommendations were released in 2017 and 2018 (Biasutti-Brown 2017; IEAC 2018b).

2.3.2 Methylmercury Issue

One of the central scientific debates that emerged over the course of the assessment was whether methylmercury impacts would extend beyond the Churchill River, where the Muskrat Falls Project is located, into downstream Goose Bay and Lake Melville (Figure 2.3.2). Reservoir flooding accelerates the methylation of inorganic mercury in flooded sediments, thereby increasing the concentration of neurotoxic methylmercury, sometimes up to hundreds of kilometers downstream (Kasper et al. 2014). Methylmercury then bioaccumulates in the food web, and humans are primarily exposed through consumption of aquatic foods (Clarkson 1993). In 2009, Nalcor released an Environmental Impact Statement (EIS) detailing potential socio-ecological impacts of the Project, in which it made the assumption that Lake Melville would dilute any methylmercury that would be produced in the reservoir, and therefore, from a methylmercury perspective, it was unlikely that there would be any downstream effects (Nalcor Energy 2009). As a result, the downstream effects of methylmercury production were omitted

from the assessment area and were not studied in the interim Human Health Risk Assessment (HHRA) included in the EIS.

Nalcor's assertion of no downstream methylmercury impacts was questioned by various participants in the Panel hearings, notably the Nunatsiavut Government, Indigenous knowledge holders, and downstream community members (Interview 1; Joint Review Panel 2011). The Nunatsiavut Government and downstream communities viewed Nalcor's framing of the methylmercury problem as a scientifically unfounded exclusion of downstream communities, a view shared with some regulatory experts, the Joint Review Panel, and other Western scientific experts (Calder et al. 2020; Interview 3; Interview 4; Interview 5; Joint Review Panel 2011). The Joint Review Panel recommended a comprehensive assessment of downstream methylmercury impacts in their final report. The Government of Newfoundland and Labrador then ordered Nalcor to submit a HHRA plan addressing methylmercury, contaminants in country foods, and effects on human health (LeBlanc 2020b). Nalcor submitted the first revision of the HHRA plan in 2014 (Nalcor Energy 2014).

Nalcor's Final Baseline HHRA, released in 2016, reported baseline methylmercury conditions in upstream and downstream communities along Lake Melville, not including the community of Rigolet. The Nunatsiavut Government did not issue ethics approval for Nalcor's consultants to conduct this research in Rigolet (Dillon Consulting Limited 2016). It was not until late 2018 that predictions of future methylmercury impacts was released by Nalcor in a Supplementary HHRA, after the IEAC recommendations were made, in which it was deemed "extremely unlikely" that Muskrat Falls will significantly increase methylmercury exposures and risks beyond the baseline (Willis 2018).

Following Project sanction in 2012, the Nunatsiavut Government requested funding from the Government of Newfoundland and Labrador to conduct its own research on downstream methylmercury impacts and implement an aquatic monitoring program (LeBlanc 2020a). This request was refused, and the Nunatsiavut Government proceeded in pursuing methylmercury research with the founding of the Lake Melville: Avativut, Kanuittailinnivut research program in collaboration with academics from several institutions, including Harvard University and Memorial University (Durkalec and Sheldon 2016). The objective of the research program was to study the impacts of hydroelectric projects on downstream methylmercury concentrations, methylmercury contaminants in country foods, and Inuit health. The range of methods included environmental sampling and modeling, dietary surveys, and human biomonitoring. The results of the research program were finalized in 2016, and the resulting publications argued that methylmercury impacts would extend further into Lake Melville than Nalcor had estimated and therefore downstream Inuit communities may experience methylmercury exposure over regulatory guidelines (Calder et al. 2016; Durkalec and Sheldon 2016; Schartup et al. 2015).

2.3.3 Reservoir Clearing Issue

During the Joint Review Panel hearings, Nalcor maintained the position that there was no feasible way to reduce methylmercury formation in the reservoir (LeBlanc 2020b). This was disputed by some, who suggested reservoir clearing as a mitigation measure. Clearing the soil and trees in the reservoir area prior to impoundment is predicted by some scientists to decrease the production of methylmercury, although it is not universally agreed upon, with some experts stating that soil disturbance can increase soil methylation (Durkalec and Sheldon 2016; IEC 2018). In their report, the Joint Review Panel recommended full clearing of vegetation in the

reservoir area prior to flooding (Joint Review Panel 2011). The IEAC echoed the sentiment of this recommendation again in 2018 when it unanimously supported wetland capping and supported targeted soil removal in the reservoir area with one dissenting vote (IEAC 2018a). However, there was widespread disagreement amongst experts, some of whom supported a combination of mitigation measures and others supporting none (IEC 2018).

Although targeted soil removal and wetland capping were recommended by the IEAC, full inundation of the reservoir proceeded in 2019 without these mitigation measures (LeBlanc 2020a). There was a considerable amount of uncertainty surrounding why the recommended measures were not taken, and the Government of Newfoundland and Labrador has not yet formally responded to the IEAC recommendations (Interview 1; Interview 5; LeBlanc 2020a; 2020b). The Public Inquiry into the Muskrat Falls Project revealed that Nalcor applied for a permit to complete wetland capping in July 2018, but it was not issued during the time window during which it would not cause significant delays to construction (LeBlanc 2020b). This timeline led many to question whether the delay in directing Nalcor to complete mitigation measures was intentional on the part of the Government of Newfoundland and Labrador (Interview 1; Interview 3; Interview 5; Roberts 2019). Certainly, these recommendations would cost hundreds of millions of dollars and be technically difficult according to an engineering report, a significant barrier for a project that was already billions of dollars over-budget and behind schedule (Vaughan 2018).

2.4 Results and Discussion

The following section analyzes instances of knowledge conflicts that fall into three categories and uses illustrative examples from the Muskrat Falls case study. The knowledge

conflicts are written as questions to facilitate their application to other controversial environmental policy problems. To clarify, I use the term EIA practitioner scientists to refer to scientists who often conduct their work in EIA and applied contexts.

2.4.1 Framing of the Methylmercury Policy Problem

Environmental policy problems are often socially constructed by particular epistemic communities, resulting in distinct framings of a given problem (Jasanoff 2001; Miller 2008). Throughout the Muskrat Falls EIA process, disputes about the framing of the methylmercury policy problem emerged (Table 2.4.1.1). There were two aspects of the methylmercury policy problem framing that caused disagreements amongst actors: the temporal boundaries of knowledge construction within the broader decision-making process and the physical scoping of the assessment area. Firstly, Nalcor and EIA practitioners frame the scientific portion of the EIA as an evolving process in which information and data is gathered over long periods of time and findings are continuously reviewed and validated. The framing of the methylmercury problem as iterative resulted in a significant portion of scientific knowledge construction about methylmercury impacts occurring post-sanction, after an important amount of political will and administrative law principles had contributed to the Project's momentum towards completion. Secondly, Nalcor and EIA practitioners framed the methylmercury policy problem as one in which downstream communities were not at risk of methylmercury impacts. In contrast, the Nunatsiavut Government and downstream communities focused their framing on those living downstream of the Project.

Broad Category of Knowledge Conflict	Knowledge Conflict	Illustrative Example from Muskrat Falls Case Study
Framing of the policy problem: *natural and social processes, networks, communities, and relationships that are relevant for the policy problem or decision-making context*	What are the spatiotemporal boundaries of the study system?	Should the physical scope of the study area extend into Lake Melville and include downstream communities?
	What are the temporal boundaries of the knowledge construction process within the broader decision-making process?	To what extent does new knowledge about methylmercury impacts influence decisions about approvals or mitigating measures?

Table 2.4.1.1 Framing of the policy problem knowledge conflicts

2.4.1.1 Temporal Boundaries of Knowledge Construction within the Broader Decision-Making Process

Nalcor and EIA practitioner scientists frame the scientific portion of the assessment as an evolving process in which data is gathered over long periods of time and findings are continuously reviewed and validated (Interview 6; Interview 9). In the case of Muskrat Falls, this framing delegated knowledge construction of baseline conditions and predictions of future impacts to future studies that occurred post-project approval. Indeed, much of the understanding of ecosystem and physical processes with respect to methylmercury was generated after the Project was sanctioned in 2012 (LeBlanc 2020b). At the time of the release of the EIS, there was limited baseline data in the area available and it relied on surrogate data from other areas (Nalcor Energy 2009). The Nunatsiavut Government and the Joint Review Panel argued that this assessment could therefore not make any detailed predictions about methylmercury impacts (Durkalec and Sheldon 2016; Joint Review Panel 2011). Additionally, the interim HHRA from

the EIS was not used by the consultants who performed the final HHRA, as the final HHRA was much broader in scope and used more robust toxicological and risk assessment approaches (Dillon Consulting Limited 2016). It was therefore the Harvard-Nunatsiavut research program and Nalcor's final HHRA, both occurring post-Project sanction, that contributed to the understanding of methylmercury cycling in Lake Melville and contaminants in country foods at that time.

This framing of understanding the methylmercury problem through evolving data gathering, interpretation, and knowledge construction is in stark contrast with the temporal political and administrative realities of EIA. Once a project is proposed and endorsed politically, interviewees noted that it appears to continue on a path towards completion, described as "Project Inertia" (Interview 3). The notion of Project Inertia is one in which a Project builds a certain amount of political will, buttressed by administrative law principles, and therefore moves forward largely unencumbered.

The political and historical context of the Muskrat Falls Project highlights the extent of political support that was fortified in the years preceding the project. Political support for the Project is further demonstrated by the Government of Newfoundland's perceived inadequate response and lack of response to recommendations made by the Joint Review Panel and the IEAC, respectively, that could threaten the viability of the project (Interview 1; Interview 5). One interviewee described the government's will to move the Project forward as follows, "…the underlying thing was that people wanted to build the dam and they didn't care what the other evidence was." (Interview 5). This was echoed by the Commissioner of the Public Inquiry into the Project (LeBlanc 2020a). Even among critics of the Project, there was a resignation to the

inevitability of Muskrat Falls given that it represented the next step towards progress for the province (Bannister 2012).

The political will contributing to Project Inertia is further buttressed by administrative law principles that come into play following Project sanction and statutory timelines. Administrative law principles limited the legal potential to revisit the decision after 2012, even though most of the work surrounding downstream methylmercury impacts occurred after that decision was made (Interview 7). Furthermore, Canadian courts rarely intervene in environmental decision-making and have limited involvement in the determination of the reasonableness of a decision, focusing instead on whether decision-makers fulfil their statutory obligations (Stacey 2015). Additionally, decision-making under scientific uncertainty must occur within timelines specified within relevant legislation that may not necessarily be consistent with community concerns or the necessary time for scientific studies to be completed (*Canadian Environmental Assessment Act* 2012; Interview 7; Interview 12).

2.4.1.2 Downstream Impacts

Nalcor and EIA practitioners framed the methylmercury policy problem as one in which downstream communities were not at risk of methylmercury impacts. In contrast, the Nunatsiavut Government and downstream communities focused their framing on those living downstream of the Project.

Acts of land protection by downstream community groups like the Labrador Land Protectors and the Harvard-Nunatsiavut research collaboration which supported these acts altered the Muskrat Falls story, rendering downstream methylmercury impacts a focal point. This revised framing placed pressure on the Government of Newfoundland and Labrador to

acknowledge these potential impacts through the establishment of the IEAC (Brake 2018). These efforts therefore contributed meaningfully to the framing of the methylmercury policy problem as one that includes downstream communities. It is unlikely that this framing would have occurred without these actors, given that Nalcor did not include downstream communities in their initial assessment area and that representatives of the Government of Newfoundland and Labrador testified in the Public Inquiry that they believed Nalcor's work to be adequate at the time (LeBlanc 2020a; 2020b; Nalcor Energy 2009).

Despite these objections, Nalcor maintains their framing of the methylmercury problem as one whose scope does not emphasize downstream impacts. In their response to the IEAC recommendations, the company stated that Muskrat Falls has a "low methylating reservoir" and therefore risk to human health as a result of methylmercury exposure was low (Azimuth 2018; IEAC 2018a; Willis 2018). Nalcor questioned the results from the Harvard study after it was published and during the IEAC process. Although the two studies shared similar assumptions and outcomes in upstream modelling predictions resulting in methylmercury concentration estimates within the same order of magnitude, whether the differences between the approaches and outcomes were significant was a source of contention amongst experts (Interview 3; Madden 2018).

2.4.2 Knowledge Construction Norms

Various knowledge construction norms also came into conflict during the Muskrat Falls EIA process (Table 2.4.2.1). There were disputes about the appropriate metric for representing population risk, how assumptions in HHRAs are captured and communicated, how data is validated, appropriate standards of data ownership and what constitutes independent research.

Nalcor and EIA practitioner scientists cited these differences in norms to question the legitimacy of the Harvard-Nunatsiavut HHRA, illustrating the emergent knowledge conflicts. Similarly, the Labrador Land Protectors used the ties between Nalcor, the Project proponent, and the regulator, the Government of Newfoundland and Labrador, to question the legitimacy of the Nalcor HHRA. Although the HHRAs were distinct, both studies were considered adequate after review by an independent Western scientist (Ollson 2018).

Broad Category of Knowledge Conflict	Knowledge Conflict	Illustrative Example from Muskrat Falls Case Study
Knowledge construction norms: *standards and norms about what constitutes legitimate research methodologies, and how to present and interpret data*	What is an appropriate metric for representing population exposure to an environmental toxin?	Should risk be expressed by population distribution of exposure, with attention drawn to those highly exposed, or expressed as the mean exposure of the general population?
		Should there be a focus on Inuit population exposure, or should the focus be placed on the general population?
	How are underlying assumptions in risk assessment captured and communicated?	How does detection of risk in a HHRA translate into actual risk? How should this actual risk be communicated to communities?
	What are the norms surrounding data validation?	To what extent is it important to validate site-specific dietary survey data with other similar communities?
	What are appropriate standards for data ownership, sharing, and transparency?	Are the norms of sharing human biomonitoring data set out by research ethics boards consistent with the level of validation and replication necessary in the regulatory context?
	What are appropriate standards for independent or neutral third-party research in the regulatory context?	Can scientific work conducted by consultants on behalf of Nalcor, with its ties to the government regulator that issues approval, be considered independent?

Table 2.4.2.1 Knowledge construction norms knowledge conflicts

2.4.2.1 Appropriate Metrics for Population Exposure to Environmental Toxins

The Harvard-Nunatsiavut HHRA represented risk as the Inuit population's distribution of potential exposure to methylmercury (Calder et al. 2016). The paper highlighted the distribution of risk across percentiles of exposure in Labrador Inuit to draw attention to the disproportionate increases in exposures expected to occur for those who are already highly exposed under baseline conditions and consume large amounts of country foods. The Harvard-Nunatsiavut group also specifically highlighted the distribution of potential exposure levels in the highest-exposed population in the Nunatsiavut town of Rigolet, which was greater than the mean of all communities in the Project area and the general population in Canada (Ollson 2018). The presentation of risk in this manner results from the methodological orientation and environmental justice perspective that with respect to environmental risks, the focus of decision-making should be at the extremes of exposure rather than the mean. One interview participant stated, "The big risks are never at the mean…as you make your way up increasing local food consumption, smaller and smaller numbers of people have more and more important risk." (Interview 3).

The Nalcor HHRA emphasized risk in a different manner, instead focusing on regulatory norms. This HHRA expressed risk as baseline and future predicted Hazard Quotients (HQs) and methylmercury concentrations in hair and blood (Dillon Consulting Limited 2016; Interview 8; Willis 2018). The HQs were presented by geographic community, sex, and by age class, with attention drawn to baseline and predicted values that exceed the target value set out by regulatory agencies. When describing risk qualitatively, EIA practitioner scientists used terminology consistent with norms in toxicology and risk assessment, such as "likely", "unlikely", and "negligible" (Dillon Consulting Limited 2016; Interview 8; Willis 2018). EIA practitioner

scientists noted that this was the standard way of presenting this kind of risk in an EIA context (Interview 8).

The Nunatsiavut-Harvard and Nalcor HHRAs differed in their population focus. The Harvard-Nunatsiavut HHRA and biomonitoring program centered around prospective risk of Inuit (Calder et al. 2016). Meanwhile, the Nalcor HHRA focused on baseline risk of communities within the Project area with some Inuit participation (Dillon Consulting Limited 2016; Golder and Associates 2015). The focus on Inuit participants and lifestyles is in line with Harvard's concerns that some populations may be more vulnerable to increases in methylmercury exposure and their risk should be captured independently. Indeed, the independent reviewer of both the Harvard and Nalcor HHRAs noted that capturing the highest-exposed population in Rigolet contributed to the representative understanding of methylmercury exposure among Inuit in the area (Ollson 2018).

2.4.2.2 Characterization and Communication of HHRA Assumptions

There were also differences in risk communication between the Harvard-Nunatsiavut HHRA and the Nalcor HHRA. Those working in the regulatory EIA sphere expressed that the Harvard-Nunatsiavut HHRA did not communicate the conservativeness inherent in its HHRA by not stating that it may overestimate risk to human health (Interview 8; Willis 2018). These interviewees argued that HHRAs typically operate under a high degree of conservatism and scientists conducting work for Nalcor conveyed that the detection of risk does not necessarily translate into actual risk, although this view is contested by other scientific experts (Interview 3).

Because of this, the Nalcor HHRA mentions several times that predictions of future exposure likely overestimate risk to human health (Willis 2018).

2.4.2.3 Data Validation Norms

Additionally, dietary survey data validation norms differed between the Harvard-Nunatsiavut HHRA and Nalcor HHRA. Scientists conducting work for Nalcor compared dietary surveys to characterize consumption patterns to other Northern systems and First Nations communities in Canada, the US, and Northern Europe (Dillon Consulting Limited 2016; Willis 2018). On the other hand, the Harvard-Nunatsiavut HHRA did not mention dietary survey data validation against other Northern communities (Calder et al. 2016).

2.4.2.4 Data Sharing and Transparency Norms

Conflicts also emerged over data sharing and transparency. The level of human biomonitoring data sharing on the part of the Harvard group and transparency in decision-making of the Harvard group was perceived by some EIA practitioner scientists as insufficient for validation and replication in a regulatory context (Interview 8). However, the Harvard group's research agreement with the Nunatsiavut Government and the Harvard University research ethics body precluded them from sharing human health data pertaining to Indigenous research participants without their consent (Interview 3).

2.4.2.5 Standards for Independent Research

The analysis also revealed contrasting norms surrounding independent knowledge construction in EIA. Downstream community groups held notions regarding what constitutes

independent knowledge construction that conflicted with those held by EIA practitioner scientists and Nalcor. The close relationship between the Government of Newfoundland and Labrador and Nalcor, compounded by the fact that in the Canadian context the proponent funds the studies that regulatory scientists and consultants conduct (Beanlands and Duinker 1986), led to a perception amongst some downstream community members that the assessment of methylmercury impacts was not independent. Political will and Project Inertia clouded any work that was conducted on behalf of Nalcor. One member of a downstream community described it as, "And no doubt in my mind, any group that works with Nalcor, and we saw that come through in the Muskrat Falls Inquiry, how many reports that were coming through were being vetted by Nalcor. They were allowed to redact whatever they felt should have been redacted. So, none of that work was really independent." (Interview 1). This sentiment of doubt surrounding the independence of any work that was sponsored by Nalcor led to a "climate of mistrust" (Interview 5), in which the Harvard group was perceived as the only source of independent knowledge.

Conversely, Nalcor and regulatory scientists consider the reputable scientists conducting the work and analysis of this work by regulatory agencies as sufficient for the work to be considered independent. EIA practitioner scientists expressed that although consultants are paid by the company, they are independent scientists who are nationally or internationally respected subject matter experts (Interview 6). Additionally, throughout the 2016 HHRA and 2018 Supplementary HHRA, there is mention of independent review by regulatory agencies such as Health Canada (Interview 8).

2.4.2.6 Contrasting Norms Results in Differences of Perceived Legitimacy

Nalcor used conflicting norms to question the legitimacy of the Harvard-Nunatsaivut HHRA. It was labeled "speculative" in nature by EIA practitioner scientists, who then argued that it therefore did not belong in the regulatory EIA arena (Interview 8; Willis 2018). EIA practitioner scientists also wrote that the Harvard-Nunatsiavut HHRA led to "…considerable fear and misperception of the actual risk posed by [methylmercury] among Lake Melville Inuit communities" (Willis 2018). Conversely, the Nunatsiavut Government and Harvard group argued that by not focusing on downstream Inuit lifestyles and consumption patterns in their risk assessment, the Nalcor HHRAs could not draw reliable conclusions about impacts on downstream Inuit communities (Durkalec and Sheldon 2016). Therefore, arguments about knowledge construction norms were used to question the legitimacy of the scientific work and what kinds of conclusions could be drawn from this work.

2.4.3 Reasoning about the Methylmercury Policy Problem

Actors interpreted the methylmercury policy problem in diverse ways, and therefore drew disparate conclusions about possible solutions (Table 2.4.3.1). Firstly, environmental harms were reasoned about by some in a relative manner and by others in an absolute manner. Next, there were clear differences in risk perceptions about methylmercury impacts, stemming in part from inconsistent conceptualizations of human health. Finally, actors invoked different interpretations of the Precautionary Principle.

Broad Category of Knowledge Conflict	Knowledge Conflict	Illustrative Example from Muskrat Falls Case Study
Reasoning about the policy problem: *how knowledge and data related to a policy problem or decision-making context is mobilized, applied, and reasoned about by decision-makers and stakeholders*	Should the consequences of a policy decision be reasoned about in absolute or relative terms?	Should the harms of the Muskrat Falls Project be considered cumulatively or relative to the baseline?
		Can the benefits of the Muskrat Falls Project offset the harms?
		Can the significance of the harms of the Muskrat Falls Project be offset by mitigation measures, such as consumption advisories?
	What constitutes a level of acceptable risk?	What level of risk are decision-makers and downstream communities willing to accept? Does the level of acceptable risk differ between the groups?
	What constitutes precaution in a decision-making context?	What does it mean to apply the precautionary principle in the context of the Muskrat Falls Project?

Table 2.4.3.1 Reasoning about the policy problem knowledge conflicts.

2.4.3.1 Relative and Absolute Reasoning About Methylmercury Impacts

Government decision-makers, EIA practitioner scientists, and Nalcor reasoned about environmental impacts in a relative manner. The relative reasoning provides justification for decisions that may cause harm by assuming that this harm can be neutralized by Project benefits and mitigation measures. Alternatively, some downstream community members reason about environmental harms in more absolute terms.

The relative reasoning about environmental harms employed by EIA practitioner scientists and Nalcor is evident in their treatment of cumulative impacts. In the case of Muskrat Falls, the severity of environmental harms was considered relative to the current environmental context of the Project area. When considering potential future exposures, EIA practitioner scientists and Nalcor drew conclusions about whether the Project would increase future methylmercury exposures and risks "beyond what occurs under *current, baseline conditions*." (Willis 2018, emphasis added). Therefore, risks to human health as a result of the Project were likely not considered in absolute terms of whether they were harmful but were instead considered based on whether the relative increases in methylmercury attributable to the Project were significant. Indeed, the 2018 Supplementary HHRA developed for Nalcor showed that there were some subgroups that could be above regulatory guidelines following reservoir flooding, however these groups were already above these guidelines at baseline (Willis 2018).

Another instance of relative reasoning is found in the statutory language that instructs decision-makers and Project proponents to consider potential environmental harm relative to project benefits (*Canadian Environmental Assessment Act* 2012). Potential environmental harms produced by a project can therefore be justified under the circumstances necessitating the project. This was the case in Muskrat Falls, wherein potential harms caused by increases in methylmercury were justified given the perceived need to develop renewable power generation on the Lower Churchill River (Canada 2011).

The relativeness in reasoning about potential environmental harms is also evident in the determination of the significance of a negative impact. When determining the significance of an impact, decision-makers and Project proponents assess the impacts after the implementation of mitigation measures (Government of Canada 2019). The main mitigation measure proposed was

consumption advisories, which involve advising at-risk populations to limit their intake of aquatic species that may contain unsafe levels of methylmercury (Nalcor Energy 2009). Therefore, potential increases in methylmercury in country foods could be justified, as it is assumed that this harm can be mitigated with consumption advisories.

In contrast, some downstream communities reason about environmental harms in absolute terms. In this way, methylmercury harms are not considered in relation to the current baseline exposure to methylmercury, do not relate to Project benefits, and cannot be lessened by mitigation. In the view of one downstream community member, "…anything that threatens land, water, lives, culture cannot be mitigated." (Interview 1). This was further evidenced in perceptions of consumption advisories as an inappropriate mitigation measure against methylmercury impacts (Durkalec and Sheldon 2016).

2.4.3.2 Conflicting Risk Perceptions and Conceptualizations of Human Health

There is a contrast between the perceptions of risk held by downstream community members, especially certain Indigenous people, and those of the Project proponent and EIA practitioner scientists. In this downstream construction of risk, the threat to downstream lives and livelihoods was perceived as existential, contrasting Nalcor's construction of the Project's risk to human health. Perceptions of risk were informed by notions of acceptable risk, with some downstream and Indigenous groups not able to accept any risk to health, culture, and lifestyle. These incompatible perceptions of risk may result from contrasting conceptualizations of human health.

The Labrador Land Protectors often framed the risk to the downstream communities as existential. This is evident in the severe and determinate language they use to describe the

Project as “poisoning” their community (Interview 1), and a threat to Indigenous and Labradorian culture and ways of life (Penney 2019). At demonstrations, land protectors held signs with similar language that read, “Don’t Poison Labrador”, and “Fighting For Our Lives” (CBC News 2012a; 2016; 2019). The Nunatsiavut Government also presented the potential impacts of the Project as existential, and being a threat to “…our health, culture, and way of life” (Nunatsiavut Government 2019). Additionally, Nunatsiavut Government leadership used the word “poison” to describe the impacts of the reservoir flooding on Inuit communities on multiple occasions (CBC News 2012a; 2019).

This language contrasts starkly with the risk framed by Nalcor and EIA practitioner scientists. The Nalcor HHRA describes the potential for human health risk as a result of baseline methylmercury exposure as “low to negligible”, and that any risks are similar to those in other North American communities in which there is a similar pattern of consumption of country and store-bought foods (Dillon Consulting Limited 2016). EIA practitioner scientists similarly described the potential for the Project to affect future methylmercury exposures and emphasized the low likelihood of impacts on future exposure. After making predictions about future exposures to methylmercury, EIA practitioner scientists concluded that, “…it is considered extremely unlikely that the [Project] would significantly increase future human [methylmercury] exposures and risks...” (Willis 2018).

The striking difference in language used to describe human health risk in downstream communities may stem from levels of acceptable risk. It was assumed by some EIA practitioner scientists that risk was misunderstood in the downstream communities (Interview 8). However, it appears that for many land protectors in downstream communities, any risk, whether low or negligible, is not acceptable. One interview participant described it as, “Now, if there’s any risk

at all, we can't take it" (Interview 1). Land protectors emphasized the unacceptable nature of the risks brought on by the Project through their descriptions of the Project as destruction of traditional lifestyles and direct actions taken against the Project (Brake 2018).

Levels of acceptable risk may stem in part from contrasting conceptualizations of human health. For many downstream community members, in particular those who are Indigenous, engaging in cultural practices on the land and harvesting country foods forms an integral part of their health and wellbeing (Donaldson et al. 2010; Penney 2019). The Nunatsiavut Government described consumption advisories as a "flawed health protection strategy" (Durkalec and Sheldon 2016) because of the adverse impacts associated with reduced consumption of country foods (Calder, Bromage, and Sunderland 2018; Durkalec and Sheldon 2016; Penney 2019).

The Government of Newfoundland and Labrador and Nalcor hold different views about consumption advisories. Although there was an acknowledgement of the importance of country foods, the Nunatsiavut Government perceived that these actors viewed country foods as fungible (Lampe 2019). This perception is demonstrated in that there was a willingness on Nalcor and the Government of Newfoundland and Labrador's part to accept some reduction in country food consumption and, as a result, offer monetary compensation (Azimuth 2018; CBC News 2019). For some, the stance that country foods can be replaced through monetary compensation implies that they are not integral to community health.

2.4.3.3 Conflicting Interpretations of the Precautionary Principle

Those involved in constructing knowledge related to the Muskrat Falls Project in part reasoned about the uncertainty of the methylmercury policy problem by invoking the Precautionary Principle. During the IEAC process, different interpretations of the Precautionary

Principle became a point of contention in debates surrounding whether the IEAC should recommend targeted soil removal and wetland capping in the Muskrat Falls reservoir as physical mitigation measures.

The interpretation of the Precautionary Principle held by the Nunatsiavut Government emphasizes that any physical mitigation measures that could potentially reduce environmental harm ought to be taken. The Nunatsiavut Government went on to explain, "We must do everything we can to protect the health of the Indigenous and local population through mitigation efforts to minimize impacts from methylmercury before the reservoir is inundated." (IEAC 2018b).

Nalcor's interpretation of the Precautionary Principle centered around the claim that there would not be significant methylmercury impacts downstream and therefore targeted soil removal was not necessary and in fact could be dangerous. One EIA practitioner scientist expressed, "We see the Precautionary Principle as we shouldn't take actions that will cause harm if we don't have the scientific evidence to support that it does not cause harm. As [for] mitigation for methylmercury, there was a very fulsome body of evidence…that we would not see an effect further downstream in the Lake Melville area" (Interview 6). This reasoning relied heavily upon questioning the feasibility, safety, and cost-effectiveness of targeted soil removal. Nalcor depicted targeted soil removal as a merely theoretical mitigation measure that was also potentially dangerous and therefore not in line with the Precautionary Principle (IEAC 2018b). Other experts also questioned the value of targeted soil removal as a methylmercury mitigation measure (IEC 2018).

Although the Government of Newfoundland and Labrador was unclear about preferred mitigation measures and interpretations of a Precautionary Approach, statutory language and

guiding documents provides insight into how levels of government interpret the Precautionary Principle and mitigation measures. For instance, federal legislation points to the interpretation of the Precautionary Principle associated with the 1992 Rio Declaration, referring to "*cost-effective measures* to prevent environmental degradation" (*Canadian Environmental Protection Act* 1999, emphasis added). The federal legislation detailing in part the requirements for the Muskrat Falls Project also repeatedly refers to a precautionary approach (*Canadian Environmental Assessment Act* 1992). Although it is not explicitly mentioned in the relevant provincial statutory language (*Environmental Assessment Regulations* 2003; *Environmental Protection Act* 2002), the Government of Newfoundland and Labrador acknowledges that a Precautionary Approach is one of the guiding principles of the legislation, defining it as, "Where there is a threat of serious or irreversible damage to the environment, all *reasonable* environmental protection measures will be taken…" (Government of Newfoundland and Labrador 2002), emphasis added).

It is important to note that the terms "cost-effective measures" and "reasonable…measures" are explicit within the federal and provincial interpretations of the Precautionary Principle. Thus, it is possible that the Government of Newfoundland and Labrador did not consider targeted soil removal and wetland capping a "cost-effective" or "reasonable" measure to protect the environment from methylmercury production and bioaccumulation. Although there was consensus that reducing the amount of bioavailable carbon in the reservoir area would result in a reduction of methylmercury formation, there was some debate amongst scientists as to whether the magnitude of reduction in methylmercury concentration would provide any measurable benefit to human health (Interview 6). The IEAC representative of the Government of Newfoundland and Labrador did not support any physical mitigation as proposed because of the unprecedented nature of the soil removal, although this was disputed. Importantly,

the representative's argument against physical mitigation also relied on the fact that that modelling exercises showed that, "…the risks were only somewhat mitigated…it is obvious that the benefit of such mitigation is small relative to modeling uncertainty." (IEAC 2018b). In other words, it was implied that the cost and effort of the targeted soil removal and wetland capping would not result in a corresponding measurable reduction in methylmercury exposure. It could therefore be argued that these mitigation measures were not "cost-effective" or "reasonable", even though they were desired by some downstream communities.

2.5 Chapter 2 Conclusions

This case study demonstrates the presence of different knowledge orders in the public arena of EIA. Distinct modes of constructing and applying knowledge for policymaking within particular social and institutional arrangements were employed by the downstream community, legal, regulatory, administrative, and academic knowledge orders. These distinct modes of knowledge construction resulted in knowledge conflicts over the framing of the policy problem, norms of knowledge construction, and modes of reasoning. Knowledge orders interacted, overlapped, and collided in ways that created knowledge-making patterns expressing methylmercury risks to human health (Miller 2008). The knowledge conflicts highlighted here and supported by empirical evidence from the Muskrat Falls case study also provide a theoretical contribution to studies of EIA politics and processes.

These distinct ways of knowing and applying knowledge have implications for discussions about improving EIA. When making recommendations, many scholars emphasize scientific rationale, transparency and accountability in decision-making, improving consultation processes, and ensuring impartiality between decision-makers and proponents as ways to de-

politicize the assessment process (Calder et al. 2020; Doelle 2014; Gibson, Doelle, and Sinclair 2016; Singh et al. 2020; Stacey 2015). Although these recommendations are certainly warranted, it is also imperative to pay closer attention to existing power disparities in the regulatory arena that may privilege certain norms and modes of reasoning over others.

Processes of knowledge co-production with distinct ways of knowing and applying knowledge often reinforce existing power inequalities (Turnhout et al. 2020). De-politicization of the knowledge construction process often contributes to these power inequalities in three important ways. Firstly, emphasis on scientific rationale and certain ways of knowing ignores power inequalities between elite actors who shape the knowledge construction process in their own interest (Parkinson 2012). In the case of Muskrat Falls, Nalcor framed the methylmercury policy problem in a way that could justify minimizing consultation with certain downstream communities, including those within the jurisdiction of the Nunatsiavut Government (LeBlanc 2020b). Although this framing is disputed by Nalcor, the Commissioner of the Public Inquiry into the Project concluded that the Government of Newfoundland and Labrador did not consult with the Nunatsiavut Government to the same extent as Innu Nation, who were engaged in considerable consultation and had their Traditional Knowledge incorporated into the EIA process, and that Nalcor refused to "acknowledge and consider the…effects of the Project downstream into Lake Melville" (Interview 8; LeBlanc 2020b). When a competing framing emerged, EIA practitioner scientists and Nalcor questioned that framing based on its misalignment with regulatory norms of knowledge construction, marking a clear boundary between regulatory and academic science. Furthermore, in sanctioning the Project with undesired mitigation measures like consumption advisories and allowing reservoir inundation without the

physical mitigation desired by some downstream community members, decision-makers demonstrated preference for a relative reasoning about Project impacts.

Secondly, processes of co-production that emphasize consensus often ignore differences in risk and stakes, leading to marginalization of knowledge systems (Chilisa 2017; Klenk and Meehan 2015; Turnhout et al. 2020). The Government of Newfoundland and Labrador's emphasis on consensus in the reservoir clearing issue obscured the risk perceptions of certain downstream communities, even though the stakes for these communities, particularly certain Indigenous groups, were extraordinarily high due to the importance of country foods for community health. Minimizing certain Indigenous voices in this way demonstrates a preference for Western conceptualizations of human health and relationships to the environment.

Finally, a lack of acknowledgement of the historical and political contexts of regulatory processes ignores existing power disparities that inform the co-production process (Akaateba, Huang, and Adumpo 2018; Foley et al. 2017; Turnhout et al. 2020). In this case, there was no acknowledgement of importance of the pro-development agenda of the Government of Newfoundland and Labrador and history of resource extraction in Labrador that contributed to the "Project Inertia" felt in Muskrat Falls EIA, and how this could affect the framing of the policy problem and modes of reasoning about methylmercury impacts.

These power inequalities demonstrate the privilege that can be bestowed upon the regulatory knowledge order in an EIA process. This privilege is aligned with previous criticisms of the Canadian regulatory landscape's broader civic epistemology, that is, one in which the environment exists solely for resource extraction (Behn and Bakker 2019; Stacey 2015). The modes of reasoning and norms favoured by decision-makers perpetuate this deeply engrained colonial relationship with the environment. Accordingly, suggestions to improve the EIA process

that do not acknowledge the asymmetrical power relations between knowledge orders will fall short. The future of EIA should include a pluralistic approach to knowledge construction that acknowledges existing power inequalities and provides a public arena for debates about knowledge to occur without emphasizing consensus.

Chapter 3: Educational Activity Illustrating Knowledge Conflicts in Environmental Impact Assessment

3.1 Introduction

Environmental policy choices are fraught with competing trade-offs between economic, environmental, social, and human health impacts. These trade-offs are further complicated in cases in which there are competing knowledge orders and historical power asymmetries, as is the case of the Muskrat Falls Hydroelectric Project. The inclusion of public participation in such decisions is hypothesized to lessen the divide that arises during environmental management conflicts (Arvai, Gregory, and McDaniels 2001). However, there remains a challenge to environmental decisions in balancing public input and values with economic constraints and government objectives (Czaika and Selin 2016). Such difficulties are particularly salient in the case of the Muskrat Falls Project, as discussed in Chapter 2 of this thesis.

Decision science research suggests that individuals and groups experience difficulty defining the multitude of concerns in complex decision-making contexts, such as EIAs (Fischhoff, Slovic, and Lichtenstein 1978). Decision-makers may therefore be unequipped to make complex decisions in which there may be conflicting knowledge orders, such as the Muskrat Falls Project, which may result in decisions that only address certain dimensions of concerns (Bohnenblust and Slovic 1998). The dimensions that are emphasized are often those that are in line with the norms and modes of reasoning that sit comfortably within privileged knowledge orders (Parkinson 2012), such as those described in Chapter 2 of this thesis.

Structured decision-making (SDM) is a framework for environmental and public policy decision-making that may facilitate the process of complex decision-making (Gregory 2012). The process provides a deliberative framework that guides meaningful stakeholder participation and attempts to address power asymmetries between knowledge orders by valuing multiple ways of knowing and not emphasizing consensus. In line with this, research demonstrates that when SDM is used in a public input context, a broader range of decision alternatives are explored and participants are more satisfied with their decisions (Arvai, Gregory, and McDaniels 2001). Therefore, SDM could address certain challenges associated with the EIA process that were identified in Chapter 2 of this thesis.

The SDM process involves a collective definition of the decision problem, elicitation of stakeholder values, generation of evaluation criteria and decision alternatives, and evaluation of alternatives against the evaluation criteria to understand the consequences of each decision alternative (Gregory 2012). Research suggests that SDM allows decision-makers to understand the consequences of decisions by actively exploring the decision space themselves rather than passively receiving information (Dowlatabadi 1995). As a result, decision-makers are more likely to meet or exceed initial priorities (Czaika and Selin 2017). Additional research in conflict-riddled conservation areas showed that group deliberation as a result of SDM lead to the identification of options best suited to reduce conflict (Redpath et al. 2004). Furthermore, research shows that when SDM is used in a public input context, a broader range of decision alternatives are explored and participants are more satisfied with the decisions that are made (Arvai, Gregory, and McDaniels 2001).

Serious games are educational role-play simulation activities that enable students to explore the SDM process. In these activities, instructors assign stakeholder roles and a realistic

decision context to participants, who must then advocate on behalf of their role in a simulated public negotiation. Oftentimes, there is an assigned decision-maker who must draft a policy decision at the end of the experience. Serious games are commonly used as an experiential learning tool to teach students about the social processes that interact with regulatory science, as well as to evaluate the processes and outcomes of sustainability decision problems and negotiations (Czaika and Selin 2017; 2016; Stokes and Selin 2016; Herbst and Schwarz 2011). One study found that post-secondary students expressed learning about how scientific uncertainty affects policy decisions and social processes affect environmental negotiations after participating in a serious game focused on international mercury politics (Stokes and Selin 2016). Serious games therefore represent an excellent learning activity in the post-secondary context.

This chapter describes an educational activity that enables post-secondary students to explore how Structured Decision-Making (SDM) may address knowledge conflicts in an Environmental Impact Assessment (EIA) context. The educational activity is designed based on the results from the Chapter 2 case study of the Muskrat Falls Project and takes the form of a role-playing simulation "serious" game, in which students participate in a public hearing which culminates in a final decision about whether to approve the Project. The public hearing structure either follows the conventional EIA process or uses an SDM approach, and students are encouraged to reflect on their experience at the end of the activity through a series of surveys and in-class discussions. There are four participants in each group, including the decision-maker, the Nunatsiavut Government, the Labrador Land Protectors, and Nalcor Energy. The decision context centres around the issue of reservoir flooding as a physical mitigation measure to reduce the bioaccumulation of methylmercury. The students either follow a decision-making framework

of a typical EIA or an SDM framework. At the end of the activity, the student assigned the role of decision-maker must decide whether to approve the Project and under which mitigating measures, as well as provide justification for their decision. Finally, students receive a pre-survey and post-survey and engage in a class discussion to prompt reflection upon the science and policy interactions in an EIA context and the social, human health, environmental, and economic dimensions of environmental decision-making. This work contributes to the ongoing improvement of the Canadian EIA process by educating future environmental leaders about pluralistic approaches to environmental decision-making.

3.2 Description of Serious Game

3.2.1 Serious Game Design

The serious game is a four-party, single issue, scoreable simulation game. The premise of the serious game is a simulation of a public hearing that occurred during the consultation portion of the Muskrat Falls EIA, after the completion of the EIS by Nalcor in 2009 and prior to project sanction in 2012 (see Figure 2.3.1 for details of the Project timeline). The decision context centres around the issue of reservoir flooding and associated methylmercury impacts. There will be three pre-selected decision alternatives, selected based on the results of the case study analysis in Chapter 2 of this thesis. Option 1 is to approve the Project with partial (70%) reservoir clearing, option 2 is to approve the Project with full (100%) reservoir clearing, and option 3 is not to approve the Project. This activity is intended to be an adaptation of the Muskrat Falls Hydroelectric Project EIA process, and therefore is not wholly representative of the process itself and stakeholder input that was elicited throughout the process.

There are three levels of randomization in this serious game. First, participants are randomly assigned to either a structured or unstructured decision-making framework. Next, participants are randomly assigned to a group of 4 participants with whom they play the game. Finally, each participant is randomly assigned a role to play based on the Muskrat Falls case study. There are four roles: the Minister of Environment and Climate Change (the decision-maker), the Nunatsiavut Government, the Labrador Land Protectors, and Nalcor Energy (the Project proponent). A simulation facilitator is needed to ensure the activity runs smoothly and answer questions. The role of the facilitator is not to facilitate or direct the meetings in any way; the instructions given to participants should be clear enough for them to conduct their own meeting. Multiple iterations of the game run in concert in a medium to large-sized lecture hall. Before starting the game, participants are instructed by the facilitator to engage in discussion solely with their group.

The serious game includes two different frameworks for decision-making that students follow and various measures that encourage students to reflect on the quality and outcome of the decision (Table 3.2.1.1). The students are placed either in a group that follows a SDM framework or an unstructured decision-making framework, which is intended to replicate a typical EIA process. The quality of the decision process is measured using 7-point Likert scale surveys given to students before and after the activity (see Appendices B.1 and B.12). The variables associated with decision quality include whether participants felt there was enough information for the decision-maker to make an informed choice, whether the decision-maker's choice reflected the information presented by participants, how satisfied participants were with the decision, and whether the decision reflected the concerns of their role and those of other

stakeholders. The decision outcome is assessed by which alternative is selected by the decision maker, role-specific preference point scores, and the total preference point scores of groups.

	Decision-Making Frameworks	
	Structured Decision-Making	**Unstructured Decision-Making**
Decision Quality and Outcome Measurements	Decision Quality Surveys	Decision Quality Surveys
	Decision Alternative Selected by Decision-Maker	Decision Alternative Selected by Decision-Maker
	Preference Points	Preference Points

Table 3.2.1.1 Serious game design

The quality of decision outcomes can be measured in terms of how well the decision represents the goals and priorities of stakeholders and how well the decision compares to other alternatives (Czaika and Selin 2017). Preference points present a way to operationalize these somewhat abstract concepts of decision quality and decision outcome in the game design. Each stakeholder role will have different amounts of preference points associated with each decision alternative found in their role instructions (Table 3.2.1.2). This game design element operationalizes the first dimension of quality of decision outcomes. If the preferred decision alternative for a given stakeholder is selected by decision-maker, the stakeholder will gain the maximum number of preference points.

Decision Alternatives	Roles and Associated Points			
	Nunatsiavut Government	Labrador Land Protectors	Nalcor Energy	Minister of (Total Points)
Option 1: Approve project with partial reservoir clearing	2	2	10	14
Option 2: Approve project with full reservoir clearing	10	5	5	20
Option 3: Don't approve project	5	10	2	17

Table 3.2.1.2 Preference point allocation for various roles

There will also be total preference point scores for each group, which represent the sum of the total preference points from each stakeholder. This addition to the game operationalizes the latter concept of the quality of the decision outcome. The game will therefore be designed to have one decision alternative which achieves the Pareto Frontier of achieved outcomes. The Pareto Frontier represents the policy choice whereby improvement in one policy dimension coincides with decline in one or more additional policy dimensions (Mattson, Mullur, and Messac 2004). The alternative on the Pareto Frontier is Option 2, "Approve with full (100%) mitigation" because this option represents that in which the preference points are maximized for all stakeholders.

3.2.2 Activity Timeline

The serious game activity follows the timeline in Table 3.2.2.1. Participants are given five documents to read before class. These include an Introductory Presentation (Appendix B.2),

which introduces participants to the game, how it is played, and some background information about EIA, a General Instructions document (Appendix B.3), which briefs participants on the premise of the game, a Scientific Briefing document (Appendix 4), which conveys scientific information about hydroelectric projects and methylmercury contamination and bioaccumulation, their role's instructions (Appendices B.5, B.6, B.7, B.8), which details each stakeholder's concerns, values, responsibilities and motivations, and a Discussion Guide (Appendices B.10, B.10), which guides students through the discussion portion of the simulation using either an SDM or unstructured framework.

Unstructured Decision-Making Framework	Structured Decision-Making Framework
Before class 1. Random assignment of stakeholder role 2. Review documents (20 min) 3. Pre-Survey and quiz (10 min) **During class** 4. Opening statement (5 min) 5. Unstructured group discussion (20-30 min) • Each party is given a limited period of time to make comments 6. Government Decision (5 min) 7. Post-Survey (10 min) 8. Class discussion (20 min)	**Before class** 1. Random assignment of stakeholder role 2. Review documents (20 min) 3. Pre-Survey and quiz (10 min) **During class** 4. Opening statement (5 min) 5. Structured group discussion (20-30 min) • Problem definition • Elicitation of evaluation criteria • Evaluation of decision alternatives • Assessment of trade-offs 6. Government Decision (5 min) 7. Post-Survey (10 min) 8. Class discussion (20 min)

Table 3.2.2.1 Serious game activity timeline

Participants complete the Pre-Survey and quiz online before coming to class (Appendix B.1). The quiz ensures that the students have read the assigned material, and the Pre-Survey

elicits initial perceptions about knowledge co-construction and stakeholder and expert input in environmental decision-making. After organizing into their groups of 4, participants from both conditions present their role's opening statements to their group. Participants in the structured decision-making condition then go through the decision structuring tasks in a group discussion format, which includes defining the problem, eliciting evaluation criteria, and evaluating decision alternatives. Participants in the unstructured decision-making treatment engage in an unstructured group discussion of the same length. Following group discussions, the decision-maker select from the 3 pre-selected options based on the content of group deliberations and are asked to justify their decision to their group and on the Decision Form (Appendix B.11). Participants will finish the game upon completion of the Post-Survey (Appendix B.12), designed to capture their perceptions about the decision process and outcome and compare them with answers from the Pre-Survey. The Post-Survey is followed by a class discussion about the participants' experience, the EIA process, how to determine policy-relevant social and natural processes in a decision-making context, how standards and norms legitimize knowledge and knowledge construction, and how knowledge is reasoned about, mobilized, and applied in a regulatory context. The entire activity has a running time between 1-2 hours.

3.3 Chapter 3 Conclusion

This Chapter proposes a novel experiential educational activity in the form of a serious game based on the Muskrat Falls Hydroelectric Project case study discussed in Chapter 2 of this thesis. It is appropriate for post-secondary students in a variety of sustainability-related disciplines. I successfully facilitated this educational activity in seven undergraduate and graduate classrooms at the University of British Columbia in 2019. These classes fell within the

disciplines of geography, environmental science, environmental studies, interdisciplinary studies, and applied sciences.

The serious game experience discussed here encourages students to engage in discussions relevant to Chapter 2 of this thesis. These discussions include those about knowledge construction in the regulatory context, as well as how knowledge conflicts emerge through conflicting framings of the policy problem, disparate norms of knowledge construction, and disputed modes of reasoning about the policy problem. Further, it introduces future sustainability leaders to the SDM framework to environmental decision-making and encourages students to recognize the importance of pluralistic approaches to knowledge construction in an EIA context.

Although SDM appears promising, its use is currently restricted to few fields, such as conservation management. Past research has disproportionately focused on testing the development of tools, comparing different tools, or improving the SDM design process and often relies on case studies (Davies et al. 2014; Huang, Keisler, and Linkov 2011). This approach lacks the empirical evidence required to strengthen the claim that SDM can address power asymmetries and other shortcomings in the EIA context.

Chapter 4: Conclusion

4.1 Research Contributions

This thesis provides empirical support for the presence of distinct knowledge orders in Environmental Impact Assessment. These findings build on the theoretical and empirical contributions of scholars who highlight the importance of social and institutional processes in knowledge construction in the regulatory sphere (Miller 2008; Jasanoff 1987; 1991; 2005; Öberg and Mason-Renton 2018). In the case of the Muskrat Falls Hydroelectric Project EIA, knowledge orders interacted, overlapped, and collided in ways that generated knowledge-making patterns expressing methylmercury risks to human health. Moreover, this work provides a theoretical contribution to studies of knowledge politics in EIA by identifying and categorizing potential knowledge conflicts that may emerge over the course of a controversial environmental regulatory decision using illustrative examples from the Muskrat Falls case study. Finally, this thesis provides a practical contribution to the sustainability education literature in its proposal of an educational activity that allows participants to explore knowledge orders and their implications in a controversial decision-making context and the potential for a Structured Decision-Making framework to address such implications.

In Chapter 2, I discuss the regulatory and academic-community knowledge orders in the Muskrat Falls case study. These knowledge orders differ in their ways of knowing and reasoning about policy problems embedded within distinct political and institutional orders (Miller 2008). The regulatory knowledge order consists of the Government of Newfoundland and Labrador, Nalcor, and EIA practitioner scientists. The academic-community knowledge order includes the academic scientists, the Nunatsiavut Government, and downstream community members. I find

that these knowledge orders differ in their framing of the policy problem, norms of knowledge construction, and modes of reasoning about the policy problem. These differences have been noted in other jurisdictions, such as carcinogenic risk assessment, climate change, and the use of embryonic stem cells for scientific research (Jasanoff 1991; Nisbet and Mooney 2007). Indeed, some scholars argue that the framing of a policy problem that invokes science and the way in which that problem is discussed can impact the direction of future research and the way in which the public is aware of and thinks about policy issues and contributes to knowledge construction in the public arena (Elliott 2011; Nisbet and Mooney 2007; Larson 2011). Furthermore, in Chapter 2 I analyze the implications of the power structures that exist in EIA. The implications of power asymmetries in the EIA process are that the regulatory knowledge order is privileged because it perpetuates modes of reasoning that are in line with the view that the environment exists largely for resource extraction, which other scholars have duly noted (Behn and Bakker 2019; Stacey 2015; Turnhout et al. 2020), and is also reflected in the Government of Newfoundland and Labrador's pro-development agenda and marginalization of downstream community voices, risk perceptions, and conceptualizations of human health.

In Chapter 3, I incorporate the implications of the research findings discussed in Chapter 2 into the design of an experiential learning activity. This activity builds on previous serious games designed for sustainability education that are valuable for post-secondary student learning and is novel in its focus on domestic policy issues in EIA (Czaika and Selin 2017; 2016; Stokes and Selin 2016).

4.2 Research Limitations

The Muskrat Falls case study is limited in its generalizability to other cases, but also provides substantial insight into how the Canadian EIA process addresses megaprojects, particularly hydroelectric development legacies. In qualitative inquiry, case studies are generalizable to theory rather than to populations (Yin 2014b). The Muskrat Falls case is therefore not necessarily representative of all EIAs in Canada.

In many ways, Muskrat Falls is an exceptional case. Many interviewees expressed that it is one of the most intensely studied EIAs in Canadian history (Interview 8; Interview 6; Interview 2; Interview 5; Interview 10). Those who participated in the EIA process describe boxes upon boxes of scientific data and information that were reviewed by expert panels and a wide variety of regulatory experts (Interview 10; Interview 2; Interview 6). There was also significantly more public engagement in the Project than is typical in an EIA; the Joint Review Panel traveled to dozens of potentially affected communities and representatives from Innu Nation contributed significantly to the design and implementation of the Project (Interview 10; LeBlanc 2020a; "The Tshash Petapen Agreement New Dawn Agreement" 2008). Additionally, due to concerns about the government handling of the Project, there was a Public Inquiry held in 2019 and 2020 (LeBlanc 2020a). Moreover, the case attracted significant media attention, with protests and hunger strikes across the country (CBC News 2012a; Brake 2018; CBC News 2016; Barry, White, and Goodyear 2016).

Despite these exceptionalities, Muskrat Falls is also representative of the broader issues identified in EIA and theoretical concepts in the realm of science and policy. For instance, the limitations in geographical scope of the study area and data gaps that mired the early part of the

Muskrat Falls EIA are also present in other jurisdictions (Singh et al. 2020). Marginalization of certain voices, in particular Indigenous voices, has also been noted in the case of the Site C dam in British Columbia (Behn and Bakker 2019). Additionally, conceptualizations of human health that prioritize the biophysical aspects of health have also been documented in other EIAs in Canada, for instance in the case of hydroelectric development in northern Manitoba (Hackett, Liu, and Noble 2018a; Peterson, E. & Kosatsky 2016b). In terms of connections to theory, the findings discussed in Chapter 2 illustrate the presence of knowledge orders identified by Miller 2008, and that competing knowledge claims and scientific uncertainties are assessed and legitimized based on values and normative concerns (Miller 2008; Jasanoff 1991). Therefore, the case study analysis in Chapter 2 may be representative of the larger landscape of hydroelectric development legacies in Canada and the EIAs that assess such projects. It is also representative of broader theoretical concepts in knowledge politics and civic epistemologies.

Further limitations to this research include the lack of evaluation of the serious game educational activity proposed in Chapter 3. Therefore, I cannot make claims about the quality of the activity or whether the learning objectives were attained by the participants. However, anecdotally, many students and educators enjoyed the activity, with several educators repeating it in subsequent semesters.

4.3 Future Research Directions

There are several future directions for this research, some of which would address the limitations discussed in section 4.3. Firstly, the experiential learning activity described in Chapter 3 could be evaluated for whether it achieves the intended learning outcomes of exploring

knowledge politics in EIA and whether SDM offers insights to participants about what constitutes meaningful stakeholder participation.

Secondly, the assumption that SDM aids in the process and outcome of complex decisions in pluralistic regulatory contexts ought to be empirically evaluated. Future research could use the simulated learning activity presented in Chapter 3 in post-secondary student populations to empirically test whether the use of SDM leads to a different experience and decision outcome when compared with those who follow the unstructured decision-making framework. The experiment could include a multipart design with one independent variable (structured decision or unstructured decision) and various dependent variables which operationalize the quality of the process and decision outcome. The dependent variables measuring the process could include whether participants felt there was enough information for the decision-maker to make an informed choice, whether the decision-maker's choice reflected the information presented by participants, how satisfied participants were with the decision, and whether the decision reflected the concerns of their role and those of other stakeholders. The dependent variables measuring decision outcome could include which alternative is selected by the decision maker, role-specific preference point scores, the total preference point scores of groups. The experiment could follow the same structure as the activity described in Chapter 3 (Table 3.2.2.1). and use the same surveys (Appendices B.1 and B.12) and the Decision Form (Appendix B.11) presented in this thesis to collect that data.

Finally, a study of whether the categories of knowledge conflicts identified and described in Chapter 2 apply to other controversial regulatory decisions would provide further insight into knowledge politics in EIA and whether these conflicts are representative of the broader Canadian regulatory landscape. For example, as the Site C dam share some similarities with the Muskrat

Falls Project, it is possible that the same categories of knowledge conflicts apply to that case as well.

4.4 Policy Implications

Following the conceptualization and implementation of this research, the new federal *Impact Assessment Act* (IAA) entered into force. Although this iteration of the legislation is finalized, it will hopefully continue to be improved upon in the future. My research provides insight into avenues for improvement of IA in the Canadian context, detailed below.

The new legislation is transformative in that it expands the scope of traditional EIA to an Impact Assessment (IA) model, which focuses in on sustainability goals more broadly rather than specific environmental impacts (Johnston 2019). The consequence of this change is that a more expansive range of impacts will be considered in assessments, including social, economic, gender, and human health impacts. This is a welcome addition to a process that has previously been fragmented in its treatment of human health impacts (Hackett, Liu, and Noble 2018a; Peterson, E. & Kosatsky 2016b; McCallum, Ollson, and Stefanovic 2018) and, like the Muskrat Falls case discussed in Chapter 2, is somewhat narrow in its interpretations of what constitutes a meaningful impact on human health. Additionally, the Act does not restrict participation in assessments to a subset of interested parties as did the 2012 legislation (Johnston 2019). This is another positive aspect of the legislation because, as the Muskrat Falls case study demonstrates, the role of community activists in knowledge construction is important for framing the policy problem and reasoning about it in a way that reflects the knowledge orders to which community members adhere.

Despite these improvements to the legislation, there remain significant areas that could be improved. For instance, there is still a significant amount of discretionary power given to decision-makers (Johnston 2019). Scholars often criticize expansive discretionary power because it tends to reduce transparency and accountability in decision-making (Stacey 2017). Indeed, in the case of the Muskrat Falls Project, the Government of Newfoundland and Labrador was not required to provide a formal justification for its lack of implementation of the IEAC's recommendations and therefore did not, resulting in a lack of accountability to downstream community members. In the future, decision-makers should be required to provide a detailed justification for decision-making that addresses the concerns outlined by communities, which many scholars have recommended in the past (Gibson, Doelle, and Sinclair 2016; Stacey 2017). Others recommend legally binding recommendations from scientific and expert panels to resolve the accountability issue (Calder et al. 2020), however I am skeptical of such strict measures that could reinforce existing power structures and encourage adherence to dominant regulatory norms and modes of reasoning.

Furthermore, despite the legislation opening participation to the entire public, it is unclear whether this will result in meaningful participation. Scholars argue that power asymmetries can result from lack of public access to funding and knowledge about the EIA process (Turnhout et al. 2020). Unfortunately, there are no requirements for participant funding programs in the new IAA (Johnston 2019). This could exacerbate existing inequalities identified in Chapter 2 in the regulatory sphere. Future iterations of IA legislation should bridge this gap by providing guaranteed funding for groups that wish to participate meaningfully in the process. Additionally, public participation in the process needs to occur in the early stages; the concept of Project Inertia described in Chapter 2 illustrates the importance of early injection of scientific and local

knowledge in the IA process before political interests and legal constraints limit decision-making. In the case of IAA, the public will have the opportunity to participate in the planning phase of the Project, however there are cases in which decisions can be made immediately following the public comment period, which indicates that decisions will largely be made prior to the finalization of public input (Johnston 2019). Such measures unfairly constrain knowledge construction to predefined timelines and should instead be flexible to accommodate local knowledge and scientific knowledge constructed outside of the regulatory sphere.

It is unclear how the new legislation will integrate different knowledge orders. Although the Act mentions coordination with Indigenous authorities, which could aid in the integration of different ways of applying and legitimizing non-Western forms of knowledge, the colonial government maintains authority over decision-making (Johnston 2019). This authority means that the dominant Canadian regulatory civic epistemology that emphasizes consensus instead of differences in stakes, does not acknowledge the importance of historical and political contexts in decision-making, and prioritizes relative modes of reasoning will remain intact. The integration of distinct knowledge orders requires the disruption of this broader civic epistemology.

To move towards a more inclusive and pluralistic form of IA, we need to make room for different knowledge orders in the regulatory sphere by acknowledging power and politics, emphasizing deliberation in the public arena, and providing viable avenues for resolution of knowledge conflicts. Some scholars argue that EIA should include the establishment of impartial government bodies involved in initial decision-making, with opportunities for ministerial or cabinet review or reversal of decisions (Gibson, Doelle, and Sinclair 2016). Although I agree that it would reduce public perceptions of the lack of impartiality in current decision-making, I would like to problematize the assumption that impartiality in these government bodies will result in

more inclusive decision-making. Indeed, as previously discussed in section 2.6, Turnhout et al. 2020 detail the perils of de-politicization of regulatory decision-making, in which norms of knowledge construction, evidentiary standards, and modes of reasoning held by powerful elites are maintained. Instead, there should also be an explicit acknowledgement of stakes via an assessment of the distribution of risks and benefits of a proposed undertaking and analyses that detail the historical and political contexts that could influence decision-making. Additionally, knowledge construction in IA should resemble SDM: emphasize different ways of knowing to accommodate contrasting knowledge orders, focus on deliberation rather than consensus to generate a broader range of decision alternatives, and explicitly acknowledge values and objectives early in the process. Finally, I agree with other scholars who recommend that future legislation include a decision appeals process that be used to dispute scientific rationale and evidence used for regulatory decision-making, similar to how in the US, regulatory decisions can be challenged in court (Gibson, Doelle, and Sinclair 2016; Miller 2008; Jasanoff 1991).

Despite the promising and less-than-promising aspects of the new legislation, it is not likely that enough time has passed to fully understand the social, environmental, economic, cultural, and human health-related consequences of the new Act (Interview 7). Whether the Act's goals of a justifiable decision-making framework that aims to promote sustainability are achieved will depend on future policy and implementation at the provincial and federal levels of government.

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Interview 7. n.d. Interview with legal expert.
Interview 8. n.d. Interview with Environmental Impact Assessment practitioner scientist.
Interview 9. n.d. Interview with Environmental Impact Assessment practitioner scientist.
Interview 10. n.d. Interview with legal expert.
Interview 11. n.d. Interview with Environmental Impact Assessment practitioner scientist.
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Appendices

Appendix A : Chapter 2 Case Study Semi-Structured Interview Instrument

1. When did you/your Organization become involved in the scientific and/or policy debates surrounding this project? What prompted your involvement/the involvement of your Organization?
2. In your view/the view of your Organization, what are the potential risks and benefits of the Muskrat Falls hydroelectric project? How are these distributed?
3. What is your/your Organization's impression of the initial Environmental Assessment that the Project went through, especially as it relates to human health?
4. The credibility of the initial assessment was called into question by community members, community organizations, and independent researchers. Why do you think that was the case?
5. What is your/your Organization's impression of public participation in the Environmental Assessment process and the Joint Review Panel process?
6. What are your/your Organization's impressions of the Joint Review Panel's recommendations?
7. What are your/your Organization's impressions of the Independent Expert Advisory Panel's' recommendations?
8. In the Independent Expert Advisory recommendations, it was documented that there was disagreement about the interpretations of predicted methylmercury impacts. Where do you/does your Organization stand on this?
9. What role do values play in the Environmental Assessment process?

Appendix B : Educational Activity Illustrating Knowledge Conflicts Environmental Impact Assessment Documents

B.1 Pre-Survey and Quiz Given to Students Before the Activity

1. What is your current level of study?

Undergrad Year 1	Undergrad Year 2	Undergrad Year 3	Undergrad Year 4 or 5	Graduate

2. What is your student number?

3. What is your area of study?

4. What group number were you assigned to?

5. What was your assigned role in the game?

Minister	Nunatsiavut Government	Nalcor Energy	Labrador Land Protectors

6. In general, how comfortable are **you** speaking in a small group setting?

Not very comfortable			Somewhat comfortable			Very comfortable
1	2	3	4	5	6	7

7. Do **you** think policy decisions involving hydroelectric projects, such as the Muskrat Falls project, should include public input or should they be largely made by technical experts?

Entirely by public input			Both public and experts			Entirely by experts
1	2	3	4	5	6	7

8. In general, how knowledgeable are **you** about hydroelectric projects and their various impacts?

Not very knowledgeable			Somewhat knowledgeable			Very knowledgeable
1	2	3	4	5	6	7

9. In terms of the decision-maker's ability to make a decision about whether to approve the Muskrat Falls project and under which conditions, do **you** feel as though they have enough information about the issues at this time to make an informed decision? Remember, this we are asking for your opinion and not for your role's opinion.

Not nearly enough information			Just enough information			Too much information
1	2	3	4	5	6	7

10. Imagine you had 100 points to distribute between the different dimensions of impacts (economic, human health, social, and environmental impacts) in the Muskrat Falls case based on how important **YOU** think they are (not your role's opinion). Allocate them here (all points must add up to 100):

Number of points given to economic costs of reservoir clearing /100

Number of points given to potential increase in human exposure to methylmercury /100

Number of points given to loss of access to traditional harvesting /100

Number of points given to benefits of greenhouse gas reductions /100

The following are comprehension questions about the documents you were asked to read (General Instructions, Scientific Briefing, Role Instructions, Discussion Guide, Introductory Presentation)

11. Who is the Decision maker?

Nunatsiavut government	Labrador Land Protectors	Canadian Minister of Environment and Climate Change	Newfoundland and Labrador Minister of Environment and Climate Change	Nalcor Energy

12. Which step of the EA process is this game taking place in?

After Project approval	Between the impacts studied and before project approval	Before deciding which impacts to study	Before deciding whether an EA is necessary

13. Where are methylmercury concentrations the highest?

At the bottom of the food web	At the top of the food web	In estuaries	In freshwater

14. Please list three concerns related to your role. If you are playing the Minister, please list three things that your decision should be based upon.

Table B.1.1 Pre-survey and quiz

B.2 Introductory Presentation

Figure B.2.1 First slide of introductory presentation

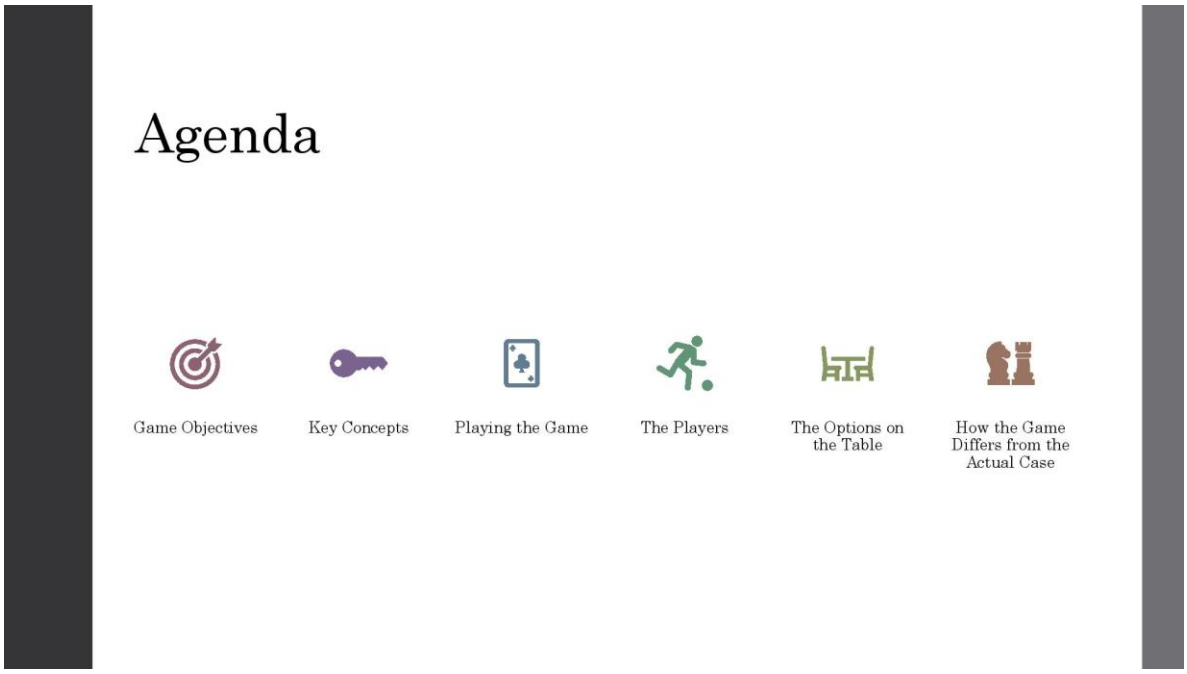

Figure B.2.2 Second slide of introductory presentation

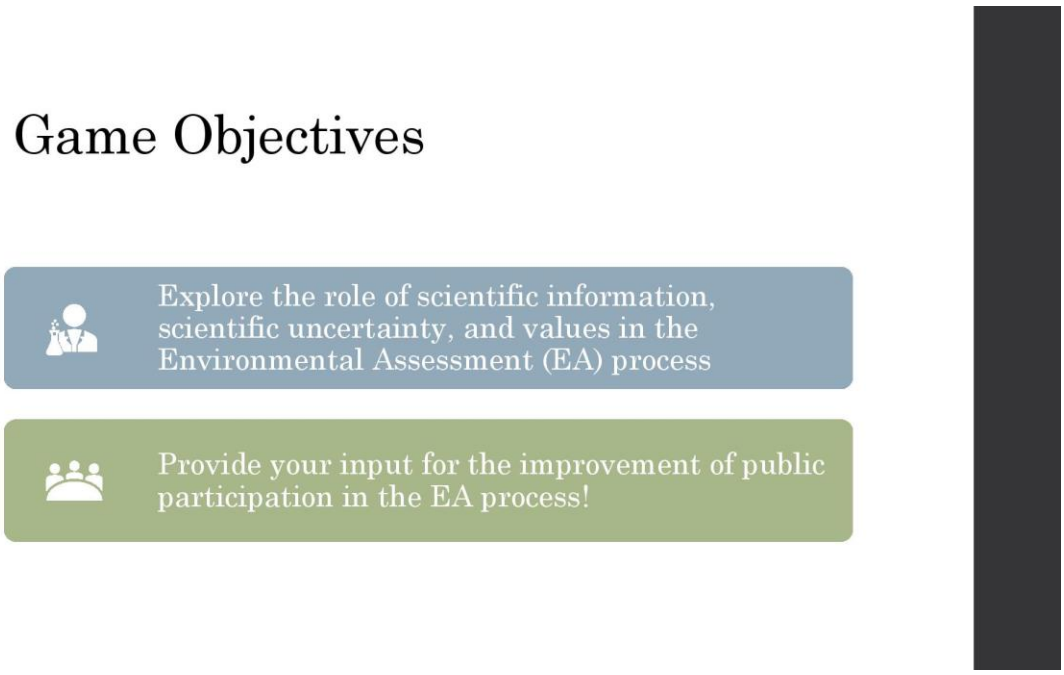

Figure B.2.3 Third slide of introductory presentation

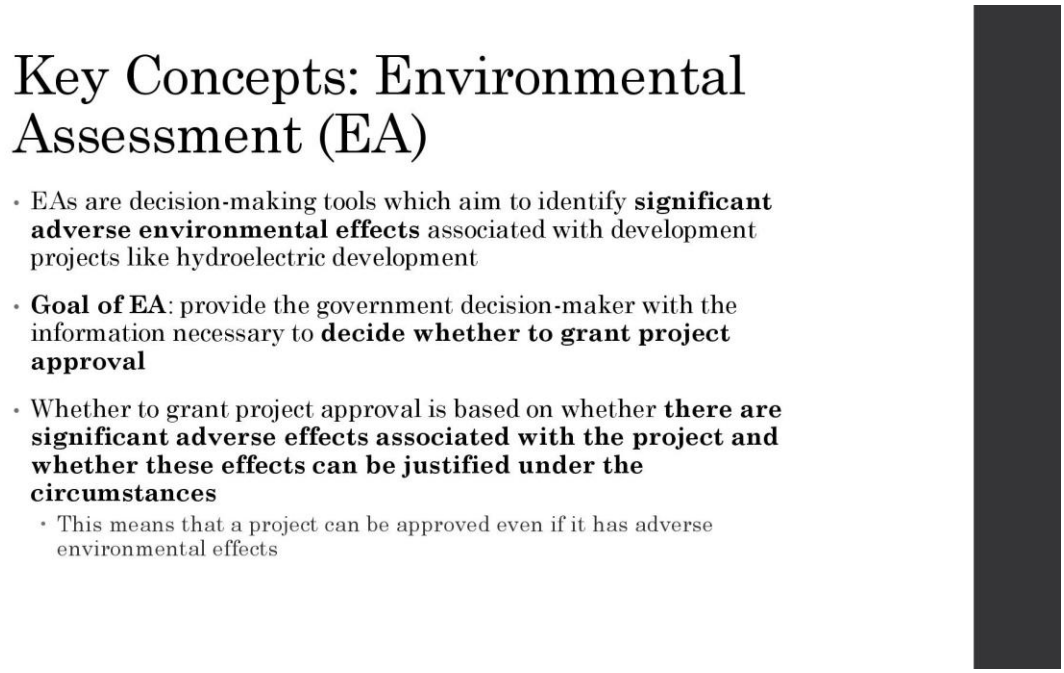

Figure B.2.4 Fourth slide of introductory presentation

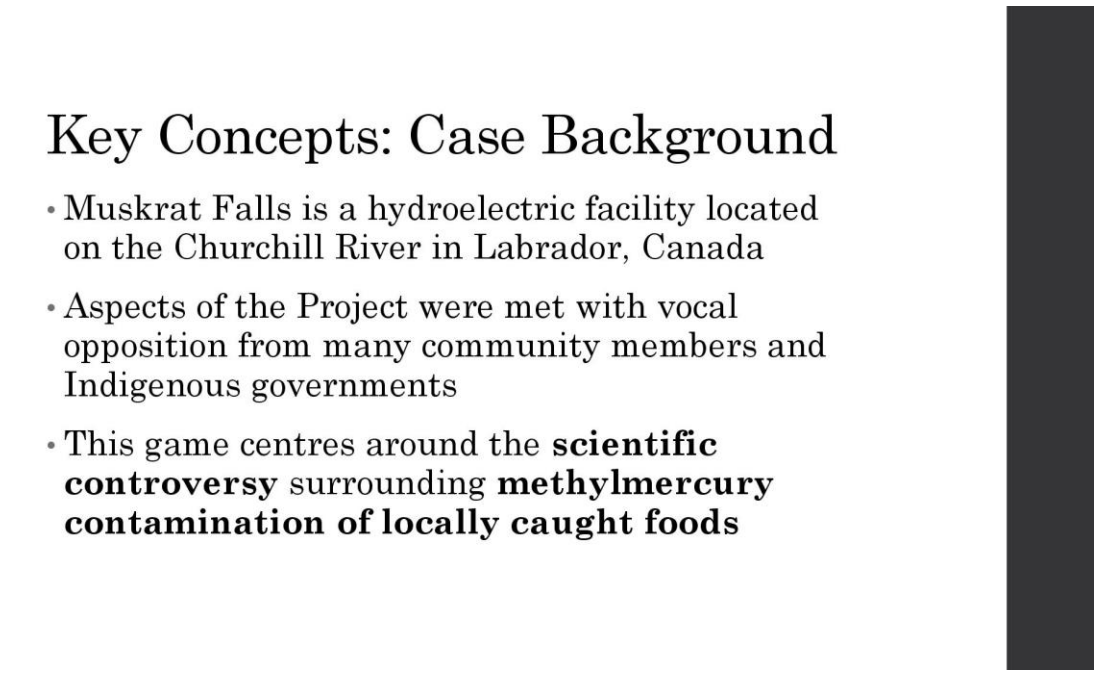

Figure B.2.5 Fifth slide of introductory presentation

Figure B.2.6 Sixth slide of introductory presentation

Figure B.2.7 Seventh slide of introductory presentation

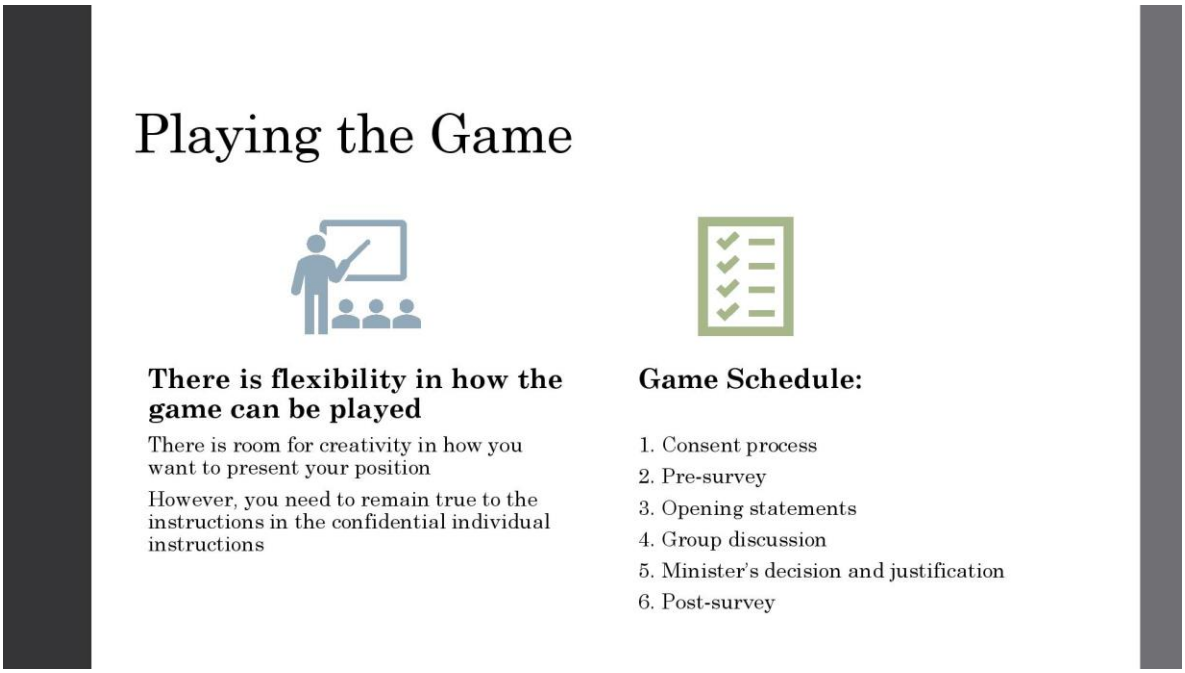

Figure B.2.8 Eigth slide of introductory presentation

Figure B.2.9 Ninth slide of introductory presentation

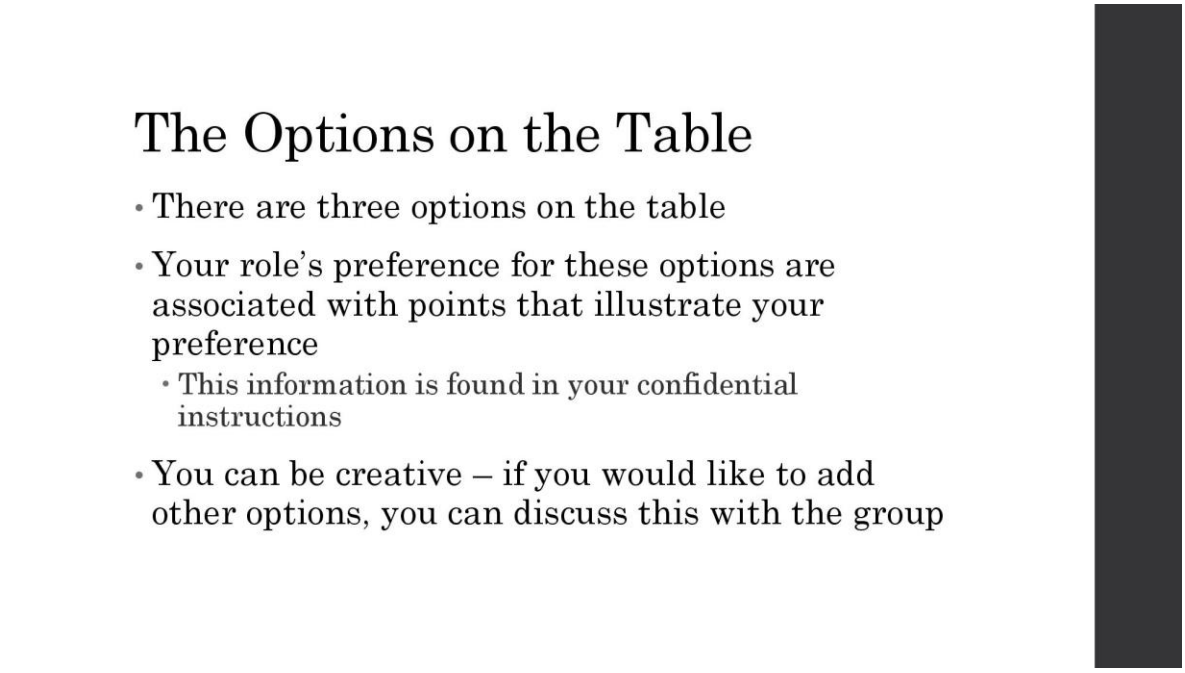

Figure B.2.10 Tenth slide of introductory presentation

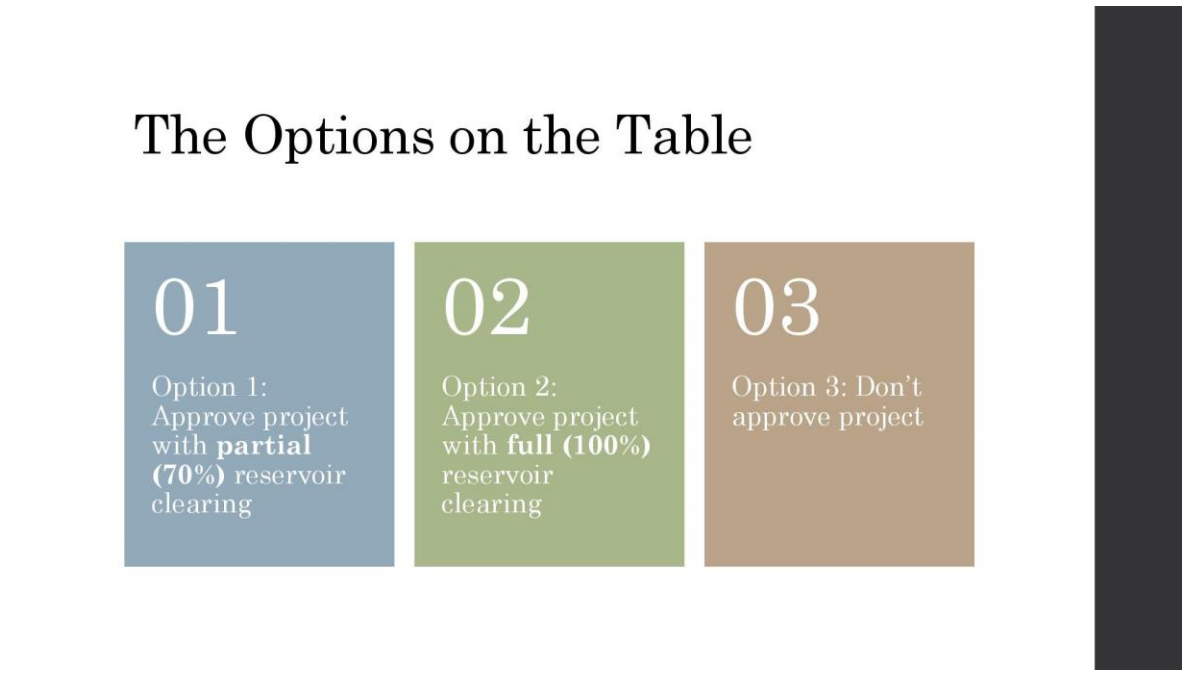

Figure B.2.11 Eleventh slide of introductory presentation

Figure B.2.12 Twelfth slide of introductory presentation

B.3 General Information for all Participants Document

Note: this game is an **adaptation** of the Muskrat Falls hydroelectric project. This game mirrors the Environmental Impact Assessment process but does not follow it exactly.

Introduction

Nalcor Energy is a provincially owned and operated corporation which generates electricity for the province of Newfoundland and Labrador as well as other parts of Canada. Nalcor Energy is interested in building and operating an 824 MW hydroelectric generating facility at Muskrat Falls on the Churchill River (Figure 1). Nalcor Energy claims that the Project is needed to:

- Address the future demand for hydroelectric generation in the Province
- Provide an electric energy supply for sale to third parties in Canada and the US
- Develop the Province's natural resource assets for the benefit of the Province and its people

The Project is in the process of undergoing an Environmental Assessment (EA) to determine whether the project will have adverse environmental effects and if so, whether they could be justified under the circumstances. In this case, **the Minister is the decision-maker and has final say over project approval**.

This project has been met with vocal opposition from the Indigenous and local communities that are within 30 km of the proposed site (see Figure 1). The local community and local Inuit government are concerned about potential environmental impacts, **including potential release of methylmercury into the environment**.

In response these concerns about the health and environmental risks of the project, the Canadian government has decided to hold a **topic specific hearing session**, which you will participate in. The hearing session will address human health, particularly the health of Indigenous and local populations affected by the project. The project cannot proceed without government approval, and the government seeks to only approve projects which are in the public's best interest.

The purpose of the meeting is for the Minister to receive public input and to then decide whether to approve the project and under which mitigating conditions. The government's decision will be based upon the following question:

- **Are there significant adverse impacts associated with this option and are they justified in the circumstances?**

There is an agenda of this public hearing in Table 3 that you will follow. However, the Minister is able to call a decision at any time during the discussion period if they feel as though they have received enough information.

The Project

The Project will consist of the development of one hydroelectric generating facility and the construction of an associated dam and reservoir. Project construction will be a major undertaking which will require a large effort including materials supply and transportation, support infrastructure, equipment and labor. Temporary access roads will be required, and construction camps will be built. The projected cost of the hydroelectric generating facility is roughly $6 billion in current dollars. The Project is expected to begin generating electricity for the Province at the end of 2019.

The Muskrat Falls hydroelectric facility will have a capacity of 824 MW. The main components include:

- The powerhouse, with four fixed turbines
- A concrete dam with two sections on the north and south abutments of the river
- A reservoir 59 km long, flooding 41 km^2 of area

The Parties

There will be four parties present at the special topics hearing:

Minister of Environment and Climate Change – Decision Maker

- Decides whether to approve the Project and under which mitigation measures.
- Committed to fulfilling its legislative requirements
- Eager to promote development in Canada
- Sensitive to the public's opposition to large hydroelectric projects
- **Main concern:** ensure the mitigation of potential adverse impacts and enhancement of Project benefits

Nalcor Energy - Project Proponent

- Leading the proposed project
- Estimates that this facility could bring Newfoundland and Labrador to a 99% renewable and clean energy portfolio within 10 years
- Believes this project will bring local, regional, and national economic and environmental benefits
- **Main concern**: gain approval for a Project plan that is mindful of the environment, Canadians, and the EA consultation process

Nunatsiavut Government – Indigenous Regional Government

- Self-governing – has the ability to make laws within its land claim area
- Land claim area includes the local communities (Happy and excludes project area
- The community in the area relies on subsistence fishing for its nutritional, social, cultural, and spiritual benefits.
- **Main concern**: the reservoir flooding plan is based on inaccurate assumptions and insufficient scientific evidence; therefore, the human health impacts of this Project are more serious than initially assessed

Labrador Land Protectors Group – Community Organization

- Composed of Indigenous and non-Indigenous people living in the local communities (shown in Figure 1)
- Generally opposed to any development near their community
- **Main concern**: existential threat the project poses to their community due to contamination of aquatic species with methylmercury

The Decision Context

This decision centres around the **reservoir flooding**, which is required to construct the dam that forms a part of the generating facility. It is predicted that such flooding may cause an **increase in methylmercury levels** in downstream water bodies and risk contaminating fish and other wildlife. Humans become exposed by eating contaminated fish and other species. Details are found in the Scientific Briefing attached to these documents.

This adverse effect can be mitigated by removing vegetation and trees and clearing topsoil, a process known as **reservoir clearing**. Nalcor Energy explored several options for reservoir clearing and proposed that **partial (70%) reservoir clearing** was the most economical way to decrease the likelihood of bioaccumulation of methylmercury. They also claimed that their commissioned studies demonstrated that methylmercury contamination **would likely not be an issue for the local communities** living downstream of the project due to the dilution of methylmercury that occurs in those water bodies.

The Nunatsiavut government collaborated with public health scientists from Harvard University to model potential increases in methylmercury concentrations and resulting health impacts. **They found evidence that countered Nalcor's assertion that methylmercury concentrations would be diluted, and that partial (70%) clearing of the reservoir would result in adequate protection of human health.** The Labrador Land Protectors generally oppose the project and has engaged in public demonstrations and hunger strikes to protest the imminent reservoir flooding.

As a result of this controversy, **four options** have surfaced from previous discussions and policy documents produced by the parties, shown below. Further information about these options

is found in the Scientific Briefing. The government will decide at the public hearing which of the options will proceed as the Project plan.

Options for Muskrat Falls Project:

- Option 1: Approve project with **partial (70%)** reservoir clearing
- Option 2: Approve project with **full (100%)** reservoir clearing
- Option 3: Don't approve project

Information about Public Hearing

The meeting should last for **1 ½ hours** including the consent and debriefing processes. **The Minister of Environment and Climate Change for the Canadian government will chair the meeting and act as decision-maker**. This means that they will moderate the public hearing and discussions. **The Minister can choose to call a decision at any time during the group discussion** if they feel as though they have enough information to make an informed decision.

Before Public Hearing

Pre-survey (In Class): 10 minutes

If you consent to have your survey data collected, you will be asked to fill out a pre-survey before the public hearing begins. It will ask some basic demographic information and your opinions about environmental policy.

During Public Hearing

Opening Statements: 3 minutes each (15 minutes total)

The public hearing begins with opening statements from each party. The opening statements will include their positions and interests.

Group discussion: 20 minutes

The Minister of Environment and Climate Change will then moderate a discussion to further evaluate each policy option.

Minister's decision: 5 minutes

If they have not already called a decision, the participant playing the role of the Minister will be given 5 minutes to review the information presented to them and decide how the Project should proceed.

After Public Hearing

Post-survey: 10 minutes

This survey is similar to the pre-survey and will ask additional questions about your perceptions about the decision process and outcome.

B.4 Scientific Briefing Document

Methylmercury and Human Health Impacts

This scientific briefing summarizes the scientific information related to methylmercury and associated human health impacts. It is a synthesis of expert input and scientific studies conducted by Nalcor Energy and other scientists. It is designed to ensure that all parties present at the hearing have access to the same information.

Hydroelectric Dams are Constructed for Generating Electricity

Hydroelectric facilities often involve the construction of hydroelectric dams. Dam construction involves diversion of an existing water body, excavation of rock or sediment, and creation of a foundation. Concrete is then pumped into the empty space to form the dam structure (Cey et al. 2018). A reservoir is then created by flooding the previously diverted area. Hydroelectric dams store reservoir water until its controlled release is used to turn hydraulic turbines. The potential energy of the stored water is transformed into mechanical energy as the water flows down the dam, and then into electric energy through the turbine generator.

Reservoir Flooding is Associated with Methylmercury Production

Inorganic mercury is naturally present in the environment, stored in vegetation and soil within the area that becomes the reservoir. When that area is flooded to create the reservoir, bacteria use organic carbon to transform inorganic mercury into methylmercury, which is highly toxic to humans. In the case of Muskrat Falls, it is predicted that methylmercury levels would peak 5-16 years after flooding and then return to background levels within the following decades.

Methylmercury Bioaccumulates in the Food Web

Methylmercury can bioaccumulate up the aquatic food web, and humans become exposed by eating contaminated fish and other aquatic species whose tissues contain significantly higher concentrations of methylmercury than is present in the water. Methylmercury is a neurotoxin and exposure may result in many health problems, including cardiovascular and neurological problems and severe developmental issues in children when exposed in utero.

Reservoir Clearing Options

Bioaccumulation of methylmercury may be mitigated by removing vegetation and clearing topsoil, a process known as reservoir clearing. Nalcor Energy considered two strategies of reservoir clearing, which make up two of the three options being considered at today's hearing (see Table B.4.1 for details).

Reservoir Clearing Options, Strategies, and Results		
Reservoir Clearing Option	**Strategy**	**Result**
Option 1: Partial reservoir clearing[1]	Remove all **trees 3m above and 3m below the water level** that will occur after reservoir flooding (shown in Figure 3)	This level of clearing results in clearing up to **70% of flooded vegetation** within the reservoir
Option 2: Full reservoir clearing[2]	Remove **vegetation, trees, and topsoil** from whole area presented in Figure 3.	This level of clearing results in clearing **100% of flooded vegetation, trees and topsoil** within the reservoir

Table B.4.1 Reservoir clearing options

[1] This option is based on what Nalcor, the project proponent, proposed as a reservoir clearing option in their Environmental Impact Statement (Nalcor Energy 2009).
[2] This option is based on what the Nunatsiavut Government proposed as a reservoir clearing option in their policy document (Durkalec and Sheldon 2016).

Controversy Surrounding Reservoir Clearing

There remain important points of debate and scientific uncertainty about the relationship between reservoir flooding, methylmercury and human health. Indeed, this is the reason that this special topic hearing was called. The points of debate are as follows[3]:

<table>
<tr><td colspan="2">Issue 1: It remains unclear what the magnitude of expected methylmercury contamination caused by reservoir flooding will be</td></tr>
<tr><td>Evidence for significant increase in methylmercury exposure</td><td>Evidence against significant increase in methylmercury exposure</td></tr>
<tr><td>• Scientific studies commissioned by Harvard University scientists and the Nunatsiavut government show a linear relationship between organic soil carbon content and mercury methylation rates
• This relationship was used to inform a methylmercury model (The Calder model) which predicted significant increases in methylmercury exposure of Labrador Inuit due to reservoir flooding
• The Calder model is supported by the Nunatsiavut government and the Labrador Land Protectors</td><td>• Nalcor’s scientific experts say that the Calder model overestimates methylmercury exposure levels – they assert that Muskrat Falls is a low methylating reservoir based on the modeling and empirical studies found below
• Nalcor’s methylmercury model shows no measurable effects of reservoir flooding associated with commonly consumed species of fish
• Nalcor argues that empirical studies in other reservoirs show that transport of inorganic mercury from flooded soils occurs at a rate lower than that predicted by the Calder model
• Nalcor argues that empirical studies in other reservoirs show that methylmercury increase in locally caught foods are much lower than predicted by the Calder model
• Nalcor argues that the most recent surface water monitoring data of the Muskrat Falls reservoir (which is already 25% flooded) does not agree with Calder model predictions</td></tr>
<tr><td colspan="2">Issue 2: It is unclear whether topsoil removal (Option 2) will be of benefit to human health</td></tr>
<tr><td>Evidence that topsoil removal will benefit human health</td><td>Evidence that topsoil removal may not benefit human health</td></tr>
<tr><td>• The Calder model predicts that soil and vegetation removal may reduce soil organic carbon content and thus minimize mercury methylation rates</td><td>• Scientific advisors to the government state that the Calder model shows that topsoil removal will only somewhat reduce exposure levels in those who experience</td></tr>
</table>

[3] These points of debate are taken from letters compiled by the Independent Expert Advisory Committee of the Muskrat Falls Project mandated to assess mitigation of human health impacts (Reimer et al. 2018). The letters were written by parties involved in the Project and scientific advisors to the government who were present at Committee meetings. The purpose of the document is to provide justification for the Committee’s recommendations to the government.

• Lower mercury methylation rates means a smaller concentration of methylmercury in water bodies and less human exposure to the toxin	the highest predicted levels of exposure. This means topsoil removal may not benefit those most at risk. • Scientific advisors to the government state that the Calder model shows that the benefits of topsoil removal may be small relative to model uncertainty • Nalcor states that soil core studies show that topsoil removal has "no measurable benefit"
Issue 3: The risks associated with topsoil removal (Option 2) are unclear	
Evidence that topsoil removal is not risky	Evidence that topsoil removal is risky
• The Nunatsiavut government argues that topsoil removal is not a novel concept in other industries, such as forestry • The Nunatsiavut government argues that best practices can be employed to minimize risks, i.e., removal during frozen conditions	• Topsoil removal is experimental in nature • Nalcor argues that topsoil removal experiments show an increase in mercury methylation rates for 3 out of 4 samples – therefore topsoil removal could result in increased mercury methylation • Nalcor argues that various negative environmental effects are possible and have not been studied • Some scientific advisors to the government have said the benefits are not worth the risks
Issue 4: What it means to use the Precautionary Principle in environmental decision-making	
View 1 of Precautionary Principle	View 2 of Precautionary Principle
• The Nunatsiavut government and Labrador Land Protectors argue that potential impacts and risks of not removing topsoil are too high • Local community members have expressed that model uncertainty can result in substantially smaller than predicted exposure to methylmercury, but also substantially larger than predicted exposure – therefore everything that *can* be done to reduce methylmercury exposures *should* be done	• Nalcor argues that the benefits of topsoil removal are unproven, and its adverse effects are unknown. Therefore, topsoil should not be removed and full reservoir clearing should not be done

Table B.4.2 Reservoir clearing issues

The special topic hearing will hopefully address these issues and enable the decision-maker to make a choice that balances competing interests and considers uncertainty about reservoir clearing options. The decision will ideally provide benefits at the local, regional, and national scale.

Key words

- **Bioaccumulation:** increased accumulation of a substance, such as methylmercury, up the food web
- **Methylmercury**: a neurotoxic form of mercury which increases in concentration at higher levels in the food web. Methylmercury poisoning occurs when humans consume contaminated fish and other species
- **Precautionary Principle (based on the Rio Declaration on Environment and Development):** "When there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (United Nations 1992)
- **Reservoir**: an artificial body of water behind a dam used to store water that will propel through the dam to generate electrical energy
- **Topsoil**: the upper part of the soil which contains the most organic matter and biological activity
- **Topsoil removal**: removal of the upper part of the soil to reduce the amount of mercury methylated once a reservoir has been flooded

References

Cey, Edwin, Jordan Hanania, Kailyn Stenhouse, and Jason Donev. 2018. "Hydroelectric Dam." Energy Education University of Calgary. 2018. https://energyeducation.ca/encyclopedia/Hydroelectric_dam.

Durkalec, Agata, and Tom Sheldon. 2016. “Summary for Policymakers - Lake Melville: : Avativut Kanuittailinnivut (Our Environment, Our Health).” Nain, NL: Nunatsiavut Government.

Nalcor Energy. 2009. “Lower Churchill Hydroelectric Generation Project Environmental Impact Statement.”

———. 2015. “Muskrat Falls Project Information Sheet: Methyl Mercury.” December 2015. https://muskratfalls.nalcorenergy.com/wp-content/uploads/2014/08/Muskrat-Falls-Mercury-Info-Sheet_Dec2015_Final.pdf.

Reimer, Kenneth, Carl McLean, NunatuKavut Community Council, David Kieser, Greg Nuna, Peter Penashue, Abla Hanna, and Martin Goebel. 2018. “Independent Expert Advisory Committee for the Muskrat Falls Project Recommendations.”

United Nations. 1992. “The Rio Declaration on Environment and Development.”

B.5 Minister of the Environment and Climate Change Role Instructions

You will be playing the role of the Canadian Minister of the Environment and Climate Change (the Decision maker). You will be serving as Chair for the special topics public hearing on the Muskrat Falls Project organized by your government. This means that **you will be leading the discussion portion of this public hearing.** You are also welcome to add your opinion and engage in the discussion. Follow the section "Meeting Agenda" for ideas on how to start the public hearing.

There are several concerns about the project, which you will hear today. **It is your job to make a decision about how to proceed with the Muskrat Falls Project.** We are certain that we can count on you to listen carefully as representatives present their positions and facilitate the discussion portion of the hearing. We hope you can maintain neutrality and remain responsive to all parties' concerns.

It is clear that there are certain benefits and adverse impacts associated with this project. One of the advantages of this project is the **potential reduction of 1.1 million tonnes of GHG emissions per year and its ability to bring Newfoundland and Labrador to a 98% renewable energy portfolio[4].** This is of benefit to all Canadians and will help Canada meet its Paris Agreement targets. However, there are **risks of methylmercury contamination of locally caught foods** which the local and Indigenous communities rely on. This public hearing centers on the discussion of whether to approve the project and under which mitigating conditions.

Meeting Agenda

[4] Based on the displacement of the thermal generating plant in Holyrood, Newfoundland. This was mentioned in the Government of Canada's response to the Joint Review Panel report.

1. **Introduce yourself as meeting chair, Decision-maker and representative of the Canadian government.** You are welcome to create your own introduction, or you can use the following script:
    - "Hello, and welcome to today's public hearing on methylmercury and human health impacts associated with the Muskrat Falls hydroelectric project. I am the Minister of Environment and Climate Change for the government of Canada, and I will be Chairing this public hearing. I am also the Decision-maker. Let's begin with the opening statements from each participant."
2. **Opening statements (2 minutes each = 6 minutes total).**
    - Each party has 2 minutes to speak and it is your job to keep time.
3. **Group discussion (50 minutes)**
    - Instructions are found in the Discussion guide.
4. **Minister decision (5 minutes)**
    - The decision can be made when you feel as though there is enough information to make your recommendation based on whether there are any significant adverse effects associated with this Project and whether they are justified in the circumstances (additional details found in the "Meeting Outcome" section of this briefing)
5. **Minister justification for decision (5 minutes).** Part of your job is to provide justification for your decision to the participants of this public hearing. There are two ways you must do this:
    I. **Announce your decision and justification** to the other participants of the special topic hearing

II. If you are consenting to participate in the research, please also provide justification for your decision in the Postsurvey

Meeting outcome

After hearing from various parties and engaging in a discussion, you will decide **which of the three options the Canadian federal government should proceed with**. You are able to make your recommendation any time after the discussion has begun. We recommend that you make the decision **when you feel as though there is enough information to make your recommendation based on the criteria below.**

Each participant at the public hearing has a preferred option associated with a maximum number of points. **Your objective is to choose the option with the highest total number of preference points – that is, the sum of the three other participants' scores.**

Overall, you should base your recommendation on whether the option is in the public's best interest. More specifically, you should consider whether the evidence presented by the parties demonstrates that there are **significant adverse effects associated with the project and whether these effects can be justified in the circumstances**[5]**.** Environmental assessment legislation is not specific about how this should be determined and in practice, this has been interpreted as[6]:

- The project should promote **sustainable development**

[5] Based on Canada's Environmental Assessment legislation: Canada, 2012. *Canadian Environmental Assessment Act (2012)*, S.C. 2012, c.19, s.32.

[6] Interpretations from legal scholar Meinhard Doelle. It is further discussed in Doelle, Meinhard. 2014. "The Lower Churchill Panel Review: Sustainability Assessment Under Legislative Constraints." SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2480368.

- There should be **significant gains** associated with the project that **compensate for adverse effects**

Good luck!

B.6 Labrador Land Protector Role Instructions

You will be attending the public hearing on the Muskrat Falls Project organized by the Canadian federal government. We are sending you to this meeting as a representative of our community group, the Labrador Land Protectors.

Who we are: **a group of concerned citizens fighting against the development of the Muskrat Falls mega-project.**

We are very concerned about Nalcor Energy's proposal. This development will **impact community wellbeing** and represents an **existential threat to our livelihoods**.

During the **opening statements**, please introduce us and pay attention to our concerns listed below. When engaging in the **discussion**, please pay to our position, objectives, and which options we favour. You are welcome to use as little or as much information as you want but remember that **you are trying to convince the Decision-maker to choose our preferred option.**

Here are our concerns[7]:

- We agree with the Nunatsiavut government's research and the Calder model which show that Muskrat Falls will cause **increased exposure to methylmercury** through traditionally harvested foods
- Our community relies on **traditional harvesting** (fishing, hunting, gathering) for its **nutritional, cultural, spiritual, psychological and social benefits** and this Project threatens our ability to engage in these practices

[7] The stance and concerns presented here are derived from a research paper produced as a result of interviews conducted with Labrador Land Protectors. For more information, see Penney. 2019. "'The Safety That Was, Is Gone': Muskrat Falls and Labrador Land Protectors' Changing Health and Wellbeing."

- Because of this project, we **fear for the health and wellbeing of our community**
- We believe this project will result in **cultural changes**[8] as a result of reduced access to land-based activities and traditional diets, which is an example of **"ongoing colonialism"**[9]
- **Our position: we do not want the project to be approved**
- **Our objectives: protecting our environment, culture and community health and wellbeing**

Scoring

To further illustrate how different options serve or harm our interests, we have decided to associate preference points with each option. **The goal of this public hearing is to present our interests and position in a way that convinces the decision-maker to choose our preferred outcome.** Compromising on an option is worth a deduction of a certain number of points, which depends on how much we dislike that option. The differences in points therefore tells you which options are most and least preferred for us. Although using points may seem artificial or abstract, it enables us to compare options using a single currency. You can therefore understand potential losses and gains associated with different options.

[8] Cultural changes such as confidence in food sources, quality of life, self-identity, "cultural continuity", relationships with the environment, and responsibility to the environment were expressed. See Penney 2019 for more details.

[9] This Project was described by the Labrador Land Protectors and Penney 2019 as a "colonial practice" and "ongoing colonialism" because it prevents Labradorians from engaging in traditional land uses, thereby altering their culture

Below we explain **which options are acceptable to us** and **the impacts associated with each option that are important to us**[10]:

Option 1: Approve project with partial reservoir clearing = **2 points**

- Acceptability: **This option is not acceptable**
- Cultural consequence: This option will result in **significantly reduced access to traditional harvesting compared to present day**[11]

Option 2: Approve project with full reservoir clearing = **5 points**

- Acceptability: **This option is less preferable**
- Cultural consequence: This option will result in **limited access to traditional harvesting compared to present day**

Option 3: Don't approve project = **10 points**

- Acceptability: **This option is your strong preference**
- Cultural consequence: This option will result in **the same access to traditional harvesting compared to present day**

We obviously prefer that the government does not approve this project. Therefore, it receives the most points. There is a large difference in points between option 2 and option 3, while the differences between options 1 and 2 is smaller. This conveys the fact that we are not

[10] These options are based on the research paper by Penney 2019, in which traditional diets were described as important parts of Inuit and Indigenous life. They have not been reviewed by the Labrador Land Protectors or Penney and therefore do not represent their official position.
[11] These measures are based on the probable concentrations of methylmercury in locally caught foods based on the Calder model.

very interested in the alternatives to option 3. We think option 2 is the most tolerable after our preferred option.

B.7 Nalcor Energy Role Instructions

You will be attending the public hearing on the Muskrat Falls Project organized by the Canadian government. We are sending you to this meeting as a representative of Nalcor Energy.

Who we are: **an energy company with a strong commitment to provide safe and reliable electricity to the province of Newfoundland and Labrador and beyond.**

This is obviously a very important project to us. It has tremendous profit potential, particularly if we can obtain approval under **the partial (70%) clearing option**.

During the **opening statements**, please introduce us and pay attention to our concerns listed below. When engaging in the **discussion**, please pay to our position, objectives, and which options we favour. You are welcome to use as little or as much information as you want but remember that **you are trying to convince the Decision-maker to choose our preferred option.**

Here is our stance and various concerns[12]:

- Our experts agree that the modelling studies that the Nunatsiavut government is relying on **significantly overestimate the amount and duration of methylmercury exported** to the water bodies near the local community. They therefore **overestimate the magnitude and duration of increase in methylmercury exposure**. Our conclusions are based firmly in real-world data and are superior to the modelling studies that the Nunatsiavut government relies on.

[12] The stance and concerns are inferred from the Environmental Impact Statement issued by Nalcor Energy: Nalcor Energy. 2009. "Lower Churchill Hydroelectric Generation Project Environmental Impact Statement." and the letter Nalcor provided to the Environment Minister along with the Independent Expert Advisory Committee on methylmercury's recommendations: Reimer, Kenneth, Carl McLean, NunatuKavut Community Council, David Kieser, Greg Nuna, Peter Penashue, Abla Hanna, Martin Goebel, and Nalcor Energy. 2018. "Independent Expert Advisory Committee for the Muskrat Falls Project Recommendations."

- **There is no evidence that the costly and unprecedented undertaking of large-scale soil removal provides a measurable benefit of protecting human health**. Targeted soil removal has not been proven to reduce methylmercury. In fact, soil core studies demonstrate that soil removal has no measurable benefit or could possibly increase methylmercury concentrations.
- There are many **environmental risks** associated with targeted topsoil removal, including erosion and habitat destruction.
- Employing the precautionary principle would mean **NOT performing a risky and expensive topsoil removal** with an unknown and unproven outcome.
- **Our position: we support our original proposal of partial reservoir clearing**
- **Our objectives: providing clean and cost-effective energy to Canadians**

Scoring

To further illustrate how different options serve or harm our interests, we have decided to associate preference points with each option. **The goal of this special topics hearing is to present our interests and position in a way that convinces the decision-maker to choose our preferred outcome.** Compromising on an option is worth a deduction of a certain number of points, which depends on how much we dislike that option. The differences in points therefore tells you which options are most and least preferred for us. Although using points may seem artificial or abstract, it enables us to compare options using a single currency. You can therefore understand potential losses and gains associated with different options.

Below we explain **which options are acceptable to us** and **the impacts associated with each option that are important to us**:

Option 1: Approve project with partial reservoir clearing = **10 points**

- Acceptability: **This option is your strong preference**
- Economic consequence: **Cost of $30 million to Nalcor Energy (a provincially owned corporation)**[13]

Option 2: Approve project with full reservoir clearing = **5 points**

- Acceptability: **This option is not preferred**
- Economic consequence: **Cost of $409-742 million to Nalcor Energy (a provincially owned corporation)**[14]

Option 3: Don't approve project = **2 points**

- Acceptability: **This option is not acceptable**
- Economic consequence: **Loss of $3.5 billion in income to labour and business for Canadians and loss of $545 million in taxes to the Canadian government**[15]

We obviously prefer that the Decision maker approve the project with partial reservoir clearing because it is the most cost-effective way to protect human health. Therefore, it receives the most points. There is a large difference in points between option 3 and option 1, while the differences between options 2 and 3 is smaller. This conveys the fact that we are not very interested in the alternatives to option 1, and that we think option 2 is the most tolerable after this option.

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[13] This is what Nalcor stated the costs for partial reservoir clearing would be. It has been reported by various news outlets: https://www.cbc.ca/news/canada/newfoundland-labrador/2-of-3-indigenous-groups-agreement-1.5221624
[14] Based on the engineering firm SNC-Lavalin's preliminary estimate. This does not include costs associated with construction delays, premiums associated with contractor risk, or contingency.
[15] Estimate based on the Newfoundland and Labrador government: https://www.gov.nl.ca/lowerchurchillproject/backgrounder_7.htm

B.8 Nunatsiavut Government Role Instructions

You will be attending the public hearing on the Muskrat Falls Project organized by the Canadian federal government. We are sending you to this meeting as a representative of our government, the Nunatsiavut government.

Who we are: **We are a self-governing Inuit regional government whose community members live 30 km downstream of the proposed Project. We have authority over various areas of central governance and the power to make laws.**

We are very concerned about certain aspects of Nalcor Energy's proposal. This development, as it is proposed, will adversely affect our peoples' health and traditional land use activities.

During the **opening statements**, please introduce us and pay attention to our concerns listed below. When engaging in the **discussion**, please pay to our position, objectives, and which options we favour. You are welcome to use as little or as much information as you want but remember that **you are trying to convince the Decision-maker to choose our preferred option.**

Here is our stance and various concerns[16]:

- Scientific evidence demonstrates that Nalcor's predictions about the magnitude of expected methylmercury contamination are false and built upon incorrect assumptions. The Calder model shows that there will be **significant increases in methylmercury production and that will have significant adverse effects on Inuit health and rights.**

[16] The stance and concerns were adapted from Durkalec, Agata, and Tom Sheldon. 2016. "Summary for Policymakers - Lake Melville: : Avativut Kanuittailinnivut (Our Environment, Our Health)." Nain, NL: Nunatsiavut Government. This is a policy document produced by the Nunatsiavut government, outlining their conclusions about project impacts and recommendations to decision-makers.

- Full topsoil, tree, and vegetation removal will reduce the organic carbon content in the reservoir that increases mercury methylation, and it will therefore **significantly reduce Inuit exposure to methylmercury**.
- Some may say that reservoir clearing is risky. However, topsoil removal is not a new concept and best practices will be employed to minimize risks.
- Peer reviewed science and Indigenous knowledge clearly show that the potential impacts and **risks of not implementing full reservoir clearing are too high** and we must take a Precautionary approach. This means a full reservoir clearing.
- **Our position: we are opposed to the project <u>as it is currently proposed</u> by Nalcor Energy**[17]
- **Our objectives: protecting Inuit health and harvesting rights**

Scoring

To further illustrate how different options serve or harm our interests, we have decided to associate preference points with each option. **The goal of this public hearing is to present our interests and position in a way that convinces the decision-maker to choose our preferred outcome.** Compromising on an option is worth a deduction of a certain number of points, which depends on how much we dislike that option. The differences in points therefore tells you which options are most and least preferred for us. Although using points may seem artificial or abstract, it enables us to compare options using a single currency. You can therefore understand potential losses and gains associated with different options.

[17] Throughout their policy document, the Nunatsiavut government objects to the current Project plan rather than the Project itself. This is not, however, indicative of full project support.

Below we explain **which options are acceptable to us** and **the impacts associated with each option that are important to us**[18]:

Option 1: Approve project with partial (70%) reservoir clearing = **2 points**

- Acceptability: **This option is not acceptable**
- Human health consequence: **between 90 and 200**[19] **Inuit projected to exceed Health Canada methylmercury exposure guidelines**

Option 2: Approve project with full (100%) reservoir clearing = **10 points**

- Acceptability: **This option is your strong preference**
- Human health consequence: **a minimum of 30 Inuit projected to exceed Health Canada methylmercury guidelines**

Option 3: Don't approve project = **5 points**

- Acceptability: **This option is less preferable**
- Human health consequence: **the number of Inuit people projected to exceed Health Canada methylmercury guidelines would not change compared to present day. We would also lose out on other benefits of the project.**[20]

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[18] These options are based on the Durkalec and Sheldon 2016 policy paper produced by the Nunatsiavut government. The projected ranges of the number of Inuit individuals exposed to methylmercury above Health Canada guidelines are based on Calder model predictions.

[19] There is a range of outcomes presented here because of model uncertainty. It is not certain whether there will be moderate or low breakdown of methylmercury downstream, and there are therefore a range of possible outcomes.

[20] This is not a position that has been expressed explicitly by the Nunatsiavut government. This position has been inferred by the author of this game from the Nunatsiavut government's Department of Education and Economic Development website, which states its interest in identifying opportunities of Inuit resources: https://www.nunatsiavut.com/department/economic-development/. It has also been inferred based on the Joint Review Panel's report which states there are economic benefits and development opportunities associated with the project. More information can be found by consulting: Joint Review Panel. 2011. "Report of the Joint Review Panel Lower Churchill Hydroelectric Generation Project Nalcor Energy Newfoundland and Labrador.

We obviously prefer that the government approve the project with full reservoir clearing because it represents an economic opportunity for the communities we represent while reducing the risk of methylmercury exposure. Therefore, it receives the most points. There is a large difference in points between option 2 and option 1, while the differences between options 2 and 3 is smaller. This conveys the fact that we are not very interested in the alternatives to option 2 and that we think option 3 is the most tolerable after our preferred option.

B.9 Discussion Guide for Unstructured Groups

The Minister (Decision maker) will act as Chair for the special topics meeting. Their main task is to facilitate the discussion that occurs after the opening statements. The discussion should last around 50 minutes.

To do so, you will maintain speaking order using a speaking list on a piece of paper or on your computer. It is the Minister's job to ensure that parties do not speak over one another and that order is maintained.

Here are the options on the table for discussion:

- **Option 1:** Approve project with partial (70%) reservoir clearing
- **Option 2:** Approve project with full (100%) reservoir clearing
- **Option 3:** Don't approve project

Follow the following structure in your discussion:

1. Announce that you will allow parties to comment on all of the options, starting with Option 1
2. Instruct the parties that if a party would like to speak, they must to raise their hand
3. Once a party raises their hand, you, as Chair, will add them to the speaking list
4. The parties will then be given the chance to speak when it is their turn
5. After roughly 7 minutes, move on to discussing the next option

To ensure that you are able to discuss all of the options thoroughly, we recommend allotting 7 minutes to the discussion of each option. However, there is some flexibility and you can be more creative in how you choose to structure the discussion.

B.10 Discussion Guide for Structured Groups

The Minister (Decision maker) will act as Chair for the special topics meeting. Their main task is to facilitate the discussion that occurs after the opening statements. The discussion should last around 20 minutes. There are a series of tasks that you must complete as a group in an open discussion format.

The structure of the discussion will follow these steps:

1. Clarify the decision context
2. Define the objectives and performance measures
3. Estimate consequences of options using consequence table
4. Discuss and evaluate trade-offs

Step 1: Clarify the decision context

It is important to create a common vocabulary so that all parties are on the same page during the discussion.

- Start by putting the decision into context. Take turns answering the following questions:
    - What is your understanding of the decision?
    - Who should be involved in making the decision?
- Create a list of concerns that the parties have using discussion the questions below as prompts. The Minister should keep a list of the concerns on a piece of paper or laptop.
    - What is your position?
    - What are your interests?
    - What is the acceptability of each option?
    - What are your concerns?

Step 2: Define objectives and performance measures

- Use the list of concerns to write down the **objectives** associated with this project. Participants have different knowledge about which objectives may be appropriate for this decision.
    - **Objectives define what matters in a decision**. They are what the decision is based upon. An objective is phrased as maximizing a desirable quality or minimizing an undesirable quality.
        - E.g., minimize costs associated with a project, minimize the number of people exposed to methylmercury above regulatory guidelines
- Next, generate **performance measures** associated with each alternative.
    - **Performance measures enable the measurement of objectives.** They help determine how well an option performs with respect to each objective.
        - E.g., cost (in dollars) associated with an option if the objective is to minimize costs, the number of people exposed to methylmercury above regulatory guidelines if the objective is to minimize the number of people exposed to methylmercury above regulatory guidelines
    - Performance measures should also be used for objectives that may be considered unmeasurable so that they can be considered alongside other objectives.
        - E.g., if a First Nation would like to maintain an important cultural site, they may consider an objective of "minimize disturbance to cultural site" and a performance measure of "number of access days per year"

- Brainstorm performance measures as a group. Participants have different knowledge about which performance measures may be appropriate for certain objectives, which is in the Scoring section of their individual instructions.

Step 3: Clarify options

- The options for this decision have already been generated based on previous discussions and expert input. To ensure that all participants have a good understanding of the options, it would be helpful to list the options again and discuss the details of what each option entails.

Step 4: Estimate consequences using consequence table

- Fill out the consequence table that is provided at the end of this document. Consequence tables are a way to evaluate each option with respect to the objectives based on the performance measures. Objectives go in the first column, evaluation criteria are in the second column, and each option are in the next 3 columns.
  - There are some key considerations you should discuss when evaluating alternatives:
    - Does the alternative allow for adaptive management, i.e., are the consequences reversible?
    - What is the uncertainty associated with each alternative? Is there are range of possible outcomes or are the outcomes highly certain?

5: Discuss and evaluate trade-offs

- Environmental decision making involves value-based judgements that need to be made explicit during the decision-making process. Discussing and evaluating trade-offs is one

way which enables the exploration of which objectives are important to various participants.

- Compare options through discussion about the following:
    - Use the consequence table to go through options one at a time and determine whether there are any options which are totally dominated by another, meaning an option which is outperformed by one or more options on all objectives.
    - Compare 2 options at a time. Use the consequence table to compare which objectives the options outperform one another in.
- Use these questions to guide the discussion of trade-offs:
    - Which objectives are most valued?
    - Which options do you enthusiastically support or oppose, and why?
    - Which options can you live with, and why?

Objectives (what matters)	**Performance measures** (how you measure the performance of objectives)	**Option 1:** Approve project with full (100%) reservoir clearing	**Option 2:** Approve project with partial (70%) reservoir clearing	**Option 3:** Don't approve project

Table B.10.1 Consequence table

B.11 Decision Form

Group number: _____

Group members and their roles:

- Minister: _____
- Nunatisavut government: _____
- Labrador Land Protectors: _____
- Nalcor: _____

This form is to be filled out by the Minister of Environment and Climate Change (the Decision maker). Please remember that your decision should be based on the following criteria:

Overall, you should base your recommendation on whether the option is in the **public's best interest.** More specifically, you should consider whether the evidence presented by the parties demonstrates that there are **significant adverse effects** associated with the project and whether these effects can be justified in the circumstances. Environmental assessment legislation is not specific about how this should be determined and in practice this has been interpreted as:

- The project should promote **sustainable development**
- There should be **significant gains** associated with the project that compensate for adverse effects

Please circle which option you selected:

- Option 1: Approve project with **partial (70%)** reservoir clearing
- Option 2: Approve project with **full (100%)** reservoir clearing
- Option 3: Don’t approve project

Please provide a rationale for your decision based on the criteria above in the space below. You can use this same rationale to justify the decision to the rest of the participants.

B.12 Post-Survey Given to Students After the Activity

1. What is your current level of study?

Undergrad Year 1	Undergrad Year 2	Undergrad Year 3	Undergrad Year 4 or 5	Graduate

2. What is your student number?

3. What is your area of study?

4. What group number were you assigned to?

5. What was your assigned role in the game?

Minister	Nunatsiavut Government	Nalcor Energy	Labrador Land Protectors

6. In general, how comfortable are you speaking in a small group setting?

Not very comfortable			Somewhat comfortable			Very comfortable
1	2	3	4	5	6	7

7. Do you think policy decisions involving hydroelectric projects, such as the Muskrat Falls project, should include public input or should they be largely made by technical experts?

Entirely by public input			Both public and experts			Entirely by experts
1	2	3	4	5	6	7

8. In general, how knowledgeable are you about hydroelectric projects and their various impacts?

Not very knowledgeable			Somewhat knowledgeable			Very knowledgeable
1	2	3	4	5	6	7

9. In terms of the Minister's ability to make a decision about whether to approve the Muskrat Falls project and under which conditions, do you feel as though they have enough information about the issues at this time to make an informed decision?

Not nearly enough information			Just enough information			Too much information
1	2	3	4	5	6	7

10. Imagine you had 100 points to distribute between the different dimensions of impacts (economic, human health, social, and environmental impacts) in the Muskrat Falls case based on how important you think they are. Allocate them here (all points must add up to 100):

Number of points given to economic costs of reservoir clearing /100

Number of points given to potential increase in human exposure to methylmercury /100

Number of points given to loss of access to traditional harvesting /100

Number of points given to benefits of greenhouse gas reductions /100

11. In general, how stressful did you find the engaging in the discussion process? (Answering questions, presenting your position and interests)

Not at all stressful			Somewhat stressful			Very stressful
1	2	3	4	5	6	7

12. In general, how mentally difficult did you find engaging in the discussion process? (Answering questions, presenting your positions and interests)

Not at all difficult			Somewhat difficult			Very difficult
1	2	3	4	5	6	7

14. Which option did the Decision Maker select (please circle)?

Option 1: Approve with partial (70%) reservoir clearing	Option 2: Approve with full (100%) reservoir clearing	Option 3: Don't approve project

15. Considering your role's position and interests, how satisfied are **YOU** with the Minister's selected option? Remember to answer based on **YOUR** personal opinion rather than your role's
desired option.

Not at all satisfied			Moderately satisfied			Very satisfied
1	2	3	4	5	6	7

16. Can you tell us more about why you may or may not have felt satisfied with the selected option? Remember to answer based on YOUR personal opinion rather than your role's desired option.

17. How accurately do you feel that the Minister's selected option reflects the true values and concerns of the role that you played? Remember to answer based on YOUR personal opinion rather than your role's desired option.

Not at all accurately			Somewhat accurately			Very accurately
1	2	3	4	5	6	7

18. Can you tell us more about why or why not you may have felt that the Minister's selected option reflects the true values and concerns of the role you played? Remember to answer based on YOUR personal opinion rather than your role's desired option.

19. Without considering the outcome of the decision, how satisfied were you with the *process*? Remember to answer based on YOUR personal opinion rather than your role's desired option.

Not at all satisfied			Somewhat satisfied			Very satisfied
1	2	3	4	5	6	7

20. Can you tell us more about which elements of the process led to your satisfaction or dissatisfaction? Remember to answer based on YOUR personal opinion rather than your role's desired option.

18. Without considering the outcome of the decision, was there opportunity for your roles' concerns and interests to be heard? Remember to answer based on YOUR personal opinion rather than your role's desired option.

No opportunity			Some opportunity			Lots of opportunity
1	2	3	4	5	6	7

19. Can you tell us more about whether or not you had an opportunity to have your roles' concerns and interests heard? Remember to answer based on YOUR personal opinion rather than your role's desired option.

20. If you played the MINISTER'S role, please provide your justification for your decision in the space below

21. Please feel free to tell us anything else about your experience participating in the decision making process in the space below.

Table B.12.1 Post-survey