AN ANALYSIS OF LEGISLATION AND GUIDANCE FOR UNCERTAINTY DISCLOSURE AND CONSIDERATION IN CANADIAN ENVIRONMENTAL IMPACT ASSESSMENT

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ABSTRACT

Environmental Impact Assessment (EIA) is a process designed to predict, and identify means to mitigate, the potential environmental effects of proposed development actions. As a decision-aiding tool, EIA assists decision-makers by providing them with the information needed to make an informed decision about the acceptability of a proposed development. Uncertainty is inherent in any process that is focused on future conditions, but recent research has shown that EIA practitioners do not fully disclose, consider or communicate uncertainties inherent in the EIAs for their development projects. The result is a reduction in the credibility and efficacy of EIA, and decisions potentially being made without full knowledge of, and thus consideration for, such uncertainties. Agencies and scholars have demanded that proponents and practitioners be more explicit about uncertainties in EIA reporting, but there has been no systematic examination of the requirements or guidance made available to practitioners concerning uncertainty reporting in EIA or the types of uncertainties that should be disclosed.

The purpose of this research was to examine the provisions for communicating and addressing uncertainty in Canadian EIA. The research was conducted via review of Canadian federal, provincial, and territorial EIA legislation, regulations, and guidelines, which are publically available on the official websites of the corresponding agencies and authorities. Results indicate that requirements and recommendations for uncertainty disclosure and consideration exist in most of Canadian federal, provincial and territorial EIA legislation, regulations and guidelines, but they vary considerably from one jurisdiction to the next. The difference is reflected in many aspects, including: the extent of requirements and recommendations for addressing uncertainty in EIA;

variability of the provisions given; differences in location of the requirements in legislation versus regulations versus guidelines; and differences in the clarity of requirements. In addition, the requirements and recommendations to manage uncertainty associated with the different stages and components of EIA are inconsistent. Some of the EIA stages were covered better than others, but none of the jurisdictions provided requirements and recommendations for addressing uncertainty in all stages of EIA. The results further indicate that existing requirements and recommendations for uncertainty treatment in Canadian EIA practice are, overall, inadequate and sometimes confusing. This is likely to result in insufficient communication and treatment of uncertainty and decisions being made without consideration of such uncertainty. Therefore, the development of national, standardized best practices and more systematic guidance are, at a minimum, required to ensure that uncertainty is properly addressed and communicated in EIA across EIA jurisdictions.

Keywords: environmental impact assessment (EIA); uncertainty disclosure and consideration; uncertainty addressing; EIA legislation, regulations and guidelines

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LIST OF ABBREVIATIONS

CEAA	Canadian Environmental Assessment Act
CEAA	Canadian Environmental Assessment Agency
EEA	European Environment Agency
EIA	environmental impact assessment
EIS	environmental impact statement
IAIA	International Association for Impact Assessment
NEPA	National Environmental Policy Act
NGEOs	non-governmental environmental organizations
SEIA	socio-economic impact assessment
VEC	Valued Ecosystem Component

CHAPTER ONE:
INTRODUCTION

EIA is a process designed to predict, and propose means to mitigate, the potential environmental effects of proposed development actions or projects. In doing so, EIA is intended to help decision-makers make informed decisions about the potential impacts of proposed development initiatives (Noble, 2015). First adopted in 1969 in the United States as part of the US National Environmental Policy Act (NEPA), EIA primarily was a political response to a growing public concern about the environmental impacts of economic development, and also a response to a growing environmental movement concerning the rights of each person to a healthy environment (Cashmore, 2004). To date, EIA is recognized as the most practiced environmental management tool worldwide, and is now implemented in more than 190 countries (Noble, 2015). In Canada, EIA was introduced in 1973 as a policy-based process (Hanna, 2016). Today, the authority to conduct EIA in Canada is shared between the federal and provincial/territorial governments, each with their own EIA regime that reflects jurisdictional-based EIA requirements, objectives, and approaches (Carver et al., 2010).

As a decision-aiding tool, EIA is focused on providing decision-makers with information about various alterations that may occur in the environment in response to the implementation of a particular proposed activity, to support informed decisions and to ensure an appropriate level of environmental protection (Tennøy et al., 2006). EIA aims to identify, predict and evaluate the potential environmental impacts of proposed initiatives, and to elaborate on the most effective mitigation measures to promote environmentally sound and sustainable development (United Nations Environment Program [UNEP], 2002). Recent reviews of EIA practice, however, have shown that predictions in EIAs are sometimes wrong, and impacts sometimes more severe and

mitigation efforts less effective than anticipated or communicated (see Tennøy et al., 2006; Wood, 2008). Since EIA is focused on future conditions, uncertainty is inherent in the EIA process (Duncan, 2008; Wardekker et al., 2008; Lees et al., 2016). Wood (2008) argues that there is much more uncertainty in EIA practice than what is acknowledged or reported. Practitioners often do not fully consider or communicate uncertainties in EIA, perhaps resulting in reduced efficacy and credibility of EIA findings, and decisions being made without full consideration for such uncertainties (Tennøy et al., 2006).

Many authors have argued that essential to the efficacy and credibility of EIA as a decision-aiding tool, and ensuring the transparency of EIA decisions, is properly disclosing and addressing uncertainty in EIA and project decisions (e.g., Tennøy et al., 2006; Leung et al., 2015; Lees et al., 2016). There has been some interest internationally on how uncertainty is reported in EIA practice (e.g., Cashmore, 2007; Duncan, 2008; Geneletti et al., 2003; Tennøy et al., 2006). Some researchers, also, explored this question in the Canadian context. For example, Lees et al. (2016) reviewed a sample of 12 environmental impact statements from 1995 to 2012 and concluded that uncertainty was poorly communicated in the majority of the reviewed documents. Even, when uncertainty was disclosed, there were very limited or no details on how uncertainty may be treated. They also reported an inconsistency of the uncertainty disclosure among the reviewed EIA reports and a lack of standard practice, procedure, and terminology used. Further, they suggested that the practice of uncertainty disclosure and consideration lacks specific requirements and guidance on how EIA practitioners and project proponents have to communicate uncertainty and how decision-makers may consider uncertainties in their decisions. Similarly, Leung et al. (2016) found that the majority of survey respondents (over 80%) indicated that disclosed uncertainty may improve EIA as a decision-supporting tool. However,

86% of the respondents mentioned that guidance for uncertainty disclosure and consideration available for practitioners, proponents, and decision-makers is insufficient.

Obviously, there is a need for a better understanding of uncertainty disclosure in EIA, and the development of practical solutions, including guidance and procedures for uncertainty reporting, to maintain effective, informed and transparent EIA processes; but there has been little examination of the requirements and provisions that are currently available for practitioners and project proponents to disclose uncertainty. In Canada, EIA is regulated by federal, provincial, and territorial governments, which establish the mandates for EIA within their respective jurisdictions (Carver et al., 2010). The respective regulatory authorities determine the procedures and requirements for EIA practice, including those related to the disclosure, consideration, and communication of uncertainty. Project proponents and EIA practitioners must then comply with the requirements prescribed by the relevant EIA legislation and regulations, and ideally, follow the recommendations and guidelines made available. Therefore, in order to understand the current practices of uncertainty disclosure or nondisclosure in EIA, it is important to first examine the scope of current EIA legislation and supporting guiding documents and to determine the nature and type of requirements or provisions for uncertainty disclosure and consideration that currently exist to direct or guide uncertainty consideration practices. By analyzing current Canadian EIA legislation, regulations, and guidelines, this research explores whether current practices of uncertainty nondisclosure in EIA practice can be explained, at least in part, by the nature and extent of the requirements and guiding instructions made available to EIA practitioners.

The timeliness of this research may be supported by the great demand for more effective EIA in the light of the recent weakening of the EIA process in Canada (Gibson, 2012) and some

other countries, including the United Kingdom, Western Australia, and South Africa (Bond et al. 2014). The radical changes to the federal EIA regime, introduced in the Canadian Environmental Assessment Act, 2012 (CEAA 2012), are harshly critiqued by some authors. For example, Bond et al. (2016) argue that with the introduction of significant streamlining to the EIA process, the federal EIA lost some potential benefit that it is intended to deliver as an environmental management tool. Similarly, although Gibson (2012) noted the positive changes in eliminating delays and assessment duplication, he highlighted a reduction of the scope of projects to be assessed under CEAA 2012, which is now even more limited to major developments, the adverse impact of which potentially may be significant; the substitution of the federal EIA with provincial or territorial assessment; and the assignment of assessment and licensing responsibilities to the Canadian Nuclear Safety Commission (CNSC) and the National Energy Board (NEB), which lack EIA experience and capability. Those changes to EIA illustrate the reduction of the effectiveness of EIA as an environmental management and decision-aiding tool in the favor of efficiency of the process. At the same time, EIA receives great attention from multiple stakeholders as a mean to cope with environmental concerns at the global and a local scale. To satisfy the demand of the public and many affected communities, a more effective EIA process is yet to be designed (Gibson, 2012). In this light, Gibson (2012) urges that "assessment provisions of CEAA 2012 severely compromise potential effectiveness by narrowing scope and application" (p. 186). In the same direction, this research is aimed to explore the opportunities to increase the effectiveness and transparency of the Canadian EIA through increasing of the efficacy of uncertainty management practices by contributing to an understanding of the range of provisions and guidance that might exist for addressing uncertainty in EIA, which, in turn, might help identify opportunities for the improvement of uncertainty disclosure and consideration

requirements and provisions.

1.2 Research purpose and objectives

The overall purpose of this research is to examine the current provisions, guidance and requirements for disclosing and communicating uncertainty in Canadian EIA systems. The specific objectives of this research are to:

1. determine the current provisions for addressing uncertainty in EIA in Canadian federal, provincial and territorial impact assessment legislation, regulations and guidelines;
2. identify the types or range of provisions that currently exist for addressing uncertainty in EIA; and
3. recommend practical solutions and research directions for improving guidance and procedures for uncertainty reporting in Canadian EIA practice.

1.3 Thesis structure

This thesis consists of six chapters, starting with this Introduction. Chapter Two provides a review of EIA literature, focusing on the substantive purposes of EIA; identifying and classifying uncertainties inherent in EIA, their types and sources; and the potential influence of uncertainty on EIA outcomes and decision-making. Chapter Three provides an overview of the methodology and an explanation of the document analysis method applied in the research. Chapter Four presents the results of the review of the Canadian federal, provincial and territorial EIA legislation, regulations and guidelines. Chapter Five discusses the significance of the findings. The last chapter presents conclusions and recommends practical solutions for improving guidance and procedures for uncertainty reporting in Canadian EIA practice, and outlines opportunities for further research.

CHAPTER TWO:
LITERATURE REVIEW

Since the introduction of EIA in the early 1970s, much has been written about uncertainties inherent in EIA practice. Much of the academic literature related to the topic has focused on the particular types of uncertainties identified in the components of an EIA, such as uncertainties in baseline studies (Geneletti et al., 2003; Duncan, 2008), uncertainties in modeling (Duncan 2008), or uncertainties in environmental impact predictions (Buckley, 1989; Tennøy et al., 2006). Some authors connect uncertainty in EIA to those inherent in science (Cashmore, 2004; Sarewits, 2004). Some attention has also been given to the identification and classification of uncertainties in EIA (e.g., Rowe, 1993; Canter, 1996; Walker et al., 2003). Various agencies and scholars have highlighted that undisclosed uncertainties in EIA practice can decrease the credibility and efficacy of EIA (Tennøy et al., 2006; Wood, 2008), and have demanded that the proponents of proposed initiatives, and EIA practitioners, be clearer about uncertainties (Duncan, 2013; Tennøy et al., 2006; Wood, 2008). However, very little attention has been given to the examination of the requirements or guidance made available to practitioners concerning uncertainty reporting in EIA, or the types of uncertainties that should be disclosed. The following review focuses on the identification of uncertainties in EIA, and issues related to EIA uncertainty disclosure and consideration.

2.1 Environmental impact assessment

Environmental impact assessment was first introduced in 1969 by the US National Policy Act (NEPA) primarily as a political response to the changing scale and nature of industrial development, growing public concern about the environmental impacts of economic

development, and the inability of existing decision tools, such as cost-benefit analysis, to adequately address these concerns (Cashmore, 2004). To date, EIA laws have been adopted by more than 190 nations worldwide, by all development banks and by most international aid agencies (Cashmore, 2004; Morgan, 2012), and are commonly used in the assessment of development initiatives, policy-making, trade negotiations, and poverty reduction strategies (Cashmore, Bond, & Cobb, 2008). The role of EIA in the decision-making process has been formally expressed in Principle 17 of the Rio Declaration on Environment and Development (Report of the United Nations Conference on Environment and Development, 1992: Annex I): "Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority".

The rationale for EIA is to be an aid to decision-making by providing decision makers with the information needed to be aware of various alterations that may occur in the environment in response to the implementation of a particular proposed activity, and to make informed decisions so as to ensure an appropriate level of environmental protection (Tennøy et al., 2006; Bond et al., 2015). Simply put, EIA is a systematic process to identify, predict and evaluate the environmental effects of proposed actions and projects, and to identify the proper enhancement and mitigation measures to promote environmentally sound and sustainable development (United Nations Environment Program [UNEP], 2002).

2.2 Environmental assessment process and uncertainty

Although EIA has been practiced internationally for more than 40 years, many questions have emerged about the effectiveness of EIA (Cashmore et al., 2007b), particularly concerning

the ability of EIA to accurately predict the impacts of future projects (Tennøy et al., 2006; Duncan, 2008; Duncan, 2013), the quality of information contained in EIA documentation (Dipper, 1998), and whether decisions taken based on EIA documentation are sufficiently informed regarding the uncertainty that characterizes impact predictions (Buckley, 1989; Tennøy et al., 2006; Duncan, 2013). Prediction is the essence of EIA (Glasson, Therivel, & Chadwick, 1999). However, based on comparisons of environmental monitoring and post-assessment auditing data with impact predictions, it has been much stressed in the literature that predictions in EIA often prove to be inaccurate and impacts more severe than stated in prediction documents (Buckley, 1989; Tennøy et al, 2006). Most authors recognize there are many potential uncertainties in EIA, which are often unavoidable (Tennøy et al., 2006). Those uncertainties play a leading role in the reduction of the accuracy of environmental impact predictions and the certainty of EIA processes (Buckley, 1989; Dipper, 1998; Tennøy et al., 2006). Since EIA is based on knowledge that is subject to uncertainty (Canter, 1996), there is a need for disclosing and communicating uncertainty in EIA - an integral attribute of the EIA process (Canter, 1996; El-Sayed, 1996; Tennøy et al., 2006; Bond et al., 2015; Leung et al. 2015, 2016; Lees et al., 2016).

The disclosure of uncertainty is not only important for increasing the quality of an EIA report, it is also important for understanding the risk of adverse environmental impacts and the effectiveness of proposed mitigation, thereby helping to minimize or avoid public and environmental hazards (Duncan, 2013; Shrader-Frechette, 1996). Arguably, the public typically requires more risk protection than the proponents of a new project or risky technology, since the public has fewer financial resources and limited information (Shrader-Frechette, 1996). Various approaches exist for managing uncertainty in different scientific and socioeconomic fields. The

precautionary principle is one of the most commonly cited approach when dealing with environmental decisions under conditions of uncertainty (Benidickson et al., 2005).

2.3 Precautionary principle in EIA

Over the last few decades, the number of decisions made under risk and uncertainty has increased due to the changing scale and nature of industrial development; the increased significance of proposed initiatives; and the introduction of new technologies. Researchers and academia exhibit interest in exploring concepts of risk and uncertainty, and the interconnections between them (Samson, Reneke, & Wiecek, 2009). Already in 1921, the economist Frank Knight highlighted a distinction between uncertainty and risk. He stated that risk is measurable and always represents probabilities with negative outcomes or losses. In contrast, uncertainty, which may not be quantified, combines different possible outcomes (both negative and positive) with the unique instances that are unknown (Knight, 1921). However, many authors link the phenomenon of uncertainty to risk (Samson et al., 2009). For instance, Lawrence argued that "risk is a subset of uncertainty"; it is "a form of uncertainty to which probabilities can be attached" (2003: 425). Further, he noted interconnection between risk and uncertainty and stated that both concepts are overlapping (Lawrence, 2003). However, when the difference between uncertainty and risk is not yet entirely clear, the precautionary principle has to be applied (Vinuales, 2010).

The Principle 15 of the Rio Declaration on Environment and Development (1992) is considered as the first formal statement on the precautionary principle (Huber, 2012). Principle 15 says: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where 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". Thus, the use of protective measures is required in accordance with the precautionary principle in response to possible risks, even if the existence of this risk has not yet been proven by current scientific knowledge.

The precautionary principle is broadly applied in European regulation of science and technology (EEA, 2001, 2013). It is a general principle for the protection of human, animal or plant health, and the environment in the face of potential risks, and is integrated into EIA requirements in Australia and the European Union (Lawrence, 2003). It is also applied in international treaties and laws related to the environment (Lawrence, 2003). In Canada, the precautionary principle is found in most federal environmental laws, including the Canadian Environmental Protection Act (CEPA), the Canadian Environmental Assessment Act, 2012 (CEAA 2012), the Species at Risk Act (SARA), the Oceans Act, the Fisheries Act, and the Pest Control Products Act (PCPA) (Tollefson, 2012).

In a broad sense, a precautionary principle is a decision-making approach. Four central components of the precautionary principle are closely related to environmental decision-making, among them: taking preventive measures in situations under uncertainty; placing the burden of proof on the development proponent; evaluating a wide range of alternatives, including worst-case scenarios; and increasing public involvement in decision-making (Kriebel et al., 2001). This principle empowers (or even obligates) decision-makers to consider uncertainty when making decisions. It also contributes to sustainable project planning. Although the use of the precautionary principle would acknowledge uncertainty in EIA, its application does not necessarily lead to explicit recommendations or requirements to EIA practitioners about how to disclose and communicate uncertainty. However, the disclosure of uncertainty should be

considered as a prerequisite for uncertainty management. It is essential for the evaluation of proposed mitigation measures and the justification of a preferred project alternative, and is important for increasing the awareness of decision-makers and the public about the degree of certainty (or uncertainty) of an EIA and subsequent decisions. The first step to dealing with uncertainty is an understanding of uncertainty as a phenomenon, and the identification of its types, sources, and possible consequences.

2.4 Scientific uncertainty

Science is an inalienable part of EIA (Cashmore, 2004). It supplies legitimated scientific facts, which build an appropriate base of knowledge that guides human acts (Sarewitz, 2004). However, as stated by Walker (2003), scientific evidence contains uncertainty of various natures and levels. Uncertainty, as a phenomenon, broadly refers to any situation where we are not absolutely confident in our assumptions (Yoe, 1996). Narrowly defined, uncertainty represents situations where the knowledge of system characteristics and direction is accompanied by an unknown nature of the result or its probability (Lawrence, 2003). Many definitions are in use to describe uncertainty, from lack of certainty, or doubt, to a more formal definition such as: *"any deviation from the unachievable ideal of completely deterministic knowledge of the relevant system"* (Walker et al., 2003). The lack of knowledge or incomprehension about cause-effect interconnections/links in existing or future conditions, as well as the natural variations of those conditions, causes uncertainty (Carpenter, 1995). Since natural systems are complex, dynamic, self-organizing, undetermined and evolve chaotically, all environmental issues involve uncertainty (Carpenter, 1995). Adequate evidence, which is designated to support scientific conclusions, will always include some *scientific uncertainties* and various interpretations

(Lawrence, 2003).

There are many *forms of uncertainty*, such as conceptual uncertainty, scientific or methodological uncertainties, measurement uncertainty, uncertainty related to the conditions of observation, sampling uncertainty, modeling uncertainty, and causal uncertainty (Walker, 2003; Lawrence, 2003). Uncertainty may have the character of objectivity or subjectivity, be quantitative or qualitative, temporal or spatial, or may be due to a difference in base values or a conflict of interests (Lawrence, 2003).

There are also many *sources of uncertainty*, such as the lack of information, knowledge, insight, or experience. Many factors contribute to uncertainty in EIA, among them: inadequate methods and explanatory paradigms; controversy on existing data; inadequate study designs and sampling designs; incorrect and simplified models; insufficiency of time and expertise; doubt in judgments; randomness; errors and bias; changes in proposal characteristics and design; new situations and innovations in technology, materials, and methods; absence of direction; poor management and communication; and deficiencies in EIA requirements and guidelines (Carpenter, 1995; Lawrence, 2003). There are also a number of *concepts* related to uncertainty, which are based on different approaches for understanding and addressing uncertainty. Lawrence (2003), for example, describes several general key uncertainty-related concepts, including:

- ignorance/incomplete knowledge: characterized by a lack of knowledge and unknown outcomes; ignorance of the highest order - don't know what we don't know;
- errors/mistakes/bias: include the three types of errors[1]; errors of measurement, calculation, and judgment; bias in data acceptance and in data interpretation;

[1]Type I error (false positive) is refers to assumption of possible effect and rejection of a null hypothesis that is actually true; type II error (false negative) is represented by rejection of possible effects and accepting a null

- Heisenberg's uncertainty principle: posits an absolute, theoretical limit on the combined accuracy of certain pairs of simultaneous, related measurements (impossibility to measure simultaneously position and momentum – the better position is known, the less momentum is known, and vice versa);

- indeterminism/inconclusiveness: based on an assumption that uncertainty may never be significantly reduced due to the inconclusiveness of information and scientific knowledge;

- fuzziness/vagueness: based on fuzzy thinking, which is not precise; it reflects truths, but not facts or statistics; thought to be a good technique to deal with nonlinear systems;

- ambiguity/non-specificity: includes more than one possible meaning; intentionally or unintentionally, obvious or hidden;

- approximations: based on the simplifications of complex real systems;

- doubt: usually involves several parties; based on disagreements and conflicting interests;

- confusion/linguistic imprecision/dissonance: where dissonance is based on a pure conflict (one statement is true and its competitors are false); confusion is based on a pure and potential conflict; procedural confusion arises due to the complexity and uncertainty of the situation that exceeds the problem-solving capacity of existing decision-making techniques, procedures, and institutions; linguistic imprecision is based on imprecise communications;

- surprise: an appearance of uncertainty that cannot be predicted; a significant difference between observations and expectations; and

- uncertainty analysis: the analysis of information related to a partially known or unknowable risk to evaluate the degree of confidence; consists of quantitative and qualitative analysis.

Different approaches to uncertainty evaluation and management are based on these uncertainty-related concepts in various scientific and social fields. They are also valuable for addressing uncertainty in EIA and risk assessment.

hypothesis that is actually false (Shrader-Frechette, 1996); type III error (wrong problem) involves mistakes in problem definition (Lawrence, 2003).

2.5 Uncertainties inherent in EIA

Since EIA consists not merely of applied science, but also includes social, economic and political components, limitations and complexities tied to EIA practice are even greater than those which appear in applied scientific research (Lawrence, 2003). The EIA process consists of a series of systematic steps: project description, screening, scoping, impact prediction and evaluation, impact management, review and decision, and implementation and follow-up (Noble, 2015). Each of these steps involves potential sources of uncertainty (Sigel et al., 2010). Thus, understanding and identification of types of uncertainty, their sources and possible implications is of paramount importance when dealing with uncertainty inherent in EIA.

The possibility to predict the environmental impacts of a proposed development with complete certainty is rare (Buckley, 1989). Many potential uncertainties inherent in EIA practice have been recognized and studied by different authors. Among them: uncertainties in baseline data (e.g., incomplete or inadequate information) (e.g., Geneletti et al., 2003; Duncan, 2008); uncertainties in models science adopted to predict impacts (e.g., model structural uncertainty, inputs uncertainty, model validation and verification uncertainty) (e.g., Bastin et al, 2013; Shrader-Frechette, 1996); uncertainties in impact predictions themselves (e.g., assumptions, changing conditions) (e.g., Wood, Dipper & Jones, 2000; Canter, 1996; Hellström & Jacob, 1996; Söderman, 2005; Rowe, 1994); uncertainties in impact significance evaluation (e.g., lexical uncertainty, uncertainties related to the definition of criteria and thresholds for evaluation of impact significance, expert judgment) (e.g., Wood, 2008; Beven, 2002); uncertainties in the effectiveness of proposed mitigation measures (e.g., Söderman, 2005; Tennøy, 2008); and uncertainties in project design (e.g., projects definitions and characteristics, different alterations that may have occurred to the project design from the time a project is proposed and the EIA

completed) (e.g., Rowe, 1994; Pardo, 1997, Canter, 1996). Since this research focuses on provisions for uncertainty disclosure and communication in EIA guidance, the scope of the literature reviewed on the subject of uncertainty is designed to help build necessary knowledge in this particular context. The mentioned above potential uncertainties in EIA of different types and sources that most commonly identified in EIA practice are described below.

2.5.1 Uncertainties in baseline data

Uncertainties inherent in baseline data arise on the basis of inadequate knowledge, which is available to practitioners and policy makers and is frequently fragmentary and not systemized (Sigel et al., 2010). Baseline studies in EIA often lack complete information or contain errors (Geneletti et al., 2003). The outputs of predictive models in EIA depend on the credibility of inputs used in the modelling process (Duncan, 2008). Hence, during the baseline study, it is of high importance to accurately collect relevant information to ensure the quality of the environmental impact predictions (Geneletti et al., 2003). The main uncertainties associated with modelling inputs (or data required for the modelling process) arise due to: measurement uncertainty (the intrinsic uncertainty in a given measurement, e.g., due to noise in the electronics of the sensor system); representation uncertainty (due to difference between the spatial and temporal sampling footprint and difficulties in the definition of the spatial and temporal representation of reality); sensor model uncertainty (characterized by incomplete knowledge of the sensor); and transmission uncertainty (due to errors introduced by the computer systems and electronics that control the sensor observations) (Bastin et al., 2013). Inaccuracies or errors in baseline data can alter the outcomes of impact predictions and assessment, thus the selected means to mitigate the potential environmental impacts of proposed development will be affected

as well (Geneletti et al., 2003). In addition to the limited availability of the information, collection of qualitative data may also be restricted by time and geographic limitations and the high expense of obtaining certain data, and the need for the recalibration of some data or measurements (Duncan, 2008). Finally, project proponents are responsible for providing 'appropriate' environmental information; thus, project proponents gain the opportunity to control the analysis by supplying decision-makers with data that increase the apparent environmental soundness of a project and may be tempted to hide information which could complicate a project approval (Wood, 2008).

2.5.2 Model uncertainties

Uncertainties also were identified in models applied in the EIA process. People make sense of the world through their beliefs using some set of facts about reality and its functioning (Sarewitz, 2004). Consequently, models of the environment that serve as a conduit for EIA predictions are "simplified assumptions" of the real world with potentially low reproduction of reality and, as a result, each prediction is affected by unavoidable uncertainty (Geneletti et al., 2003). Natural systems are characterized by high complexity, poorly understood interconnections, and uncontrolled boundary conditions, which engenders considerable uncertainty in our knowledge (Beven, 2002).

The key sources (or causes) of model uncertainty include: mechanism/structural uncertainty (the inability to include in the model all mechanisms and components of physical, chemical, biological or human processes that act on reality entails the simplification of models – they include only certain components/processes, which are prioritized); representation uncertainty (related to the discretization of spatial, temporal and spatiotemporal parameters of

models); parameter uncertainty (many model inputs that cannot be directly observed/measured often are determined empirically); numerical uncertainty (often modeling processes require differential or difference equations, which introduce additional uncertainty) (Bastin et al., 2013). Also, scientists and researchers usually claim their models to be validated and verified merely based on the comparison of outcomes obtained from several models but not from the real world (Bond et al., 2015; Shrader-Frechette, 1996). Such statements regarding validation and verification of models may mislead decision-makers and the public about the reliability of the modeling outputs and the certainty of outcomes. However, often computer models and programs used in EIA are not only unverifiable but incorrect since they are oversimplified and do not take into account all aspects and drivers of the real world (Walker et al., 2003; Bastin et al., 2013).

2.5.3 Uncertainties in impact predictions

The prediction of the environmental effects of development is the main outcome of the EIA process (Wood et al., 2000). Impact prediction is the *expected* future response of a valued ecosystem component to a particular development or action. Prediction is the most technically challenging and complicated activity of the entire EIA process (Canter, 1996). The future is always uncertain (Rowe, 1994); hence, uncertainty is inherent in any process that is focused on future conditions. Uncertainty in impact predictions has many different sources/forms, among them: the description and measurement of a proposed project; the description of the affected environment; the understanding of the possible reaction of the affected environment; the determination of the importance of the identified impact (Canter, 1996); the use of simplified assumptions regarding interactions between different components of environment systems, which do not reproduce reality (Geneletti et al., 2003; Bond et al., 2015).

Generally, there are two tasks associated with impact predictions: (1) to identify potential impacts which may occur in response to the implementation of proposed activity; and (2) to quantify (or at least, qualitatively describe) possible impacts (Canter, 1996). Different impact prediction technics are available for the EIA practitioner that may be combined in three major groups: simple techniques; indices and experimental methods; and mathematical models (Canter, 1996). Simple techniques involve:

- analogy: comparison of proposed activity with a similar type of project – "look-alike" approach;
- inventory: developing an inventory of environmental resources or valuable components of the affected environment to identify which of these components will be degraded in quality or be lost as a result of proposed activity;
- checklists and matrices: identification of the potential impacts of certain project type(s) using listings of the anticipated impacts, questionnaire checklists and matrices.

Indices and experimental methods involve factors that represent classification of baseline quality and sensitivity:

- environmental media indices (e.g., air, surface water, noise);
- other indices (aesthetic, life quality);
- habitat indices;
- experimental methods (field study, laboratory, physical models).

Mathematical models are represented by a range of different quantitative approaches (e.g., air quality dispersion, biological impact models, and socioeconomic models) (Canter, 1996). As any other models, they are the simplified assumptions of the real world and thus, the use of those tools and technics may be a major source of uncertainty in impact predictions.

Uncertainty is inherent in almost all predictions (Duncan, 2008; Hellström & Jacob, 1996). Unpredictable conditions, such as weather, economic and social changes, possible

breakdowns of a plant, etc., increase uncertainties in EIA predictions (Duncan, 2008). Rowe (1994) identifies some of the main sources of future temporal uncertainty related to impact predictions: the randomness of nature; success in short term predictions; inconsistency of human behavior; chaotic systems behavior; and unexpected, value-based human behavior. Predictions also involve expert judgment, which may be influenced, for example, by political ideologies or other personal preferences of an expert; and hence may contribute to uncertainty in impact predictions (Hellström & Jacob, 1996).

In addition, the weakness of impact predictions is also due to lack of relevant information that is supposed to be captured in the baseline study stage of EIA. Time constraints and monetary limits make it impossible to gather all necessary information. It forces EIA practitioners to base their predictions on an in-office study of existing information, which is delivered from other projects or previous surveys that are not necessarily relevant to a particular project. Such information may be inaccurate and outdated, and often remains unchecked (Söderman, 2005).

2.5.4 Uncertainties in impact significance evaluation

Impact significance evaluation remains one of the most important, complex, disputable, and unclear aspects of EIA worldwide (Wood, 2008). Evaluation of significance is a dynamic activity that starts from the project screening stage, when limited information is available, and goes through scoping, impact prediction, monitoring, and mitigation (Wood, 2008). Significance evaluation depends on many factors, such as project context and spatial scale; temporal change; ethnic and social values; ecological vulnerability; economic and institutional approaches (Wood, 2008). However, lexical, or linguistic, uncertainties can contribute to EIA efficacy problems. Among them uncertainty in the expression and interpretation of the terms used in EIA (Sattler &

Zander, 2004) and in the expression and communication of the evaluation of impact significance (e.g. expressions such as ‘major’, ‘moderate’, ‘substantial’ etc.) (Wood, 2008). This often leads to disputes and controversies around terms and definitions being used, and increases contradictions and misunderstandings among various stakeholders (Beven, 2002).

It is also important to define thresholds and criteria for impact significance evaluation. However, universally accepted regulatory thresholds or criteria for all that is assessed in an EIA do not exist; each case is unique and requires professional judgment to set the expression of values of the assessment, assessment criteria and significance thresholds (Wood, 2008). In the absence of a commonly accepted definition of the criteria and thresholds for significance evaluation, project proponents may manipulate overall assessment results (Wood, 2008). In addition to uncertainties that are associated with the criteria for evaluating impact significance, there is a possibility that even if such criteria are clear and transparent, there is little assurance that in reality those criteria were used by experts in practice (Wood, 2008).

2.5.5 Uncertainties in effectiveness of mitigation measures

Over the last few decades, environmental management practices have shifted to become prevention-oriented (Wynne, 1992); and the identification and evaluation of mitigation measures for potential impacts is the most important goal of EIA (Tennøy et al., 2006; Hanna, 2016). However, significant uncertainty is inherent in the effectiveness of proposed mitigation measures. Mitigation measures are designated to avoid, minimize or offset predicted negative impacts of proposed activities (Tennøy, 2008). There are several approaches to mitigate possible adverse impacts, including impact avoidance, impact reduction, restoration, and compensation (Ogola, 2007). The development of mitigation measures is typically based on baseline data and

impact predictions, in combination with experiences from other, similar projects. As was already described above, significant uncertainty is inherent in baseline studies and predictions, and lessons from one project are not always transferable to another – particularly for socioeconomic impacts (Noble, 2015); therefore, uncertainty in the design of mitigation measures is often a reflection of uncertainty identified in previous stages of EIA. Often, mitigation measures attempt to decrease or minimize the effect of possible impacts that were not properly identified (Söderman, 2005). There is, also, uncertainty associated with available mitigation measures (or mitigation potentials) and their costs (Ekholm et al., 2010). Mitigation potentials, in turn, depend on technological assumptions and available resources (Ekholm et al., 2010) as well as political and social will, which calls into question whether the most significant impacts have been mitigated or simply the ones which were most easy to mitigate (Söderman, 2005). Finally, not all impacts can be mitigated (Tennøy, 2008).

2.5.6 Uncertainty in project design

Uncertainty related to project design is associated with a project's characteristics, such as project size, detailed design and operational features (Canter, 1996). Project design is a dynamic process, and this often results in changes in the project design between the impact prediction stage and project implementation (Tennøy, 2008). Project designers often ignore risks and uncertainties, particularly social ones, and focus their effort on structural complexity, design requirements, and cost-effectiveness (Rowe, 1994).

Notwithstanding improved theoretical understanding of the need for a new approach to manage uncertainty in EIA, practitioners are still focused on events and phenomena that are

anticipated to occur as the result of proposed development initiatives and often ignore recommendations regarding uncertainty disclosure and consideration (Duncan, 2008). However, uncertainties in EIA practice that are not disclosed may significantly affect the overall performance of EIA as a decision-aiding tool, and decrease the usefulness of impact predictions (Tennøy et al., 2006; Cashmore, 2007). In most cases, decision-makers have only limited access to the information regarding the input data and assumptions used in impact prediction, and the validity of the approach taken, and are not aware of the hidden uncertainties in different stages of the EIA process. As Tennøy et al. (2006: 50) note: "... uncertainty is thoroughly discussed or indicated in only a minority of the documents, and… the uncertainty presented in prediction documents does not necessarily reach decision-makers".

2.6 Uncertainty disclosure in EIA practice

As a predictive and participatory process, EIA consists of two principal outcomes: its contribution to project design, and consent decisions (Cashmore, 2007). However, in most cases, EIA has little influence on the decision regarding the authorization of a particular development or project (Wood, 2008); the information collected in the EIA process may serve as the basis for project design alternatives and measures to mitigate their impacts (Wood, 2008). The increased concern of academics and the broader public about identifying and mitigating the impacts of proposed projects is reflected in a growth of EIA relevant literature (e.g. Leung et al., 2016; Lees et al., 2016; Cashmore, 2004; Tennøy et al., 2006; Wood, 2008). This primarily relates to the need to give more emphasis to improving the communication of uncertainty in EIA and to making the prediction processes more transparent in order to improve EIA as a decision-aiding tool (Bond et al., 2015; Tennøy et al., 2006).

Despite various research papers on the subject of uncertainty in EIA and the recommendation for better uncertainty communication in the EIA and decision-making process (Leung et al., 2015), current EIA practice is characterized by the lack of uncertainty disclosure and consideration (Geneletti et al., 2003; Tennøy et al., 2006; Wood, 2008; Duncan, 2008; Leung et al., 2016; Lees et al., 2016). Much of the literature on the topic tends to focus on the existence of uncertainties of different types and from different sources, and the need for its communication, but pays very little attention to the analysis of current guidance, procedures or requirements for uncertainty disclosure in EIA practice. For example, Wood (2008) mostly concentrates on issues related to impact significance evaluation and stresses the importance to communicate uncertainties associated with impact significance assessment. He does not provide any recommendations in respect to the provisions for reporting or addressing uncertainty in EIA. Similarly, Tennøy et al., (2006) repeatedly argue for the need for better communication of uncertainty inherent in EIA, yet do not take into account the scope of current guidance or regulations and procedures for uncertainty disclosure and consideration.

A better understanding of uncertainty in EIA is a prerequisite to effective decision-making based on EIA results (Duncan, 2013; Rowe, 2006). Properly disclosed uncertainty may increase the awareness of decision-makers about the hidden risks associated with a proposed development or project; hence, the acceptability of those risks will be based on informed and well-reasoned judgment (Geneletti et al., 2003; Wood, 2008). Geneletti et al. (2003) conclude that understanding and considering uncertainties in EIA help decision-makers to make better informed decisions. The disclosure of terms, criteria, and thresholds used in the evaluation of impacts is essential for an increase the efficiency and transparency of EIA as a decision-aiding tool (Wood, 2008). However, the lack of disclosure and communication of uncertainties in EIA

have been clearly described in several research papers during last few decades (e.g. Duncan, 2013; Duncan, 2008; Wood, 2008; Tennøy et al., 2006; Dipper et al., 1998; Buckley, 1991).

Many authors, also, consider that even if uncertainties are outlined and expressed in prediction documents and reports, this information may not necessarily reach decision-makers (Tennøy et al., 2006; Wood, 2008); and often decision-makers "are not made aware of the prediction uncertainty" (Tennøy et al., 2006, p. 52). Often, it is enough for governments and the general public to know that generally applicable standards will be met or that impacts will be within some broadly defined range (Wood, 2008). Further, the ultimate responsibility for providing "appropriate" environmental information rests with the project proponents, allowing project proponents to control the information provided in the EIA and to the decision-making process.

Wood (2008) argues that even if an EIA consists of comprehensive explanations of the terms, thresholds, and assessment criteria, it does not follow that the EIA practitioners actually apply this knowledge in practice. He also believes that these explanations could be simply used to add scientific credence to the assessment. Often EIA has been used as a scientific instrument to defend one’s values and interests in environmental controversies, which are usually of a political nature (Sarewitz, 2004; Wood, 2008). As Sarewitz notes, "science typically lies at the center of the debate" (2004: 386), and scientific justification frequently is invoked to support a particular action; from another point of view, the action's opponents usually select scientific uncertainties or competing results of scientific research to support their point of view (Sarewitz, 2004).

2.7 Towards improved disclosure and communication of uncertainty in EIA practice

Literature on uncertainty in EIA suggests that EIA practitioners and the proponents of a proposed activity should be more explicit about uncertainties in EIA and properly report uncertainty to decision-makers and the public (e.g., Cashmore, 2007; Duncan, 2008; Tennøy et al., 2006; Lees et al., 2016). However, discussions regarding the lack of proper communication of uncertainty in EIA will not assist EIA practitioners in applying scholars' recommendations related to EIA uncertainty reporting in practice. The implementation of the precautionary principle also does not guarantee suitable uncertainty communication, mainly because this principle is mostly oriented toward the decision-making process and does not provide recommendations or requirements for EIA practitioners about how to disclose uncertainty. Since EIA practice in Canada is regulated by federal, provincial, and territorial EIA legislation, regulations, and guidelines, EIA practitioners must follow the requirements stated in such legislation and guidance. However, it should not be assumed that if EIA practitioners do not adequately disclose and address uncertainty in EIA that there are no requirements or provisions for uncertainty disclosure and consideration – it may simply be poor practice or inadequate attention to the matter. In order to better understand uncertainty communication practice in current EIA and to aid in the development of practical solutions (or requirements) for improving guidance and procedures for uncertainty reporting in Canadian EIA practice, it is important to examine the scope of current EIA legislation, regulations, and guidelines concerning uncertainty reporting. By analyzing current EIA legislation, this research will make a contribution to the improvement of the understanding, communication, and consideration of uncertainty in EIA.

CHAPTER THREE:
RESEARCH METHODS

Uncertainty disclosure and communication requirements and provisions in EIA legislation and guidance were examined using document content analysis. Content analysis is a systematic procedure for reviewing and analyzing documents (Bowen, 2009). This method is suitable for working with different documents/sources of information, including text data (printed and electronic documents), video and audio records, pictures and other types (Elo & Kyngas, 2008). Content analysis was used as early as the 19th century as an analytical method for evaluating newspaper and magazine articles, advertisements, and political speeches (Elo & Kyngas, 2008). At that time, a quantitative approach, based on the simple counting of the occurrence of designated key words or phrases in the text, was the most commonly applied approach. Kracauer (1953) highlighted the limitations of content analysis based solely on a word-count approach, questioned the meaningfulness of the results and suggested the need to consider also qualitative content analysis. Qualitative content analysis extends beyond simple word counting and focuses on language characteristics, context and textual meaning (Hsieh & Shannon, 2005).

Krippendorff (2004: 18) defines content analysis as "a research technique for making replicable and valid inference from text […] to the contexts of their use". Content analysis is based on simplifying and categorizing information (US General Accounting Office, 1989). To follow the procedures of content analysis, collected materials (documents) are organized in a standardized format that allows analyzing the meaning and characteristics of the information (US General Accounting Office, 1989). Krippendorff (2004) noted the growing interest in content analysis due to the increasing use of computer applications in text processing.

This research adopts a summative approach to content analysis that has emerged over the

past eight years (see Rapport, 2010). This approach is a combination of examining *manifest* (explicit meaning, literally present in the text) and *latent* (implicit meaning, implied in the text) content of the text (Kondracki, Wellman & Amundson, 2002). The manifest analysis starts with identifying and often quantifying the presence of particular words and/or phrases (or content) in the text to explore their contextual usage, but not their meaning (Hsieh & Shannon, 2005). The next step, latent analysis, is qualitative and is designed to discover and interpret the underlying meaning of a word or the content identified in the text (Hsieh & Shannon, 2005). Summative content analysis generally consists of three phases: preparation, analysis, and reporting (Elo & Kyngas, 2008) (Figure 3-1).

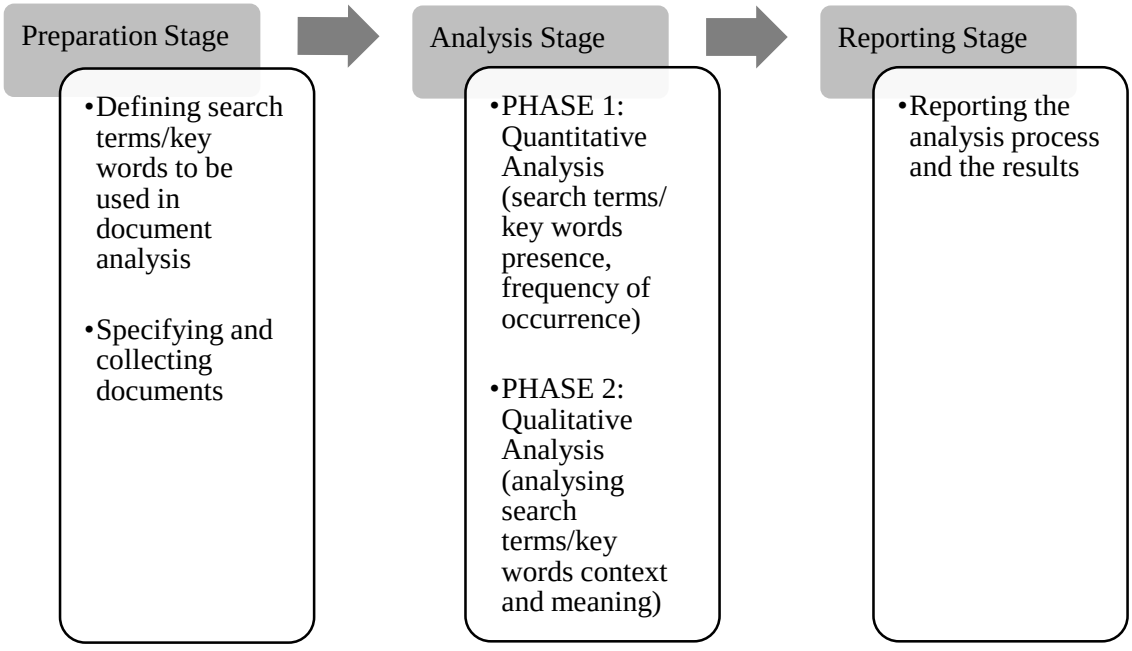

Figure 3-1. Summative content analysis process

3.1 Preparation stage: defining the search terms

Any qualitative content analysis is informed by theory or prior knowledge (Gläser & Laudel, 2013). For theory-based qualitative research, the preparation stage of the content analysis starts with deriving categories or search terms informed by a theoretical framework that serves to identify key concepts and the relationships among them. For knowledge-based qualitative research, the preparation stage starts with deriving categories or search terms informed by available practical information (Gläser & Laudel, 2013), such as key terms of concepts identified in literature or key policy documents.

Uncertainty, as a term, is commonly accepted and broadly used in academic literature. However, synonyms or alternative terms may also be used to explain the same meaning. Among them: lack of certainty; ambiguity; indeterminacy; vagueness; indetermination; suspense; incertitude; doubt; unclearness; lack of clarity; inexactness; contingency; unpredictable or unsure conditions/situations; incompleteness or uncompleted data; absence/lack of knowledge; partial knowledge; and imprecise knowledge, to name a few. Also, a reference to risk and precaution or to the precautionary principle/approach could be regarded as direction for EIA practitioners to report uncertainty. Therefore, searching EIA legislation and associated documents cannot be limited to the appearance of the term “uncertainty”; a number of other search terms, or keywords, relevant to the concept of uncertainty, must also be explored.

Three main categories of search terms were developed for the analysis of EIA documents (Table 3-1). *Category I* represents the most explicit uncertainty-related terms – the root of the word ‘uncertainty’. *Category II* was based on uncertainty-related concepts proposed by Lawrence (2003), and in the opinion of the author of this research, represents the concepts which are the most relevant to uncertainty inherent in EIA (refer to Chapter 2 for more information on

those concepts). *Category III* includes several widely applied approaches to dealing with uncertainty, among them: precautionary principle/approach (Benidickson et al., 2005); confidence interval and/or confidence limit/level (Coutand et al., 2011); contingency planning (McConnell & Drennan, 2006); risk analysis/assessment (Yoe, 1996; Yoe & Skaggs, 1997); and worst case scenario evaluation (Hauge et al., 2014; Karl et al., 2011; Williams et al, 2009).

Table 3-1. Search terms adopted for document content analysis of EIA legislation, regulations and guidelines

Search Category	Description of Search Category	Root Terms	Actual Search Term(s)
CATEGORY I	Explicit term "uncertainty"; explicit representation of the concept/ phenomenon of uncertainty	certain	- certain - uncertain - uncertainty(-ies) - lack of certainty
CATEGORY II	Based on uncertainty-related concepts proposed by Lawrence, 2003	ambig*	- ambiguity - ambiguous
		assumption	- assumption
		*conclusive	- inconclusive
		determin*	- indeterminacy - indeterminate - undetermined
		doubt	- doubt
		incertitude	- incertitude
		incomplete	- incomplete
		precis*	- precision - precise
		predict	- unpredictable
		unknown	- unknown
		vague	- vague - vagueness
CATEGORY III	Based on some commonly-accepted approaches for dealing with uncertainty	caution	- precaution - precautionary - principle/approach
		confiden*	- confident - confidence - confidence interval - level of confidence
		contingency	- contingency
		risk	- risk
		worst case scenario	- worst case scenario

* indicates truncated or root word

3.2 Preparation stage: data collection

The preparation phase begins with specifying the materials/documents to be included in content analysis and collecting materials for the review. All legislation, regulations and guidance documents used in this research were retrieved from the websites of the respective government authorities and agencies responsible for EIA in each jurisdiction. Only publicly available documents were collected; any internal guidance and directives that may exist and are available only for the internal use of EIA reviewers and decision-makers were not included in this research. All 14 Canadian EIA jurisdictions were included in the review, with the exception of Quebec.

Although Québec's *Environment Quality Act* and the regulations that exist under the Act are available in English, all EIA guidelines and sectoral directives published on the official website of the Ministry of Sustainable Development, Environment and Fight against Climate Change are available in French only. As the researcher does not speak French, and attempts to obtain the English translation of those documents from the Ministry were not successful, they were excluded from the analysis. Since it was impossible to fully analyze the requirements and guidance available for uncertainty disclosure and consideration under Quebec's EIA system, it was considered appropriate to exclude Québec from the analysis.

All Canadian federal, provincial and territorial EIA legislation, regulations and guidelines included in this research are listed in Table 3-2. The documents were grouped by jurisdiction (federal, provincial, territorial), and then by hierarchical structure (legislation, regulation, and guideline). EIA systems are hierarchically structured, whereby legislation sets the overall requirements and typically the boundaries or direction for lower levels, such as regulations and practitioner or regulator guidelines. Legislation, usually an Act or statute, is enacted by

Parliament. Some Acts of Parliament delegate authorities, such as Ministers, departments, agencies or boards, the power to make and apply subordinate legislation. This type of legislation is defined as *"delegated legislation"*, and is often described in an Act only in general terms (Parliament of Canada; 2009). Regulations represent delegated legislation, and define the application and enforcement of legislation. The lowest level in an EIA system is represented by guidelines, the departmental documents that are used to interpret legislation and/or regulation.

In most jurisdictions governments also issue 'project specific guidelines' for each individual assessment to be carried out. Project specific guidelines are informed by higher-level guidelines, regulation and legislation – but are also sensitive to local context. It is possible that these project-specific guidelines may address issues related to uncertainty, but such provisions would be case-dependent and may vary considerably from one project to the next. Project-specific guidelines were excluded from the scope of this research.

Table 3-2. Canadian federal, provincial and territorial EIA legislation, regulations and guidelines reviewed in this research

Jurisdiction	Hierarchical structure	Document name
Canadian Federal Government	Legislation	Canadian Environmental Assessment Act, 2012; S.C. 2012, c. 19, s. 52
	Regulations	Regulations Designating Physical Activities; SOR/2012-147
		Prescribed Information for the Description of a Designated Project Regulations; SOR/2012-148, [2012-07-06]
	Guidelines	*Canadian Environmental Assessment Agency:* Operational Policy Statement: Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act*, 2012
		Canadian Environmental Assessment Agency: Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under the *Canadian Environmental Assessment Act*, 2012

Jurisdiction	Hierarchical structure	Document name
		Canadian Environmental Assessment Agency: Guide to Preparing a Description of a Designated Project under the *Canadian Environmental Assessment Act*, 2012
British Columbia	Legislation	Environmental Assessment Act, S.B.C. 2002, c. 43
	Regulations	Reviewable Projects Regulation, B.C. Reg. 370/2002
		Concurrent Approval Regulation, B.C. Reg. 371/2002
	Guidelines	*British Columbia Environmental Assessment Office:* Guideline for the Selection of Valued Components and Assessment of Potential Effects (September 2013)
		British Columbia Environmental Assessment Office: Application Information Requirements Template (May 2013)
		British Columbia Environmental Assessment Office: User Guide (March 2011)
		British Columbia Environmental Assessment Office: Guidelines for Preparing a Project Description for an Environmental Assessment in British Columbia (September 2008)
Alberta	Legislation	Environmental Protection and Enhancement Act, R.S.A. 2000, c. E-12; *Part 2: Environmental Assessment Process, Approvals and Registrations (Pages 44-67)*
	Regulations	Environmental Assessment (Mandatory and Exempted Activities) Regulation; 111/93; *88/2000, 62/2008*
		Environmental Assessment Regulation; 112/93; *243/93, 251/2001; 254/2007*
	Guidelines	*Alberta Government. Environmental Assessment Program:* Alberta's Environmental Assessment Process (March 2013)
		Alberta Government. Environmental Assessment Program: Guide to Preparing Environmental Impact Assessment Reports in Alberta (March 2013)
		Alberta Government. Environmental Assessment Program: Guide to Providing Comments on Proposed Terms of Reference (February 2010)
		Alberta Government. Environmental Assessment Program: Guide to Reviewing Environmental Impact Assessment Reports (March 2010)
		Alberta Government. Environmental Assessment Program: Guide to Using the Project Summary Table (February 2012)
		Alberta Government. Environmental Assessment Program: Preparing for and Submitting an Environmental Impact Assessment Report (February 2010)
		Alberta Government. Environmental Assessment Program: Preparing Disclosure Documents For Environmental Assessment Screenings (2010)
Saskatchewan	Legislation	The Environmental Assessment Act, 1980, S.S. 1979-80, c. E-10.1

Jurisdiction	Hierarchical structure	Document name
	Regulations	*No relevant regulations exist under the Act*
	Guidelines	*Saskatchewan Ministry of Environment:* Environmental Assessment in Saskatchewan. A High-Level Overview of the Environmental Assessment Process for Developments within Saskatchewan under The Environmental Assessment Act (November 2012)
		Saskatchewan Ministry of Environment: Proponent`s Guide: Consultation with First Nations and Métis in Saskatchewan Environmental Impact Assessment. Guidelines for Engaging and Consulting with First Nations and Métis Communities in Relation to Environmental Assessment in Saskatchewan (November 2012)
		Saskatchewan Ministry of Environment: Technical Proposal Guidelines. A Guide to Assessing Projects and Preparing Proposals under The Environmental Assessment Act (November 2012)
		Saskatchewan Ministry of Environment: Guidance for the Preparation of the Terms of Reference. A Guide to Developing the Terms of Reference for a Proposed Project (or `Development`) under The Environmental Assessment Act (November 2012)
		Saskatchewan Ministry of Environment: Technical Review Guidelines. A Guide to the Technical Review Process for Environmental Impact Assessment within Saskatchewan under The Environmental Assessment Act (November 2012)
		Saskatchewan Ministry of Environment: Environmental Review Guidelines for Oil and Gas Activities (September 2012)
		Saskatchewan Ministry of Environment: Environmental Review Guidelines for Intensive Livestock Operations (March 2009)
		Saskatchewan Ministry of Environment (Saskatchewan Mineral Exploration and Government Advisory Committee): Mineral Exploration Guidelines For Saskatchewan (2012)
Manitoba	Legislation	The Environment Act, C.C.S.M. c. E125
	Regulations	*No supporting EIA-specific regulations exist under the Act*
	Guidelines	*Manitoba Conservation, Environmental Assessment & Licensing Branch:* Environment Act Proposal Report Guidelines (January 2011)
		Manitoba Conservation, Environmental Assessment & Licensing Branch: Environmental Assessment and Licensing under The Environment Act (January 2009)
Ontario	Legislation	The Environmental Assessment Act, R.S.O. 1990, c. E.18
	Regulations	General, R.R.O. 1990, Reg. 334
	Guidelines	*Ontario Ministry of the Environment:* Code of Practice: Preparing, Reviewing and Using Class Environmental Assessments in Ontario (January 2014)

Jurisdiction	Hierarchical structure	Document name
		Ontario Ministry of the Environment: Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario (January 2014)
		Ontario Ministry of the Environment: Code of Practice: Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario (January 2014)
		Ontario Ministry of the Environment: Guide to Environmental Assessment Requirements for Electricity Projects (January 2011)
		Ontario Ministry of the Environment: Guide to Environmental Assessment Requirements for Waste Management Projects (March 2007)
		Ontario Ministry of the Environment: Guide: Ontario's Transit Project Assessment Process (January 2014)
New Brunswick	Legislation	Clean Environment Act, R.S.N.B. 1973, c. C-6
	Regulations	The Environmental Impact Assessment Regulation, N.B. Reg. 87-83
	Guidelines	*New Brunswick Environment and Local Government:* A Guide to Environmental Impact Assessment in New Brunswick (April 2012)
Nova Scotia	Legislation	Environment Act CHAPTER 1 OF THE ACTS OF 1994-95 (*or* Environment Act. *1994-95, c. 1, s. 1.*); PART IV: Environmental Assessment Process
	Regulations	Environmental Assessment Regulations, N.S. Reg. 26/95
	Guidelines	*Nova Scotia Environment:* Guide to Considering Climate Change in Project Development in Nova Scotia (February 2011)
		Nova Scotia Environment: Guide to Considering Climate Change in Environmental Assessments in Nova Scotia (February 2011)
		Nova Scotia Environment: Proponent's Guide to Environmental Assessment (September 2005)
		Nova Scotia Environment: Proponent's Guide to Wind Power Projects: Guide for preparing an Environmental Assessment Registration Document (January 2012)
Prince Edward Island	Legislation	Environmental Protection Act, R.S.P.E.I. 1988, c. E-9
	Regulations	*No regulations exist under the Environmental Protection Act*
	Guidelines	*Prince Edward Island Environment, Labour and Justice:* Environmental Impact Assessment Guidelines (January 2010)
Newfoundland and Labrador	Legislation	Environmental Protection Act, S.N.L. 2002, c.E-14.2 (Part X)
	Regulations	Environmental Assessment Regulations, 2003, N.L.R. 54/03
	Guidelines	*Newfoundland and Labrador Department of Environment and Conservation:* Environmental Assessment: A Guide to the Process (February 2012)
Yukon	Legislation	Yukon Environmental and Socio-economic Assessment Act, S.C. 2003, c. 7

Jurisdiction	Hierarchical structure	Document name
	Regulations	Assessable Activities, Exceptions and Executive Committee Projects Regulations; SOR/2005-379
	Guidelines	*Yukon Environmental and Socio-economic Assessment Board:* Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions (November 2005)
		Yukon Environmental and Socio-economic Assessment Board: Rules for Screenings Conducted by the Executive Committee (November 2005)
		Yukon Environmental and Socio-economic Assessment Board: Proponent's Guide to Project Proposal Submission to a Designated Office (August 2010)
Mackenzie Valley (Northwest Territories)	Legislation	Mackenzie Valley Resource Management Act; SOR/98-429
	Regulations	Mackenzie Valley Land Use Regulations; SOR/98-429
		Preliminary Screening Requirement Regulations; SOR/99-12
		Mackenzie Valley Land Use Regulations; Office Consolidation
	Guidelines	*Mackenzie Valley Environmental Impact Review Board:* Environmental Impact Assessment Guidelines (March 2004)
		Mackenzie Valley Environmental Impact Review Board: Socio-Economic Impact Assessment Guidelines (March 2007)
Inuvialuit Settlement Region	Legislation	The Western Arctic Claim Inuvialuit Final Agreement Section 11: Environmental Impact Screening and Review Process
	Regulations	*No supporting EIA regulations exist under the Inuvialuit Final Agreement*
	Guidelines	*Environmental Impact Screening Committee (EISC) & Environmental Impact Review Board (EIRB):* Rules of Procedure for the Environmental Impact Screening and Review Process of the Inuvialuit Final Agreement (July 2011)
		Environmental Impact Screening Committee (EISC): Environmental Impact Screening Guidelines (June 2012)
		Environmental Impact Review Board (EIRB): Environmental Impact Review Guidelines (April 2011)
Nunavut	Legislation	Nunavut Planning and Project Assessment Act S.C. 2013, c. 14, s. 2
	Regulations	*No supporting EIA regulations exist under the Nunavut Planning and Project Assessment Act*
	Guidelines	*Nunavut Impact Review Board:* Authorizing Agencies' Guide – *DRAFT 2 (November 2013)*
		Nunavut Impact Review Board: Intervenors' Guide – *DRAFT 2 (November 2013)*
		Nunavut Impact Review Board: Proponents' Guide – *DRAFT 2 (November 2013)*

3.3 Analysis stage

The analysis stage consisted of two main phases: quantitative analysis and qualitative analysis (Figure 3-2). Three overall questions guided the analysis:

1. Are provisions to acknowledge uncertainty in EIA provided in i) legislation, ii) regulations and iii) guidelines?
2. If yes, what exactly is required with respect to uncertainty consideration in EIA?
3. If yes, what is the extent of such requirements?

During the quantitative analysis, *Phase 1*, Canadian federal and all provincial and territorial EIA legislation, regulations, and guidelines were reviewed to identify the presence of the keywords or search terms related to uncertainty (see Table 3-1). The *Phase 1* process consisted of three sub-phases (Figure 3-3).

The first *sub-phase* examined the content of the search terms. Since the documents used in this analysis were electronic, the majority (with some exceptions) were in PDF format, they were searched using "find" tool in Adobe Reader/Acrobat.

The second *sub-phase* was a superficial examination of the fragments of the text containing the search term(s). Some of the search terms have the same root word as other, unrelated words to the research questions and objectives. For example, the search term 'confiden*' was used for identifying references to 'confidence'. However, this search term also identifies the unrelated word *confidential*. As such, in this sub-phase, the occurrence of a search term was reviewed to determine the relevance of the identified term or concept.

In the third *sub-phase*, the relevant text fragments were extracted and saved for the further analysis.

Phase 2 of the analysis was qualitative and consisted of two sub-phases (Figure 3-3). The first *sub-phase* included a thorough examination and interpretation of the extracted texts. During this sub-phase, some extracted text fragments, after the thorough examination, were deemed as irrelevant. For example, in the Environmental Review Guidelines for Oil and Gas Activities, published by the Saskatchewan Ministry of Environment, the word "uncertainty" was used to describe possible unclear content of this document:

> *Proponents are advised to contact the ministry for further explanation and clarification of any uncertainties regarding the information provided in this document (sec. 10. Other Resources and Contact Information).*

The same word ("uncertainty") was used in Inuvialuit with a similar content. The Inuvialuit Environmental Impact Screening Committee provide the following recommendation in the Environmental Impact Screening Guidelines:

> *Environmental Impact Screening Committee (IESC) has established an Exclusion List of projects that are exempt from the environmental screening and review process. If it is uncertain whether a proposed development/project is on the Execution List, the project proponent should contact the EIS Coordinator (sec. 3.1 Environmental Impact Screening, 3.1.4 Developments not Subject to, or that are Exempt from, the Environmental Impact Screening and Review Process).*

Another example of irrelevant text was found in the Environmental Impact Review Guidelines, published by the Inuvialuit Environmental Impact Review Board. Here, the worst-case scenario is required for calculating the monetary compensation for the wildlife lost:

> *The developer's liability and possible compensation for the wildlife lost should be*

based on a worst case scenario for negative impacts to wildlife, wildlife habitat and wildlife harvesting (7. Guidance for Wildlife Compensation and Preparing a Worst Case Scenario).

All fragments of irrelevant text were withdrawn from further analysis. In the second *sub-phase*, the extracted text fragments the relevance of which to the research questions was confirmed during the thorough examination (reading) and interpretation, were organized in three tables. Refer to Appendix A, Tables A-1, A-2, and A-3 for the complete scope of relevant text – requirements and provisions for uncertainty disclosure and consideration in Canadian EIA systems.

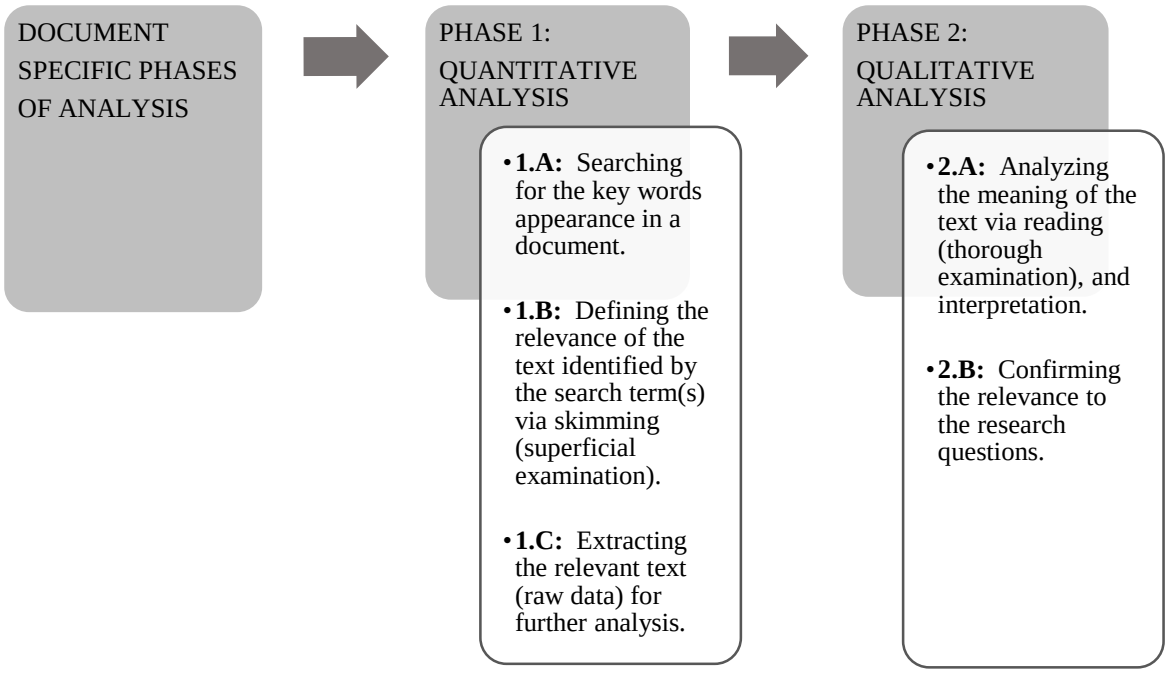

Figure 3-3. Organizational chart of the document specific analysis stage

3.4 Reporting stage

The final step of summative content analysis is to report the findings and to describe the analysis process in detail (Elo, 2008). Detailed reporting helps readers to better understand connections among documents that have been analyzed and the study outcomes, and increases the reliability of the study. The comprehensive findings of the analysis are presented in Chapter Four.

3.5 Research Limitations

There were some limitations associated with this research. First, the scope of the reviewed legislation, regulations and guidance was limited to the documents publicly available on the official websites of the respective government authorities and agencies responsible for EIA in each jurisdiction. Any internal guidance and directives that may exist and are available only for the internal use of EIA reviewers and decision-makers were not included in the analysis. Similarly, project specific guidelines, developed by the EIA authorities for the assessment of a particular project, were also excluded from the research. In addition, Québec was not included in the analyses due to the lack of availability of English-language documents.

A second limitation concerns the research methods used. A summative approach to content analysis was employed in this research. A number of search terms were developed for the analysis, including the explicit term “uncertainty” and several concepts, which are widely applied in uncertainty management worldwide and were identified in the literature. However, those terms may not have covered all existing uncertainty-related approaches. For example, follow-up programs and adaptive management are recommended approaches for dealing with

uncertainty in EIA. Although those approaches were not used as search terms in the analysis, they were required or recommended for uncertainty management in some Canadian jurisdictions. Follow-up programs and adaptive management may be required in more jurisdictions than what was identified in this research; however, the analysis was explicitly focused only on those cases where specific provisions existed for addressing uncertainty.

CHAPTER FOUR:
RESEARCH FINDINGS

This chapter presents the results of the analysis of uncertainty disclosure and consideration requirements and guidance across Canadian EIA jurisdictions. First, the number and frequency of requirements for uncertainty disclosure and consideration identified in the legislation, regulations, and guidelines of each jurisdiction are reported. Second, differences in the content of those requirements are explored. Finally, provisions for addressing uncertainty in the different phases of EIA are analyzed. A complete summary of the content analysis is presented in Appendix B.

4.1 Provisions for addressing uncertainty in Canadian EIA legislation, regulations and guidelines

The number of provisions (requirements and/or recommendations) identified in EIA legislation, regulations and guidelines for addressing uncertainty varied considerably across jurisdictions (Table 4-1). In one jurisdiction – Manitoba – no acknowledgment of uncertainty was found. In each of New Brunswick, Prince Edward Island and Newfoundland and Labrador, uncertainty related requirements were identified only once. Between three and nine different references to uncertainty were found in eight jurisdictions – Canada, Alberta, Ontario, Saskatchewan, Nova Scotia, Yukon, Inuvialuit Settlement Region and Nunavut. The most frequent requirements or references to uncertainty were found in EIA documentation for British Columbia and the Mackenzie Valley of the Northwest Territories (18 and 17 references, respectively).

Provisions identified were most often found in guidelines as opposed to legislation. In

seven of the 14 jurisdictions reviewed, provisions for uncertainty disclosure and consideration were identified *only* in guidelines. Acknowledgment of uncertainty was identified in legislation only in four jurisdictions – Canada, Alberta, Nova Scotia, and Nunavut. Two jurisdictions contained provisions for addressing uncertainty in EIA regulations – British Columbia, and Newfoundland and Labrador. In none of the jurisdictions were provisions for addressing uncertainty in EIA found at all three levels - legislation, regulations, and guidelines.

Table 4-1. Number of provisions for addressing uncertainty found in EIA legislation, regulations and guidelines of Canadian federal, provincial, territorial and land claims-based EIA jurisdictions

Jurisdiction	**Number of different provisions found in:**			**Total**
	Legislation	**Regulations**	**Guidelines**	
Federal	3	0	5	8
British Columbia	0	2	16	18
Alberta	1	0	7	8
Saskatchewan	0	0	9	9
Manitoba	0	0	0	0
Ontario	0	0	3	3
New Brunswick	0	0	1	1
Nova Scotia	1	0	4	5
Prince Edward Island	0	0	1	1
Newfoundland and Labrador	0	1	0	1
Yukon	0	0	9	9
Northwest Territories – Mackenzie Valley Region	0	0	17	17
Inuvialuit Settlement Region	0	0	5	5
Nunavut	2	0	4	6
TOTAL	**7**	**3**	**81**	**91**

4.1.1 Legislative provisions for addressing uncertainty

Limited acknowledgment of uncertainty was found in EIA legislation across all jurisdictions. Only four jurisdictions — Canada, Alberta, Nova Scotia and Nunavut — of the 14

assessed, mentioned uncertainty in their respective EIA legislation (see Appendix B). Specifically, under *CEAA 2012* and Nova Scotia's *Environment Act*, there is an overarching requirement to apply the precautionary principle (e.g., in *CEAA 2012*, defined as "a careful and precautionary manner") as the part of the purposes of those Acts. The extent to which uncertainty is acknowledged in Alberta's *Environmental Protection and Enhancement Act* is limited to contingency planning. Specifically, reference is made in relation to the inclusion of contingency plans to address the possible unpredicted adverse impacts of a project.[2] Under the *Nunavut Planning and Project Assessment Act*, there are specific provisions for the Nunavut Impact Review Board to request further review of a project where uncertainties exist – specifically in relation to the implementation of technological innovations for which the effects are unknown.[3] Also, the Board may request a proponent to include in the EIS the anticipated effects of the environment on the project, including effects associated with natural phenomena (meteorological and seismological activity, climate change, etc.); and the mitigating measures, including contingency plans.[4] It is also required that EIS reviewers take into account the measures proposed for avoiding and mitigating the potential adverse environmental and socio-economic impacts of a project.[5]

4.1.2 Regulatory provisions for addressing uncertainty

In some jurisdictions, there are no specific regulations for EIA under respective legislation, namely in Saskatchewan, Prince Edward Island, Nunavut and Inuvialuit. In other

[2] Alberta *Environmental Protection and Enhancement Act*, R.S.A. 2000, c. E-12; sec. 49. Contents of environmental impact assessment report.
[3] *Nunavut Planning and Project Assessment Act* (S.C. 2013, c. 14, s. 2); sec. 89. Project to be reviewed.
[4] *Nunavut Planning and Project Assessment Act (*S.C. 2013, c. 14, s. 2); sec. 101. Content of impact statement.
[5] *Nunavut Planning and Project Assessment Act* (S.C. 2013, c. 14, s. 2); sec. 103. Factors to consider.

jurisdictions, where EIA regulations do exist, there were limited provisions for addressing uncertainty. Only in two jurisdictions - British Columbia and Newfoundland and Labrador – were regulatory provisions for addressing uncertainty identified – though with no specific reference to uncertainty per se. In British Columbia, under the *Concurrent Approval Regulation*, the ministry can: request project proponents to submit any additional information, which is needed to complete a review – which may be considered as a means to address any uncertainties that a decision maker may have in relation to a project, including uncertainties or assumptions in the information provided; and record any uncertainties identified in a project's design that exist at that stage.[6] In Newfoundland and Labrador, under the province's *Environmental Assessment Regulations*, the minister shall require an environmental preview report for an undertaking or development, if during screening it has been determined that insufficient project details are provided, rendering it impossible to determine interconnections between the development and the environment, and the possible environmental impact of the development and its significance; or if unknown or experimental technology is proposed to be implemented in the development. These provisions do not speak explicitly to uncertainty, but they are measures designed to address uncertainty – either in the details of potential impacts of a project due to insufficient information being provided by a proponent; or in technology due to a lack of prior knowledge, understanding or experience.[7]

4.1.3 Guideline provisions for addressing uncertainty

Most of the provisions for uncertainty disclosure and consideration in EIA were found at

[6] British Columbia *Concurrent Approval Regulation, B.C. Reg. 371/2002*; sec. 8. Duties of the ministry that has authority to issue the eligible approval.
[7] Newfoundland and Labrador *Environmental Assessment Regulations, 2003, N.L.R. 54/03*; sec. 24. Screening criteria for environmental preview report.

the guidelines level (except Manitoba, and Newfoundland and Labrador). However, in some jurisdictions, the guidance for addressing uncertainty was limited. For example, in New Brunswick and Prince Edward Island only one requirement was identified in their respective EIA guidelines: namely, to describe contingency plans in the EIA report. British Columbia, Alberta, and the Mackenzie Valley all contained more and stronger provisions to address uncertainty in EIA - overall and at the guidelines level (refer to Appendix B). British Columbia, in particular, contained several provisions, and specific guidance, for addressing uncertainty. For instance, British Columbia's *Guideline for the Selection of Valued Components and Assessment of Potential Effects* includes a subsection *"Confidence and Risk"*, which is dedicated to uncertainty in impact predictions and provides explicit explanations and provisions on how this uncertainty can be addressed. Among these provisions are the requirements to report any uncertainties related to the effectiveness of proposed mitigation measures;[8] to conduct an additional risk analysis to more fully characterize the potential risk associated with uncertain outcomes;[9] and to specify the level of confidence for each prediction.[10] An explanation that the level of confidence should reflect the level of uncertainty related to the significance and likelihood of a potential effect is included, and it is indicated that this information can assist a decision-maker to assess the risks associated with a proposed development.

[8] British Columbia Environmental Assessment Office "Guideline for the Selection of Valued Components and Assessment of Potential Effects" (September 2013); sec. 3.4. Mitigation.
[9] British Columbia Environmental Assessment Office "Guideline for the Selection of Valued Components and Assessment of Potential Effects" (September 2013); sec. 3.5.4. Confidence and risk.
[10] British Columbia Environmental Assessment Office "Guideline for the Selection of Valued Components and Assessment of Potential Effects" (September 2013); sec. 3.5.4. Confidence and risk.

4.2 Types of provisions for addressing uncertainty

Despite the great variability of requirements and recommendations for uncertainty disclosure and consideration that were found during the review of the Canadian federal, provincial and territorial legislation, regulations and guidelines, some similarities were recognized. All identified requirements and recommendation were grouped into ten types of provisions (Table 4-2). As noted above, the most extensive provisions for uncertainty disclosure and consideration were in British Columbia, although primarily at the guidelines level.

Table 4-2. Summary of provisions for uncertainty disclosure and consideration in EIA legislation, regulations, and guidelines

Type of provision	Requirement or recommendation	Focus of the requirement or recommendation	Jurisdiction												
			CA	BC	AB	SK	MB	ON	NB	NS	PE	NL	YT	NT	ISR	NU
Type 1	Apply:	The precautionary principle	*L* *G*	-	-	-	-	*G*	-	*L*	-	-	*G*	*G*	-	-
Type 2	Describe, document, explain, identify, or record:	Uncertainty (scientific uncertainty); assumptions; data inputs; data gaps; sources of information; reliability and accuracy of the data used	*G*	*R* *G*	*G*	*G*	-	-	-	*G*	-	-	*G*	*G*	-	-
Type 3	Consider, describe, explain, identify, make explicit, outline, or report:	Uncertainty/ assumptions/gaps in impact predictions; Uncertainty/ assumptions in mitigation measures	-	*G*	*G*	-	-	*G*	-	-	-	-	*G*	*G*	-	-
Type 4	Consider, describe, document, indicate, specify, or be explicit about:	Level of confidence; confidence limits; level/degree of uncertainty/ certainty; relative accuracy; limits/limitations	-	*G*	*G*	-	-	*G*	-	-	-	-	*G*	*G*	*G*	-
Type 5	Assess or select:	"Worst case scenario"	*G*	*G*	-	-	-	-	-	-	-	-	-	-	*G*	-
Type 6	Assess, consider, or describe:	Accidents; malfunctions; unplanned/unexpected events	*L* *G*	*G*	-	-	-	-	-	-	-	-	-	-	-	-
Type 7	Describe, outline, propose/prepare:	Contingency plans; emergency response plans; risk management	-	*G*	*L*	*G*	-	-	*G*	*G*	*G*	-	*G*	-	*G*	*L*
Type 8	Discuss, summarize or outline:	Follow-up programs, e.g. adaptive management, monitoring	-	*G*	-	*G*	-	-	-	-	-	-	-	*G*	-	*G*
Type 9	Conduct, request, or require:	Further review; approval; additional information; additional risk analysis/ assessment	*L*	*R* *G*	*G*	*G*	-	-	-	-	-	*R*	*G*	*G*	-	*L* *G*
Type 10	Apply:	"Negotiated" approach (public participation)	-	-	-	-	-	-	-	-	-	-	-	-	*G*	-

CA (Canada); BC (British Columbia); AB (Alberta); SK (Saskatchewan); MB (Manitoba); ON (Ontario); NB (New Brunswick); NS (Nova Scotia); PE (Prince Edward Island); NL (Newfoundland and Labrador); YT (Yukon); NT (Northwest Territories - Mackenzie Valley Region); ISR (Inuvialuit Settlement Region); NU (Nunavut)

L = Legislation; R = Regulation; G = Guidelines

4.2.1 Precautionary principle

The first type of provision, found in legislation in two jurisdictions (Canada and Nova Scotia), and in guidelines in four jurisdictions (Canada, Ontario, Yukon, and Northwest Territories - Mackenzie Valley Region), is to *apply the precautionary principle* as a means to address uncertainty. Both under federal legislation and Nova Scotia's EIA act, application of the precautionary principle is mentioned as the general requirement for dealing with uncertainty. For example, in Nova Scotia, the precautionary principle is promoted as integral part of sustainable development principles under the *Environment Act.*[1] Federally, under *CEAA 2012*, the precautionary principle ("a careful and precautionary manner") is a required approach to protect the environment and human health, and should be applied to all developments to be carried out or financially supported by a federal authority, or developed on federal lands.[2] In Ontario, under the Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario, it is mentioned that when making decisions, the ministry applies the precautionary approach to protect human health and the environment.[3] In the Yukon, the precautionary principle (referred to as "precautionary manner"[4]) is to be applied specifically to address data gaps in impact assessment. The most extensive requirement for use of the precautionary principle was found in the Northwest Territories - Mackenzie Valley Region, under the Socio-Economic Impact Assessment Guidelines. Here, the precautionary principle was mentioned five times. Two requirements were quite general: first it is to be applied when conducting and reviewing Socio-Economic Impact

[1] Nova Scotia *Environment Act. 1994-95, c. 1, s. 1*; Part I, sec. 2. Purpose of Act.
[2] *Canadian Environmental Assessment Act, 2012; S.C. 2012, c. 19, s. 52*; sec. 4 (1) Purposes.
[3] Ontario Ministry of the Environment "Code of Practice: Preparing, Reviewing and Using Class Environmental Assessments in Ontario" (January 2014); sec. 3.3. Statement of Environmental Values and Ministry Decision-making.
[4] Yukon Environmental and Socio-economic Assessment Board "Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions" (November 2005); sec. Information Gaps and Uncertainty.

Assessment (SEIA),[5] and second it is simply recommended for good SEIA.[6] In two other instances, the precautionary principle is identified to address uncertainty in impact predictions.[7] The final reference is to use the precautionary principle in cases where there is a lack of acceptable certainty when collecting data and determining impact significance.[8]

4.2.2 General uncertainty and uncertainty in data

The second type of provision identified focused on disclosing (e.g., describing, documenting, explaining, identifying, and recording) and considering uncertainty (including scientific uncertainty), assumptions, data inputs, data gaps, sources of the information used, and the reliability and accuracy of assessment data. These requirements or recommendations mostly addressed uncertainty in project descriptions and during the screening and scoping stages of EIA, such as uncertainty in baseline data. Such provisions were not found in EIA legislation in all jurisdictions, but they were identified in British Columbia's EIA regulations. Also, there were several references to such provisions under jurisdictional EIA guidelines, including Canada, British Columbia, Alberta, Saskatchewan, Nova Scotia, Yukon, and the Northwest Territories – Mackenzie Valley Region, that make explicit note of the need to "clearly document," "explain" or "identify" uncertainty. However, these guidelines are often in reference to very specific issues, which vary by jurisdiction. For example, in the Mackenzie Valley there is specific reference to

[5] Mackenzie Valley Environmental Impact Review Board "Socio-Economic Impact Assessment Guidelines" (March 2007); sec. 2.2. Considerations for Conducting SEIA.
[6] Mackenzie Valley Environmental Impact Review Board "Socio-Economic Impact Assessment Guidelines" (March 2007); Appendix B. Considerations for Conducting SEIA.
[7] Mackenzie Valley Environmental Impact Review Board "Socio-Economic Impact Assessment Guidelines" (March 2007); sec. 5.6. Determining Significance; Appendix G, (G6) Cumulative Impacts and SEIA.
[8] Mackenzie Valley Environmental Impact Review Board "Socio-Economic Impact Assessment Guidelines" (March 2007); Appendix B. Considerations for Conducting SEIA.

uncertainty in baseline data and traditional and cultural activities:

> *Limited baseline data and insufficient documented information about traditional and cultural activities can create uncertainty about the developer's impact prediction.*
> *… for characterizing and predicting potentially significant impacts: Transparent identification of assumptions and information gaps, as well as any uncertainties about the predictions [is required].*[9]

Similarly, in Nova Scotia the guidelines are focused on climate change-related uncertainty, and this was the only jurisdiction that referenced uncertainty disclosure related to climate change:

> *…climate change-related uncertainty needs to be understood by decision makers; and the steps taken to address this uncertainty must be demonstrated.*[10]

Provisions for the disclosure of uncertainties related to the project description and/or design were identified in two jurisdictions – British Columbia,[11] and Alberta.[12] In the Yukon, attention focused on data gaps;[13] in British Columbia there was a reference to addressing uncertainties when identifying or selecting of VCs (valued components).[14] In British Columbia, provisions also target decision-makers (the ministry) and require a decision maker to consider *("take into account")* uncertainty in project design and notify the project proponent about such uncertainty.[15] In Alberta, project proponents are asked to describe uncertainty about the proposed

[9] Mackenzie Valley Environmental Impact Review Board "Socio-Economic Impact Assessment Guidelines" (March 2007); sec. 3.4.4. Tools for Characterizing and Predicting Impacts on the Wage Economy.
[10] Nova Scotia Environment "Guide to Considering Climate Change in Project Development in Nova Scotia" (February 2011); sec. 3.3. Uncertainty in Climate Change Projections.
[11] British Columbia *Concurrent Approval Regulation, B.C. Reg. 371/2002*; sec. 8. Duties of the ministry that has authority to issue the eligible approval.
[12] Alberta Government. Environmental Assessment Program "Preparing Disclosure Documents For Environmental Assessment Screenings" (2010); sec. Disclosure Document Content, General Information.
[13] Yukon Environmental and Socio-economic Assessment Board "Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions" (November 2005); sec. Information Gaps and Uncertainty.
[14] British Columbia Environmental Assessment Office "Guideline for the Selection of Valued Components and Assessment of Potential Effects" (September 2013); sec. 2.0. Identification and selection of valued components, 2.4 Documentation.
[15] British Columbia *Concurrent Approval Regulation, B.C. Reg. 371/2002*; sec. 8. Duties of the ministry that has authority to issue the eligible approval.

project and uncertainty about future development.[16]Alberta's guidelines also contain clear and comprehensive requirements for the disclosure of modeling uncertainty:

> *Assumptions, model inputs and data sets used to obtain modeling predictions in the EIA report must be documented, a rationale for their selection provided and a discussion of the potential implications of their use in terms of confidence in the resulting impact predictions. The EIA report must clearly identify the limitations of the models including sources of error and relative accuracy. The EIA report should also indicate what statistical confidence limits or other quantitative measurements of uncertainty were used to describe the relative accuracy of the model.*[17]

Explicit, but general, requirements to describe uncertainties, assumptions and sources of information were found in federal EIA guidelines under CEAA 2012, but primarily in relation to the assessment of cumulative environmental effects:

> *In all cases, uncertainties and assumptions underpinning an analysis should be described and information sources clearly documented.*[18]

The Northwest Territories – Mackenzie Valley Region contains guideline provisions, focused on addressing or preventing overconfidence in long term cumulative impact predictions:

> *Developers are not expected to see the future, but are expected to make the best reasonable predictions they can. Like all prediction[s] in EIA, this involves uncertainty but is necessary for the Review Board to reach the best decisions about a development. The Review Board will accept less detail and more predictive uncertainty the further in the future or the less certain the reasonably foreseeable development is.*[19]

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[16] Alberta Government. Environmental Assessment Program "Preparing Disclosure Documents For Environmental Assessment Screenings" (2010); sec. Disclosure Document Content, General Information.
[17] Alberta Government. Environmental Assessment Program "Guide to Preparing Environmental Impact Assessment Reports in Alberta" (March 2013); sec. 2.4 Modeling.
[18] Canadian Environmental Assessment Agency "Operational Policy Statement: Addressing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012"; sec. Consideration of Cumulative Environmental Effects under CEAA 2012.
[19] Mackenzie Valley Environmental Impact Review Board "Environmental Impact Assessment Guidelines" (March 2004); Appendix H: Additional Cumulative Effects Guidance, B. Determining what other developments to include.

4.2.3 Uncertainty in impact predictions and mitigation measures effectiveness

The third type of provision, focused on the disclosure and consideration of uncertainty in impact predictions and in the effectiveness of the proposed mitigation measures, addressed uncertainty associated with the impact prediction and evaluation, and impact management stages of the EIA process. This provision was found at the guidelines level only, and in five jurisdictions – British Columbia, Alberta, Ontario, Yukon, and Mackenzie Valley. With regard to uncertainty in impact predictions, provisions were identified in EIA guidelines in British Columbia, Ontario, Yukon, and the Mackenzie Valley. For example, in British Columbia it is suggested:

> *… to clearly describe the sources and nature of uncertainty associated with any residual effect prediction in the assessment to provide the basis for the stated level of confidence. The practitioner should articulate how any identified uncertainty may affect either the significance or the likelihood of the predicted residual effect.*[20]

In Ontario, the explicit requirement to address uncertainty in prediction of environmental effects was identified in the province's guide to preparing and reviewing impact assessments:

> *Where the environmental effects are uncertain, proponents should explain why and fully explain the factors that cause the problem and how it has been addressed in the evaluation.*[21]

In the Mackenzie Valley, provisions to disclose and consider uncertainties in impact predictions were identified six times in EIA guidelines. For example:

[20] British Columbia Environmental Assessment Office "Guideline for the Selection of Valued Components and Assessment of Potential Effects" (September 2013); sec. 3.5.4. Confidence and Risk.
[21] Ontario Ministry of the Environment "Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario" (January 2014); sec. 4.2.4. Assessment and Evaluation.

> *An explicit account of the level and nature of uncertainties involved in each prediction is required.*[22]

And, when determining impact significance, *the Review Board may consider:*

> *- How certain is this prediction? and*
> *- How certain are the predictions of severity and the ability to manage impacts, given mitigation proposals in place?*[23]

Regarding uncertainty in proposed mitigation measures design and effectiveness, for example, EIA guidance in British Columbia states:

> *Any uncertainty associated with the effectiveness of proposed mitigation measures should be noted in the assessment.*[24]

4.2.4 Level of confidence in predictions

The fourth type of provision identified focused on the level of confidence or confidence limits, as a quantitative measure of uncertainty, and that confidence levels are specified for impact predictions and mitigation measures. These provisions were identified in six jurisdictions – British Columbia, Alberta, Ontario, Yukon, Mackenzie Valley, and Inuvialuit Settlement Region. The identified requirements in each jurisdiction emphasized different aspects of the EIA process. For example, identification of the levels of confidence for the significance and likelihood of the

[22] Mackenzie Valley Environmental Impact Review Board "Environmental Impact Assessment Guidelines" (March 2004); sec. 3.11. Preparing Developer's Assessment Report, Impact Predictions.
[23] Mackenzie Valley Environmental Impact Review Board "Socio-Economic Impact Assessment Guidelines" (March 2007); sec. 5.6. Determining Significance.
[24] British Columbia Environmental Assessment Office "Guideline for the Selection of Valued Components and Assessment of Potential Effects" (September 2013); sec. 3.4. Mitigation.

residual adverse effect for each prediction is required in British Columbia.[25] In Alberta, the indication of confidence limits is required "to describe the relative accuracy of the model";[26] also, the level of confidence in the predictions is specifically required for any effects on soil quality. [27] In Ontario, the proponent is required "to articulate the level of uncertainty associated with data and conclusions".[28, 29, 30] The identification of the level of confidence for each assessment of significance of the environmental and socio-economic effects is recommended in the Yukon.[31] Guidance in the Mackenzie Valley suggests indicating the level of certainty in the effectiveness of mitigation.[32] The level of confidence in "impact predictions and judgment" in the determination of significance is also requested in Inuvialuit Settlement Region.[33]

4.2.5 Worst-case scenario

The fifth type of provision for addressing uncertainty identified was to consider or assess the worst-case scenario. Consideration of the worst-case scenario is a useful means for increasing the awareness of decision-makers and the public about the degree of certainty (or uncertainty)

[25] British Columbia Environmental Assessment Office, "Guideline for the Selection of Valued Components and Assessment of Potential Effects" (September 2013); sec. 3.5.4. Confidence and Risk.
[26] Alberta Government. Environmental Assessment Program, "Guide to Preparing Environmental Impact Assessment Reports in Alberta" (March 2013); sec. 2.4 Modeling.
[27] Alberta Government. Environmental Assessment Program, "Guide to Preparing Environmental Impact Assessment Reports in Alberta" (March 2013); sec. 3.3.9 Terrain and Soils.
[28] Ontario Ministry of the Environment, "Code of Practice: Preparing, Reviewing and Using Class Environmental Assessments in Ontario" (January 2014); sec. 3.3 Statement of Environmental Values and Ministry Decision-making.
[29] Ontario Ministry of the Environment, "Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario" (January 2014); sec. 3.3 Statement of Environmental Values and Ministry Decision-making.
[30] Ontario Ministry of the Environment, "Code of Practice: Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario" (January 2014); sec. 4.3 Statement of Environmental Values and Ministry Decision-making.
[31] Yukon Environmental and Socio-economic Assessment Board, "Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions" (November 2005); sec. 6.5. Determination of Significance.
[32] Mackenzie Valley Environmental Impact Review Board, "Socio-Economic Impact Assessment Guidelines" (March 2007); sec. 5.6 Determining Significance, Choosing appropriate mitigation.
[33] Environmental Impact Screening Committee (EISC), "Environmental Impact Screening Guidelines" (June 2012); Appendix E: Determination of Potential for Significant Negative Environmental Impact, Best Practices.

about a project or decision outcome. This provision was found in three jurisdictions – Canada, British Columbia, and Inuvialuit – in all cases at the guidelines level. Under *CEAA 2012* guidelines, use of the worst-case scenario is promoted as an approach for the analysis of alternative means:

> *The scenario can be selected based on practical criteria such as, likelihood that it will be implemented, efficiency in the comparative analysis of alternative means, or ease of presentation in an EIS. For instance, selecting a scenario that represents the worst case of potential environmental effects would provide increased confidence that the predictions in the project EA are applicable to any of the alternative means.*[34]

In British Columbia, when determining the likelihood of residual effects, and where baseline data is limited, it is suggested to assess the worst-case scenario:

> *A proponent may take a conservative approach, particularly if data gaps exist, and assess a 'worst-case' impact scenario.*[35]

In Inuvialuit, the application of a worst-case scenario approach is recommended for the preparation of the action plans for controlling the possible environmental impacts of a proposed development initiative:

> *Describe potential and realistic "Worst Case Scenario" associated with the proposed development and the proposed action plan(s) to adequately control the situation(s).*[36]

[34] Canadian Environmental Assessment Agency, "Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012"; sec. Considerations in Addressing "Alternative Means" of the Designated Project; Step 3: Select the approach for the analysis of alternative means; Case b: Bringing forward multiple alternative means.
[35] British Columbia Environmental Assessment Office, "Guideline for the Selection of Valued Components and Assessment of Potential Effects" (September 2013); sec. 3.5 Evaluating Residual Effects, 3.5.2 Likelihood.
[36] Environmental Impact Review Board (EIRB), "Environmental Impact Review Guidelines" (April 2011); sec. 8. Environmental Impact Statement; 8.2 Submission Requirements.

4.2.6 Potential impacts of accidents and malfunctions

The sixth type of provision identified addressed the need to disclose (describe) potential accidents and malfunctions, or consider their effects, or propose means to mitigate or manage those effects. This provision was identified in two jurisdictions – again, Canada and British Columbia. In Canada, this provision was found in legislation and guideline (as an explanation of the relevant provisions of CEAA 2012). In British Columbia, this provision was found in guidelines only. In both cases, reference was to scoping and uncertainties in impact predictions and evaluation. For example, in CEAA 2012, in Section 19 FACTORS TO BE CONSIDERED; Subsection 19(1) Factors, it is stated:

> *19. (1) The environmental assessment of a designated project must take into account the following factors:*
>
> *(a) the environmental effects of the designated project, including the environmental effects of malfunctions or accidents that may occur in connection with the designated project and any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out.*

4.2.7 Contingency plans; emergency response plans; risk management

Seventh, provisions were identified that specifically address uncertainty in relation to mitigation measures, such as risk management, contingency plans, and emergency response plans. These were identified in legislation in Alberta and Nunavut, and in EIA guidelines in several other jurisdictions, including British Columbia, Saskatchewan, New Brunswick, Nova Scotia, Prince Edward Island, Yukon, and the Inuvialuit Settlement Region. Generally, the provision is that contingency plans and emergency response plans are to be included in project mitigation measures. For example, in New Brunswick the requirement is to:

> *Describe the mitigation measures proposed to minimize the environmental impacts […]*

include but are not limited to the following: contingency plans (e.g. spill notification and clean-up, evacuation, etc.).[37]

Similarly, in other provisions, contingency plans and emergency response plans are required or recommended so as to address various uncertainties related to: unpredicted negative impacts (Alberta[38]); unexpected events (Saskatchewan[39]); risks or hazards (Saskatchewan[40]); possible impacts of the natural environment on the project (Saskatchewan,[41] Nova Scotia,[42] Nunavut[43]); accidents and malfunctions (Saskatchewan,[44] Nova Scotia,[45] New Brunswick,[46] Yukon,[47] Inuvialuit[48]); and impacts that are not completely understood (Saskatchewan,[49] Prince

[37] New Brunswick Environment and Local Government, "A Guide to Environmental Impact Assessment in New Brunswick" (April 2012); REGISTRATION GUIDE, 5.0 Summary of proposed mitigation.
[38] *Environmental Protection and Enhancement Act, R.S.A. 2000, c. E-12*; Part 2: Environmental Assessment Process, Approvals and Registrations; sec. 49 Contents of environmental impact assessment report.
[39] Saskatchewan Ministry of Environment, "Environmental Review Guidelines for Oil and Gas Activities" (September 2012); sec. 2.5 Impact Management and Protection Measures (Mitigation).
[40] Saskatchewan Ministry of Environment, "Technical Proposal Guidelines. A Guide to Assessing Projects and Preparing Proposals under The Environmental Assessment Act" (November 2012); sec. 3.4.4 Potential Impacts and Mitigation Measures.
[41] Saskatchewan Ministry of Environment, "Guidance for the Preparation of the Terms of Reference. A Guide to Developing the Terms of Reference for a Proposed Project (or `Development`) under The Environmental Assessment Act" (November 2012); sec. 3.3 Impact Mitigation and Monitoring.
[42] Nova Scotia Environment, "Guide to Considering Climate Change in Project Development in Nova Scotia" (February 2011); sec. 3.0 ADAPTATION, 3.4 Guidance, 3.4.1 Risk Management Approach.
[43] *Nunavut Planning and Project Assessment Act S.C. 2013, c. 14, s. 2*; sec. 101: Content of impact statement; and sec. 103: Factors to consider.
[44] Saskatchewan Ministry of Environment, "Guidance for the Preparation of the Terms of Reference. A Guide to Developing the Terms of Reference for a Proposed Project (or `Development`) under The Environmental Assessment Act" (November 2012); sec. 3.3 Impact Mitigation and Monitoring.
[45] Nova Scotia Environment, "Proponent's Guide to Wind Power Projects: Guide for preparing an Environmental Assessment Registration Document" (January 2012); sec. 5. Description of the Undertaking.
[46] New Brunswick Environment and Local Government, "A Guide to Environmental Impact Assessment in New Brunswick" (April 2012); REGISTRATION GUIDE, 5.0 Summary of proposed mitigation.
[47] Yukon Environmental and Socio-economic Assessment Board, "Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions" (November 2005); sec. 5.4 PROJECT PHASES AND SCHEDULING (5.4.2 Construction Phase and 5.4.3 Operation/Modification Phase); sec. 6.4 MITIGATION MEASURES, 6.4.1 Managing Accidents and Malfunctions.
[48] Environmental Impact Screening Committee (EISC), "Environmental Impact Screening Guidelines" (June 2012); Appendix F: Project Description Content Guide.
[49] Saskatchewan Ministry of Environment, "Environmental Review Guidelines for Oil and Gas Activities" (September 2012); sec. 2.5 Impact Management and Protection Measures (Mitigation).

Edward Island[50]). Such provisions typically identified contingency plans to address uncertainties as a component of the EIA reports or EISs.

4.2.8 Follow-up programs (e.g. monitoring, adaptive management)

An eighth provision identified for dealing with uncertainty was to discuss, summarize or outline follow-up programs, including adaptive management and monitoring. These requirements were captured at the guidelines level in four jurisdictions – British Columbia, Saskatchewan, Mackenzie Valley, and Nunavut. The most explicit provisions to address uncertainty through monitoring or other follow-up programs were identified in British Columbia. Particularly, in the Guideline for the Selection of Valued Components and Assessment of Potential Effects for Addressing Low to Moderate Levels of Uncertainty, subsection 3.5.4 Confidence and Risk, monitoring or other follow-up programs are recommended to determine the accuracy of predictions and the effectiveness of the mitigation measures:

> *In most cases, uncertainty (particularly low to moderate uncertainty) can be adequately addressed through monitoring or other follow-up programs that confirm actual residual effects are as predicted, that mitigation measures are implemented as described in the Application (and are required by conditions of the Environmental Assessment Certificate and/or other authorizations), and that mitigation measures are effective.*

In the same subsection, adaptive management is suggested to deal with unpredicted effects and in a case where new or modified mitigation measures are needed:

> *Adaptive management programs that facilitate action when unforeseen effects occur or the need for new or modified mitigation is identified can serve to effectively manage low to moderate levels of uncertainty. The assessment should describe the need for and scope of*

[50] Prince Edward Island Environment, Labour and Justice, "Environmental Impact Assessment Guidelines" (January 2010); sec. 6. Environmental Impact Statement, Content of the Report, Mitigation of Any Impacts.

monitoring or other follow-up programs, including adaptive management programs, to address any identified uncertainty.

Another provision suggests the consideration of follow-up programs where scientific uncertainty exists in impact predictions:

> *Summarize any proposed follow-up program activities in relation to environmental effects as defined in section 5 of the CEAA 2012, particularly in areas where scientific uncertainty exists in the prediction of effects. The follow-up program may include monitoring plans, and contingency or adaptive management provisions to be implemented if monitoring results indicate corrective action is required.*[51]

4.2.9 Further review and/or approval; additional information; additional risk analysis

The ninth provision identified was relatively broad in nature, and focused on addressing uncertainty through "further actions", such as further review and approval, or requesting additional information or conducting an additional risk assessment. These provisions were identified at all levels, from legislation to guidelines. For example, there are provisions for a responsible authority to request additional information if a project description is incomplete or insufficient project details are provided (Canada,[52] Alberta[53]); or if any additional information is required to complete the review of the project and make a decision (British Columbia[54]). Provisions for further assessment or review also focus on addressing uncertainty associated with

[51] British Columbia Environmental Assessment Office, "Application Information Requirements Template" (May 2013); sec. 10. Accidents or Malfunctions.
[52] *Canadian Environmental Assessment Act, 2012; S.C. 2012, c. 19, s. 52*; sec. 8 SCREENING; Subsection 8(2) Additional information.
[53] Alberta Government. Environmental Assessment Program, "Alberta's Environmental Assessment Process" (March 2013); sec. Technical Review.
[54] *Concurrent Approval Regulation, B.C. Reg. 371/2002*; sec. 8. Duties of the ministry that has authority to issue the eligible approval.

the implementation of new technology (or technological innovations) (Nunavut,[55, 56, 57, 58],Yukon,[59] Newfoundland and Labrador[60]); when there are insufficient details in a project description (Newfoundland and Labrador[60]); or where impact predictions and the effectiveness of proposed mitigation measures are unclear (Mackenzie Valley[61]). An example of this provision can be found in British Columbia's Guideline for the Selection of Valued Components and Assessment of Potential Effects (sec. 3.5.4 Confidence and Risk):

> *In certain situations, it may be appropriate to conduct additional risk analysis to more fully characterize the potential risk associated with uncertain outcomes, particularly if there is a low level of confidence coupled with the possibility of a significant residual adverse effect and follow-up programs are not considered sufficient to manage the potential risk.*

4.2.10 The "negotiated" approach

The final type of provision identified was to use a "negotiated" approach, found only in Inuvialuit in the Environmental Impact Screening Guidelines (Appendix E: Determination of Potential for Significant Negative Environmental Impact, Best Practices):

> *Use a "negotiated" approach when factual information is limited, there is a high degree of uncertainty or controversy regarding potential impacts. This can be science- or expert-based, or involve a broader cross-section of affected and interested parties. There is also an array of*

[55] *Nunavut Planning and Project Assessment Act S.C. 2013, c. 14, s. 2*; sec. 89: Project to be reviewed.
[56] Nunavut Impact Review Board, "Authorizing Agencies' Guide" – DRAFT 2 (November 2013); sec. 4.5 The Possible Outcomes of Screening.
[57] Nunavut Impact Review Board, "Intervenors' Guide" – DRAFT 2 (November 2013); sec. 4.5 The Possible Outcomes of Screening.
[58] Nunavut Impact Review Board, "Proponents' Guide" – DRAFT 2 (November 2013); sec. Determination and Recommendation.
[59] Yukon Environmental and Socio-economic Assessment Board, "Rules for Screenings Conducted by the Executive Committee" (November 2005); Part 5 Conduct of Screenings, including Participation of Interested Persons, the Public and, Others; sec. 67 Project requires a review.
[60] *Environmental Assessment Regulations, 2003, N.L.R. 54/03*; sec. 24. Screening criteria for environmental preview report.
[61] Mackenzie Valley Environmental Impact Review Board, "Environmental Impact Assessment Guidelines" (March 2004); sec. 2.7 Performing the "Might Test", How can the "might" test be practically applied?

social impact assessment tools which can help to determine significance from a community perspective.

The "negotiated" approach here is promoted as a "best practice principle" for determining the significance of a project's potential impacts and is identified as useful for addressing uncertainty in the EIA process where controversies arise due to limited information about a project's impacts and a high degree of uncertainty over impact predictions. Unfortunately, this approach was not defined in the guideline in detail. However, it is clear that the "negotiated" approach promoted here is *public participation*. Gauthier et al. (2011) define public participation as a "generic term" that unites several concepts of public involvement in the decision-making process, which differ by "mode, degree of formality, and timing", and include different activities, such as informing, consulting, reaching consensus, mediating and negotiating with the public (p. 49). Although the extent of public participation is not declared in the guideline; scientists, experts, interested parties and affected communities are identified as the potential participants in public involvement. The involvement of groups which have no direct interest in the development initiative, such as scientists and experts, is suggesting that the "negotiated" approach goes beyond the *negotiation*, which includes dialogs between the stakeholders. Therefore, the negotiated approach may also be defined as *public consultation*.

The negotiated approach, as public participation in EIA, is intended to help to collect valuable information related to the potential impact of the proposed development initiative, for example via meetings and discussion sessions with participation of scientists and experts, who are not a part of a consultant team but may provide valuable information related to a proposed development or initiative, and interested parties (e.g., NGEOs) and the members of affected communities, who may bring additional knowledge and a more comprehensive understanding of

issues, concerns, and needs. However, it may also include *negotiation* among all stakeholders, especially effected communities, to settle potential issues that may arise from the implementation of a proposed development; or any other types of public participation activities that include dialogs between different parties.

4.3 Provisions for addressing uncertainty in the different phases of EIA

The identified requirements and provisions for uncertainty disclosure and consideration address uncertainty in different stages of EIA in an inconsistent manner. Also, several general, or broad, requirements and recommendations, which were not associated with any particular stage of EIA, were found. Overall, provisions for addressing uncertainty were found in relation to all stages of the EIA process, from project application and screening to decision making and follow-up (Table 4-3).

Surprisingly, uncertainty associated with the first stage of EIA – the *project description/design* – was identified only in one jurisdiction – Yukon, and covered uncertainty related to proposed technologies. Specifically, when describing the project proponents are asked to:

> *Provide detailed information on the degree to which technologies being proposed are proven to be viable in northern environments, including any uncertainties. Include plans for proving the feasibility of the technologies, as appropriate.*[62]

Provisions for addressing uncertainty in EIA were most often found in relation to *impact management*. Ten of the 14 jurisdictions assessed contained some sort of requirement or

[62] Yukon Environmental and Socio-economic Assessment Board, "Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions" (November 2005); sec. 5.3 Technologies.

recommendation for addressing uncertainty applicable to impact management (two at both legislation and guidelines levels; and eight in guidelines). The majority of those requirements and recommendations were represented by Type 7 provisions - propose contingency plans, emergency response plans, risk management; they were found in nine jurisdictions. For example, in the Environmental Impact Assessment Guidelines, Prince Edward Island, it is recommended:

> *If impacts are not completely understood, it may be necessary for the proponent to undertake additional evaluation and to prepare specific contingency plans to be implemented if the impacts occur.*[63]

Provisions for addressing uncertainty during *screening* were acknowledged in eight jurisdictions. In Canadian federal EIA, such provisions were found at the legislation level. In British Columbia and Newfoundland and Labrador, those provisions were identified in EIA regulations. These were the only two requirements found in regulations across all Canadian EIA jurisdictions. The remaining five jurisdictions – Alberta, Saskatchewan, Yukon, Mackenzie Valley, and Nunavut – contained provisions in EIA guidelines to deal with uncertainty in screening. Type 9 - conduct/request further review and/or approval, additional information, additional risk analysis - was the most commonly identified provision to address uncertainty in screening; and was found in seven jurisdictions. One example of this was found in three different EIA guidelines in Nunavut:

> *The NIRB may determine that a review is required when in its judgment:…*
> *d. The project involves technological innovations for which the effects are unknown.*[64, 65, 66]

[63] Prince Edward Island Environment, Labour and Justice, "Environmental Impact Assessment Guidelines" (January 2010); sec. 6. Environmental Impact Statement, Content of the Report, Mitigation of Any Impacts.
[64] Nunavut Impact Review Board, "Authorizing Agencies' Guide" – DRAFT 2 (November 2013); sec. 4.5 The Possible Outcomes of Screening.
[65] Nunavut Impact Review Board, "Intervenors' Guide" – DRAFT 2 (November 2013); sec. 4.5 The Possible Outcomes of Screening.
[66] Nunavut Impact Review Board, "Proponents' Guide" – DRAFT 2 (November 2013); sec. Determination and Recommendation.

Addressing uncertainty in *impact predictions* was found at the guidelines level only in seven jurisdictions – Canada, British Columbia, Alberta, Saskatchewan, Yukon, the Mackenzie Valley, and Inuvialuit. A wide range of types of provisions for uncertainty disclosure and consideration in this stage of EIA was found. Interestingly, nine types of provisions from ten types defined in this research (with the exception of Type 7) were used to manage uncertainty in impact predictions among these seven jurisdictions. However, Type 2 provisions - report/consider general uncertainty/assumptions and uncertainty in baseline data - were identified in five jurisdictions. For instance, the federal guideline "Operational Policy Statement: Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012", contains the following requirement regarding assumptions:

> *The methodologies used to predict cumulative environmental effects must be clearly described. With this information, reviewers of the EIS will be able to examine how the analysis was conducted and what rationale supports the conclusions reached. Any assumptions or conclusions based on professional judgment should be clearly identified and described.*[67]

Five jurisdictions - Canada, British Columbia, Yukon, the Mackenzie Valley, and Inuvialuit – provided requirements and recommendations to address uncertainty in *impact significance evaluation*. Again, those requirements were found in guidelines only. Type 4 provisions - report/consider level of confidence and level/degree of uncertainty/certainty – were applied in three jurisdictions. For example, in Inuvialuit Settlement Region, the *Environmental Impact Screening Guidelines* recommends to project proponents or practitioners to:

[67] Canadian Environmental Assessment Agency, "Operational Policy Statement: Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012"; sec. Consideration of Cumulative Environmental Effects under CEAA 2012; Step 2: Analysis.

Describe as necessary, the confidence levels in impact prediction and judgment that underlie the determination of significance (Appendix E; page 47).

Provisions for addressing uncertainty in *scoping* were mentioned in the EIA guidelines of four jurisdictions – British Columbia, Nova Scotia, Yukon, and the Mackenzie Valley. Provisions at the guidelines level were also identified for dealing with uncertainty in the *review and decision* stage of EIA in three jurisdictions – Alberta, the Mackenzie Valley, and Nunavut. Similarly, the guidelines of three Canadian EIA jurisdictions – British Columbia, Saskatchewan, and Nunavut – include provisions for addressing uncertainty during the *implementation and follow-up* stage of EIA. General requirements and recommendations for addressing uncertainty, unrelated to any particular stage of the EIA process, were also identified in four Canadian jurisdictions – Canada, Nova Scotia, Yukon and the Mackenzie Valley. They were mostly represented by Type 1 provisions – apply the precautionary principle.

Based on Table 4-3, it is apparent that the same type of provisions was employed to address uncertainty in different stages of EIA; and vice versa, in different jurisdictions various provisions were used to deal with uncertainty in the same stage of EIA. Type 2 provisions – report uncertainty - were the most commonly used among all Canadian EIA jurisdictions. This type was proposed to deal with uncertainty in *screening* in three different jurisdictions (British Columbia, Alberta, and Yukon); in *scoping* also in three jurisdictions (British Columbia, Yukon, and the Mackenzie Valley); in five jurisdictions to report uncertainty during *impact predictions* (Canada, British Columbia, Alberta, Saskatchewan, and the Mackenzie Valley); in two jurisdictions for *impact significance evaluation* (Canada and British Columbia); in only one jurisdiction for addressing uncertainty during *impact management* (Nova Scotia) and *review and decision-*

making (Mackenzie Valley). Type 2 provisions were also used as general requirements and recommendations in two jurisdictions (Canada, and Nova Scotia). The greatest variety of provisions for addressing uncertainty at different stages of the EIA process was found in British Columbia, where multiple provisions were identified and across all stages of the EIA process. For instance, six different types of provisions (Types 2, 4, 5, 6, 8, and 9) were presented for dealing with uncertainty during the impact prediction stage of EIA.

Table 4-3. Addressing uncertainty in different phases of EIA, by provision type and by jurisdictions.

Stage of EIA	Stage Description	Guiding Document Level	Type(s) of provisions (1 – 10)* for addressing uncertainty, by jurisdiction													
			CA	BC	AB	SK	MB	ON	NB	NS	PE	NL	YT	NT	ISR	NU
Unspecified	General/broad requirements and recommendations	Legislation	*1 6*							*1*						
		Regulation														
		Guideline	*1*					*1 4*		*2*			*2*	*1*		
Project description/ design	Description of the proposed action, including its alternatives, and detail sufficient for an assessment.	Legislation														
		Regulation														
		Guideline											*2*			
Screening	Identification of development proposals requiring formal EIA; determination the required type or level of EIA.	Legislation	*9*													*9*
		Regulation		*2 9*								*9*				
		Guideline			*2*	*9*							*2 9*	*3 9*		*9*
Scoping (VCs, Boundaries, Baseline Studies, Alternatives)	Preliminary identification of impacts and key issues requiring assessment; delineation of the boundaries to be considered in the assessment, including the baseline conditions and scoping of alternatives.	Legislation														
		Regulation														
		Guideline		*2 5*						*7*			*1 2*	*1 2*		
Impact prediction (including modeling)	Feedback to project design for change and/or mitigation. Identification, evaluation and communication of key impacts for the competent authority and the public	Legislation														
		Regulation														
		Guideline	*2 5 6*	*2 4 5 6 8 9*	*2 4*	*2*		*3*					*3*	*1 2 3*	*4 5 10*	
Impact significance evaluation	Evaluation and communication of key impacts for the competent authority and the public.	Legislation														
		Regulation														
		Guideline	*2*	*2 4 6*									*4*	*1 9*	*4 5 10*	

Stage of EIA	Stage Description	Guiding Document Level	Type(s) of provisions (1 – 10)* for addressing uncertainty, by jurisdiction													
			CA	BC	AB	SK	MB	ON	NB	NS	PE	NL	YT	NT	ISR	NU
Impact Management (Proposed Mitigation Measures)	Identification of impact management and mitigation strategies, and development of environmental management or protection plans.	Legislation			*7*											*7*
		Regulation														
		Guideline		*3* *6* *7* *8* *9*	*3*	*7* *8*			*7*	*2* *7*	*7*		*3* *7*	*8*	*7*	*8*
Review and decision	Technical and public review of EIS and related documents, and subsequent decision/approval.	Legislation														
		Regulation														
		Guideline			*9*									*1* *2* *3* *4*		*8*
Implementation and follow-up programs	Implementation of project and associated management measures; continuous data collection to monitor compliance with conditions and regulations; monitoring the effectiveness of impact management measures and the accuracy of impact predictions.	Legislation														
		Regulation														
		Guideline		*8* *9*		*8*										*8*

CA (Canada); BC (British Columbia); AB (Alberta); SK (Saskatchewan); MB (Manitoba); ON (Ontario); NB (New Brunswick); NS (Nova Scotia); PE (Prince Edward Island); NL (Newfoundland and Labrador); YT (Yukon); NT (Northwest Territories - Mackenzie Valley Region); ISR (Inuvialuit Settlement Region); NU (Nunavut)

* Types of provisions for addressing uncertainty:
Type 1 – Apply Precautionary Principle; **Type 2** – Report/consider general uncertainty/assumptions and uncertainty in data; **Type 3** – Report/consider uncertainty in impact predictions and mitigation measures; **Type 4** – Report/consider level of confidence and level/degree of uncertainty/certainty; **Type** 5 – Assess "worst case scenario"; **Type 6** – Assess/consider potential impact of accidents and malfunctions; **Type 7** – Propose contingency plans, emergency response plans, risk management; **Type 8** – Outline follow-up programs (e.g. monitoring, adaptive management); **Type 9** – Conduct/request further review and/or approval, additional information, additional risk analysis; **Type 10** – Apply negotiation.

CHAPTER FIVE:
DISCUSSION

While some provisions for uncertainty disclosure and consideration in EIA do exist in most Canadian federal, provincial and territorial EIA legislation, regulations and guidelines, the extent to which they exist, particularly in legislation, is limited. This chapter presents three major observations emerging from the research results. The first concerns the identified provisions for addressing uncertainty. The second concerns the variety and significance of the requirements and provisions for uncertainty disclosure and consideration across Canadian jurisdictions, including the acknowledgment of uncertainty in different phases of the EIA process. The third addresses the implications of the variability of the requirements and recommendations regarding uncertainty in EIA practice.

5.1 Evaluation of provisions for addressing uncertainty

Since EIA is based on knowledge that is subject to uncertainty (Canter, 1996), there is a need for managing uncertainty in EIA - an integral attribute of the EIA process (Canter, 1996; El-Sayed, 1996; Tennøy *et al.*, 2006). A number of different approaches to deal with uncertainties in EIA were identified in Canadian EIA legislation, regulations and guidelines. Each of them has its advantages and disadvantages. It is not the intent here to evaluate all uncertainty-related provisions; however, some significant observations emerge concerning the provisions identified.

5.1.1 Disclosure and description of uncertainties

First, this research identified that the most commonly used type of provision for addressing uncertainty in EIA was Type 2, which unites the requirements and recommendations to disclose uncertainty (including scientific uncertainty), assumptions, data inputs, data gaps, sources of information, reliability and accuracy of the data used. This type of provision, along with Type 3 (describe and consider uncertainty/assumptions/gaps in impact predictions and uncertainty/assumptions in mitigation measures), includes direct requirements and recommendations to report uncertainty; and corresponds to the recommendations of agencies and scholars to proponents and EIA practitioners to be more explicit about uncertainties in EIA documentation (e.g., Duncan, 2008; Tennøy et al., 2006; Bond et al., 2015; Lees et al., 2016; Leung et al., 2015, 2016), which is encouraging. The outcomes of impact predictions and impact significance evaluations are heavily dependent on data inputs and can be vastly altered by inaccuracy or errors in baseline data (Geneletti et al., 2003). The elements of limited knowledge, such as uninformed judgments, assumptions, approximations, limitations and gaps, can contribute to predictions being wrong, and render mitigation less effective than anticipated (Noble, 2015). However, the literature suggests that in most cases decision-makers have only limited information regarding the amount and quality of the input data and assumptions used in impact prediction, and the validity of the approach taken, and are not aware of the hidden uncertainty in different phases of EIA (Tennøy et al., 2006; Leung et al. 2016).

Tennøy et al. (2006) stated that even if EIA practitioners took uncertainty into consideration during the assessment, they are not appropriately disclosing this information to the decision-makers. Further, they claimed that uncertainty-related information may not reach decision-makers, even if uncertainty was reported in the EIA documents. Hellström & Jacob

(1996) believed that EIA practitioners communicate uncertainty insufficiently, as they do not describe the methods employed in the assessment, which makes it difficult to understand the process and trace uncertainty. Similar results have been reported in Canadian EIA practice, including the review of a sample of Canadian EISs and panel reports conducted by Lees et al. (2016), which reported poor communication and consideration of uncertainty, and a survey of Canadian EA practitioners, regulators, and interest groups on uncertainty consideration and disclosure practices in EIA, that found that only 15% of survey respondents, the majority of which represented the group of project proponents, acknowledged a good practice of uncertainty addressing in Canadian EIA (Leung et al., 2016).

These findings were reflected by the results of this research, which identified that inadequate attention was given to requirements and recommendations to report the methods applied in EA assessment, specifically regarding uncertainty. In connection to uncertainty, a requirement or guideline for a description of the approaches and methods used in the assessment was found in only two Canadian EIA jurisdictions – federally (regarding the methodologies used to predict cumulative environmental effects), and in the Yukon (regarding methodologies used for data collection). As the selection of methods for the assessment often relies upon the personal values, skills, and experiences of EIA practitioners (Wilkins, 2003), practitioners should be encouraged to give explicit disclosure and explanation in regards to the selected methods used: this will greatly increase the understanding of the process and potential uncertainty involved. Also, along with a description of uncertainty and assumptions, the proponents of proposed activities and EIA practitioners should clearly demonstrate that the necessary actions that may reduce uncertainty (such as additional data collection or research) were undertaken, and then describe the limitations that restrict further attempts to cope with uncertainty (Benidickson et al., 2005).

As evident from above, Type 2 provisions for addressing uncertainty in EIA cannot entirely cope with uncertainty. It should be clearly noted that the disclosure of uncertainty in EIA documents would not necessarily *reduce* uncertainty (Sarewitz, 2004); rather, it would make the process and assessment more transparent. However, increased transparency of EIA will, in turn, contribute to improving the value of EIA as a decision-aiding tool (Tennøy et al., 2006).

5.1.2 Worst-case scenario and the "negotiated" approach

Second, the ten different approaches for dealing with uncertainty in EIA identified in this study were employed by different Canadian EIA jurisdictions to various extents. Surprisingly, *worst-case scenario* and *negotiation* were seldom used to address uncertainty requirements. The literature suggests that these two are valuable approaches to be applied in the face of uncertainty (see for example Hauge et al., 2014; Christie, 2008).

The worst-case scenario represents the most severe outcomes that may be reasonably foreseen to occur in a certain situation (Yoe & Skaggs, 1997). When evaluating the potential risks or impacts associated with a proposed activity, assessment of the worst-case scenario is recognized as a valuable provision to cope with uncertainty and provide more confidence in predictions (Benidickson et al., 2005; Hauge et al., 2014). Consideration of the worst-case scenario increases the range of considerations of risk and safety factors in an assessment, and helps decision-makers to better determine the acceptability of the potential effects of a proposed development initiative (Benidickson et al., 2005). If during an assessment it is determined that the worst-case scenario is likely to not cause significant adverse impacts, then all other potential hazards will be seen as less risky or relatively more acceptable (Hobday et al., 2011). Appropriate

mitigation measures may be proposed to prevent a worst-case scenario (Williams et al, 2009), thus increasing the likelihood that the mitigation measures are also effective in less severe circumstances. Requirements and recommendations to assess a *worst-case scenario* as the means to address uncertainty, however, were identified only in Canadian federal and British Columbia's EIA systems.

The *"negotiated"* approach is the only uncertainty-related provision which assumes active involvement of the community or other affected interests in addressing uncertainty in EIA. Each development initiative undergoing EIA, in general, involves three principle stakeholders: proponent, regulator, and the community (Morrison et al., 2001). The "negotiated" approach is public participation, which, as a provision for addressing uncertainty, brings to the EIA process additional sources of knowledge and experience, a greater understanding of competing knowledge, and a more comprehensive understanding of issues, concerns and needs, and perhaps additional ideas for solutions. The knowledge gained from engaging local communities, in particular, is potentially valuable to EIA practitioners or experts, proponents, and regulators in dealing with uncertainty. A community can, for example, criticize assumptions related to impacts and their significance (Pidgeon, 1998), and bring to the process new knowledge based on lived experience that is not known to other EIA interests. Much has been written in recent literature to lobby and promote public participation in EIA, and Wilkins (2003) has argued that communication between project proponents (and the EIA practitioners they retain) and the public can increase understanding between different stakeholders. A high degree of uncertainty often exists in EIA decisions; Sarewitz notes that the most important decisions "are justified by a high level of commitment to a set of goals and values" (2004: 398). Thus, decisions based on communications involving all interested parties are likely to be more meaningful, and increase the transparency of the EIA process and of the uncertainties that it may contain. However, public

participation, as an approach to address uncertainty, was identified only in the Inuvialuit Settlement Region; it was recommended for projects with a high degree of uncertainty or controversy regarding potential impacts, and where the available relevant information is limited. Additional research on the application and success of this approach in the Inuvialuit Settlement Region would help determine whether and how to extend public participation as a means to address uncertainty to other jurisdictions.

5.1.3 Combining approaches

Third, all approaches for addressing uncertainty in EIA identified by this research may be deemed effective. However, no single provision for, or recommended approach to, uncertainty disclosure and consideration may be a panacea for dealing with uncertainty in EIA, or for dealing with uncertainty at a particular stage of the EIA process. A combination of approaches is required in the desire to maintain efficacy and credibility of EIA as a decision-aiding tool. For instance, the main goal of the precautionary principle, i.e. Type 1 provision to deal with uncertainty, is to implement effective mitigation measures (Benidickson et al., 2005). However, the effectiveness of proposed mitigation measures is often unknown. Therefore, the application of Type 3 provisions (disclose uncertainty related to mitigation measures) is an important, complementary provision and beneficial for informed decision-making. In addition, follow-up provisions, such as monitoring and adaptive management measures (Type 8), can further enhance the overall confidence in EIA.

Despite that this research identified a number of different requirements and recommendations for addressing uncertainty in EIA, the scholarly literature indicates that

practitioners do not regularly disclose and consider uncertainty in EIA (e.g., Geneletti et al., 2003; Tennøy et al., 2006; Wood, 2008; Duncan, 2008; Leung et al., 2016). Various authors also distinguish the need to give more emphasis to improving the communication of uncertainty in EIA, and to make the processes more transparent in order to maintain the credibility and efficacy of EIA (e.g. Cashmore, 2004; Tennøy et al., 2006; Wood, 2008). The literature further suggests that some of the identified approaches to cope with uncertainty require specific information or data, which is not necessarily always readily available to EIA practitioners and project proponents. The level of confidence in predictions, for example, often heavily depends upon the monitoring data obtained from similar projects (Coutand et al., 2011), but access to the results of monitoring programs of similar developments, and from other project proponents, is often limited (Noble & Basnet, 2015). For instance, some proponents of similar initiatives are unwilling to share the results of monitoring programs (due to confidentiality of the results); and often only monitoring data formally reported to regulatory agencies is available. In addition, even if environmental monitoring data are available, it may be provided in different formats, for instance, some companies may provide raw data, while others may simply state that the predictions were met (Buckley, 1989; Coutand & Clastres, 2011; Ball et al., 2013). Also, systematic comparisons of predictions and real effects are very rare. Finally, in many cases, even if monitoring programs are proposed in EIA reports, they are not always implemented (Morrison et al., 2003). As a result, with limited monitoring data often available, the level of confidence in predictions can be specified as low, or may be inadequately estimated.

There are other reasons why specific information or data may not be readily available to EIA practitioners and project proponents to properly address uncertainty. Uncertainties identified in EIAs may be used by those opposing a particular project or development (Duncan, 2008; Leung et al., 2016). Therefore, EIA practitioners may be not willing to disclose uncertainty

because they do not want to reduce or lose the credibility of the assessment (Duncan, 2008). Also, practitioners may lack the expertise (Wilkins, 2003), or merely fail to discuss uncertainty because they do not know that the information is valuable for the decision-makers and the public (Tennøy et al., 2006). At the same time, decision-makers may not know, or may not be interested, how to use uncertainty information and therefore have not put it into the term of references (ToRs) as a requirement. Wilkins (2003) also pointed out that narrowing the scope of the assessment due to time and financial restrictions can often make budgets and timelines tight, and possibly insufficient for properly addressing and communicating uncertainty. Finally, hired by project proponents, the EIA practitioners may choose not to be explicit about uncertainty, to help reduce the risks of conflict, delay, or project rejection (Duncan, 2008). At present, however, little is known about the actual motivations of EIA practitioners and proponents in communicating about uncertainty in EIA, or the perceived barriers (Leung et al., 2016).

5.2 Characterization of current requirements and provisions for uncertainty disclosure and consideration in Canadian EIA systems

The authority to conduct EIA in Canada is shared between the federal and provincial/territorial governments. Each jurisdiction has its own EIA system, the fundamental characteristics of which, and approaches to, vary among jurisdictions. Carver et al. (2010) argue that it is difficult to find many common trends in EIA practice among jurisdictions. Variation in federal, provincial and territorial EIA regimes is also reflected in the variety of requirements and recommendations for addressing uncertainty in EIA. Results of this research further show that provisions in legislation, regulations and guidelines concerning uncertainty consideration and

disclosure also differ within jurisdictions, and across the different phases of EIA.

5.2.1 Variety of requirements and provisions

The results of this research revealed a variety of requirements and provisions for uncertainty disclosure and consideration. First, the extent of requirements and recommendations for addressing uncertainty in EIA varies between jurisdictions. Among the 14 assessed jurisdictions, a complete lack of uncertainty related provisions was identified in one jurisdiction (Manitoba); in three other jurisdictions (New Brunswick, Prince Edward Island, and Newfoundland and Labrador), uncertainty was acknowledged only once in EIA provisions; at least some requirements and recommendations for uncertainty disclosure and consideration were found in eight jurisdictions (Canada, Alberta, Saskatchewan, Nova Scotia, Ontario, Yukon, Inuvialuit Settlement Region, and Nunavut); and the most provisions were present in British Columbia's EIA system and in the Mackenzie Valley of the Northwest Territories. Overall, there is limited attention to uncertainty in the EIA legislation, regulations, and guidelines in the majority of Canadian jurisdictions.

A second aspect concerns the significant variability of the provisions for addressing uncertainty. In this study, all provisions for uncertainty disclosure and consideration were categorized as ten different types of provisions (see Table 4-2), each of which was used by various jurisdictions differently. For instance, the same type of provisions may be applied in some jurisdictions to deal with uncertainty in different stages of EIA; and vice versa, in some jurisdictions various provisions were proposed to address uncertainty in the same stage of EIA. For example, the worst-case scenario is recommended to be applied for assessing project

alternatives in the federal EIA system, but is applicable in determining the likelihood of residual effects, and for addressing uncertainty in baseline data in British Columbia. In addition, often requirements are applied for addressing uncertainty associated with a specific EIA activity, e.g. in the Yukon the precautionary principle is required specifically for addressing gaps, or uncertainty, in environmental data. However, in other jurisdictions, the precautionary principle was used primarily as a general provision for dealing with uncertainty - unrelated to any particular stage of EIA.

Third, a lack of consistency in the location of requirements (legislation, regulation, and guideline) was identified. Most of the requirements for uncertainty disclosure and consideration are provided in guidelines; this is one of the few similarities in uncertainty provisions across jurisdictions. Information about uncertainty, including requirements and recommendations for its addressing, are provided in a *separate section* or sub-section in only three jurisdictions - British Columbia (Confidence and Risk), Nova Scotia (Uncertainty in Climate Change), and Yukon (Information Gap and Uncertainty). In the majority of jurisdictions, uncertainty is acknowledged in different sections of EIA guiding documents, which makes it hard to track where and what is required for addressing uncertainty.

Finally, not all identified provisions explicitly require or recommend addressing uncertainty in EIA. Many provisions are latent; and speak more to the approaches for dealing with uncertainty in EIA, that were described in the literature. For example, assessment of potential malfunctions and accidents, contingency and emergency plans, or reference to risk, are not explicitly requirements to disclose or consider uncertainty. However, these approaches are referred in the literature as tools to address uncertainty in EIA. Such significant discrepancies in uncertainty related provisions between different jurisdictions may generate confusion for project proponents and EIA practitioners, who operate in multiple jurisdictions, and also result in

unevenness in the extent to which uncertainty is addressed and communicated in practice – even for a similar project with similar effects, but in different jurisdictions. In an absence of greater uniformity across jurisdictions, it is important to increase specificity (Benidickson et al., 2005) in existing provisions and approaches for uncertainty disclosure in EIA within individual jurisdictions.

5.2.2 Acknowledgement of uncertainty in different phases of EIA and issues regarding the flow of uncertainty-related information

In different Canadian EIA jurisdictions, requirements and recommendations for uncertainty disclosure and consideration cover uncertainty associated with the different stages of EIA, or a part of a stage [e.g. uncertainty in project design; uncertainty (gaps) in data inputs for modeling; uncertainty in impact predictions or in mitigation measures]. This research identified a lack of consistency among different jurisdictions in this aspect also; which is not surprising. Some of the EIA stages were covered better than others; but none of the jurisdictions provided requirements and recommendations for addressing uncertainty in *all* stages of EIA.

Each stage of the 'multilayered' EIA process involves different forms or types of uncertainty (Hellström & Jacob, 1996). For example, the literature suggests that a high degree of uncertainty inherent in EIA is often associated with the project description/design stage, and may include a number of sources, such as: project definition and characteristics, project size, detailed design, and operational features that may be alternated during the EIA process (Canter, 1996); the limited consideration of social aspects in the project description (Pardo, 1997); shifting project design, evaluation and selection (Pardo, 1997); and concentrating project design on structural

complexity, design requirements and cost-effectiveness (Rowe, 1994).

Surprisingly, among all jurisdictions, the only one provision to address uncertainty during the project description/design stage – the first stage of EIA – was identified in the Yukon and only covered uncertainty related to the proposed technologies. The requirements for EIA are often defined based on the information provided in the project description stage. Therefore, undisclosed or unconsidered uncertainty in the project description or design stage may contribute significantly to uncertainty in impact prediction and evaluation, carried forward to impact management (Pope, 2013), thus resulting in the credibility of the assessment being questioned at the latter stages of EIA (Beanlands & Duinker, 1983).

This research also identified some provisions for addressing uncertainty that are not specific to any particular stage of EIA. For example, in the federal CEAA 2012 the application of the precautionary principal ("careful and precautionary manner") is required for all projects "to be carried out on federal lands, or those that are outside Canada and that are to be carried out or financially supported by a federal authority".[1] Similarly, in the Yukon, it is required to describe any uncertainties or public concern.[2] Those provisions are broad and generic; and require substantial interpretation. Although some of them directly require project proponents and EIA practitioners to disclose uncertainty, the lack of detail may result in uncertainty being ignored or downplayed in all stages of EIA.

Interestingly, in British Columbia, without providing EIA practitioners and project proponents with recommendations to disclose uncertainty in the project design and description

[1] *Canadian Environmental Assessment Act, 2012; S.C. 2012, c. 19, s. 52*; sec. 4 PURPOSES; subsection 4(1) Purposes.
[2] Yukon Environmental and Socio-economic Assessment Board, "Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions" (November 2005); sec. 1.0 Project Introduction and Overview, 1.1 Executive Summary.

stage, decision-makers are required to consider such uncertainty during screening.[3] Similarly, in Nunavut, decision-makers are responsible for the determination if a proposed development initiative involves technological innovations for which the effects are unknown,[4] although project proponents and EIA practitioners are not specifically directed to disclose this information. This research also identified several more similar issues where decision-makers are provided with much stronger and detailed requirements and recommendations to deal with uncertainty. Despite that EIA practice is administratively well-organized, and the roles and responsibilities are clearly defined in all Canadian jurisdictions, such differences in guiding provisions for addressing uncertainty weakens the cooperation between some of the major parties involved in the EIA process (Beanlands & Duinker, 1983) – decision-makers and reviewers on one side, and project proponents and EIA practitioners on another. Practitioners may be unsure about the standards that will guide the review (Beanlands & Duinker, 1983). With a lack of direction for disclosing and addressing uncertainty, the process becomes confusing and relies on the individual expertise of the EIA practitioner, their knowledge on the matter, and their willingness to report uncertainty, and to cooperate with decision-makers and reviewers.

5.2.3 Weakness of requirements and recommendations to manage uncertainty

In addition to the variety of provisions, the overall insignificance of the requirements and recommendations for uncertainty disclosure and consideration identified in Canadian federal, provincial and territorial EIA legislation, regulations and guidelines should be highlighted.

[3] *Concurrent Approval Regulation B.C. Reg. 371/2002*; sec. 8. Duties of the ministry that has authority to issue the eligible approval.
[4] *Nunavut Planning and Project Assessment Act S.C. 2013, c. 14, s. 2*; sec. 89: Project to be reviewed.

Although the variability of requirements was not surprising, the identified weakness of the requirements for addressing uncertainty was unexpected. Canada was the second nation in the world that formally implemented a formal EIA system, immediately following the United States (Noble, 2015); and has been practicing EIA for over 40 years. Canada also plays a leading role in steering international EIA practice, and is recognized as a nation that contributes much to EIA's development (Noble, 2015). However, the importance of uncertainty in EIA has received inadequate attention in a majority of Canadian jurisdictions.

Special attention should be given to the level and scope of requirements for uncertainty disclosure and consideration that have been identified under the Canadian federal EIA system. The federal EIA regime is responsible for federal, interprovincial, and international EIA boundary issues (Caldwell & Bartlett, 1997). The assessment of the provisions for uncertainty disclosure and consideration conducted in this research indicates that the current Canadian federal EIA system does not have as strong requirements for uncertainty communication and disclosure compared with some other Canadian provincial or territorial jurisdictions, such as British Columbia and the Mackenzie Valley in the Northwest Territories.

Much has been written in the scholarly literature on uncertainty in EIA to suggest that EIA practitioners and proponents of a proposed activity ought to be more explicit about uncertainty in EIA and properly report uncertainty to decision-makers and the public (see Geneletti et al., 2003; Tennøy et al., 2006; Cashmore, 2007; Duncan, 2008; Leung et al., 2015, 2016). The literature emphasizes that undisclosed uncertainties in EIA significantly affect the overall performance of EIA as a decision-aiding tool, and decreases the reliability and usefulness of impact predictions (Tennøy et al., 2006; Cashmore, 2007; Leung et al. 2016). However, in Canada, EIA practice is regulated by federal, provincial, and territorial governments, which establish their own mandates for EIA (Carver et al., 2010). Regulatory authorities determine the procedures and requirements

for EIA practice, including those related to the management of uncertainty in EIA. Project proponents and EIA practitioners are obligated to comply with the requirements and follow the recommendations prescribed by EIA legislation, regulations, and guidelines, which regulate EIA practice in each corresponding jurisdiction.

The lack of attention to uncertainty in the majority of Canadian jurisdictions can vastly compromise the quality of the uncertainty management in EIA. In the absence or shortage of requirements for uncertainty in the majority of Canadian EIA regulatory and administrative documents, project proponents and EIA practitioners are not obligated to fully address uncertainty, and may choose not to communicate about it. In addition, in the absence of explicit guidance for proper disclosure and consideration of uncertainty in EIA, project proponents and EIA practitioners have to rely on the own experience and perceptions of uncertainty, thus increasing the variability of disclosure practices and approaches. Even with increased provisions for requirements for practitioners and proponents to disclose uncertainties, however, the requirements for uncertainty be taken into consideration by decision-making authorities also remains weak.

5.3 Effect of variety of requirements on uncertainty management in inter-jurisdictional EIA

The structure of the Constitution of Canada has resulted in overlapping regulating authorities between the federal, provincial and territorial jurisdictions (Fitzpatrick & Sinclair, 2009; Carver et al., 2010), which may lead to a development initiative to be subject to at least two EIAs - federal and either provincial or territorial (Environmental Law Centre, 2014). To avoid

duplications and prevent inter-jurisdictional disputes, which usually cause significant delays and project budget increases (Canadian Council of Ministers of the Environment, 1998), several authors have discussed different approaches to a single EIA that meets the requirements of two or more different jurisdictions, among them: standardization, harmonization, and substitution (see, for example, Fitzpatrick & Sinclair, 2009; Carver et al., 2010; Powell, 2013). However, CEAA 2012 introduced radical changes to the federal EIA regime. Under those changes, the scope of the federal assessment is limited "to matters of exclusive federal jurisdiction" (Gibson, 2012: 184). Projects requiring the authorization of both federal and provincial or territorial authority are allowed to undergo only provincial or territorial EIA. The provinces received a greater role in the shared EIA and the federal authority is permitted to rely upon the results of the provincial/territorial assessment when making decisions (Environmental Law Centre, 2014). Such approach to a joint assessment rejects coordination and harmonization between federal and provincial/territorial jurisdictions in favor of substitution (Gibson, 2012).

The benefits of substitution of the federal EIA process with provincial EIA, where there exist stronger requirements for uncertainty disclosure and consideration, such as in British Columbia and the Mackenzie Valley Region of the Northwest Territories, is obvious. However, recent cases of inter-jurisdictional EIAs (including inter-provincial/territorial EIAs, and federal-provincial/territorial ones conducted under the former federal EIA act), revealed the assessment process being conducted at lowering EIA standards (Carver et al., 2010). The substitution of federal assessment with provincial or territorial EIA with *weaker* requirements for addressing uncertainty, or the complete lack of uncertainty related provisions, may result in decisions of the federal government being made with even less, or no, consideration of uncertainty. The lower standards of some provincial and territorial EIA systems may compromise the quality of an otherwise federal EIA application. Hence, the strengthening of the provincial and territorial EIA

standards, including those related to addressing uncertainty, will also positively affect federal decision-making in those instances where the substitution process is applied under CEAA 2012.

Even more complicated issues accompany inter-provincial/territorial EIA. With the increasing shift of responsibilities for EIA from the federal government to provincial or territorial jurisdictions, a significant role is assigned to the provinces or territories to ensure inter-jurisdictional cooperation (Environmental Law Center, 2015). The effectiveness and efficiency of such cooperation are limited by the differences between EIA systems and their requirements; and improvement of the coordination among different provincial EIA regimes remains a major challenge (Carver et al., 2010). A number of different approaches to the improvement of the inter-jurisdictional cooperation have been discussed by scholars, and the literature acknowledges the benefits of application of harmonization for inter-jurisdictional cooperation in the Canadian context. Harmonization is not based on legislative uniformity but coordination; with legislative complementarity, legislative similarity or uniformity may not be required (Environmental Law Center, 2015). Through harmonization, inter-provincial cooperation may be improved without the implementation of major changes in EIA law (Environmental Law Center, 2015).

However, due to major differences in EIA systems among Canadian provincial and territorial jurisdictions, it is possible that uncertainty may be given even less attention or ignored in the joint assessment process. To ensure that all Canadian jurisdictions have adequate requirements for uncertainty, and pay due attention to uncertainty disclosure and consideration during inter-jurisdictional coordination, a more radical approach, such as standardization, may be necessary – at least in terms of uncertainty provisions. Standardization involves the development of a single set of requirements or protocols for uncertainty disclosure in EIA, which may be used across different jurisdictions. However, this approach also has a number of implementation challenges. In the 1990s, for example, the Canadian Standards Association initiated the

development of Canadian EIA standards in the form of best practice guidelines; 14 drafts were issued, but the work was not completed because provincial representatives discontinued their participation, referring to the need to allocate their time and energy to other EIA initiatives (Carver et al., 2010).

Fitzpatrick & Sinclair (2009) state that the significant variety in EIA regimes among Canadian jurisdictions limits the motivation of introducing major changes to the existing EIA systems; rather than implement changes required for standardization of the EIA practice, the provincial and territorial governments will claim the neighboring jurisdictions should make necessary adjustments. However, the establishment and implementation of national EIA standards for addressing and communicating uncertainty in EIA would be beneficial for all jurisdictions. For example, a jurisdiction may be participating in a joint EIA that will be conducted under the leadership of a jurisdiction with lower standards, which, in its turn, may compromise the quality of both the EIA and informed decision-making. It is in the interest of each jurisdiction to ensure that the minimum standards regarding uncertainty treatment in EIA are strong enough; hence, the need for national standards that ought to be met by all jurisdictions. With the application of such standards, the interests of each jurisdiction, and the integrity of their EIA systems, may be better protected. The development and implementation of EIA standards into Canadian EIA systems may be conducted through the introduction of a best practice framework, perhaps led by the Canadian Council of Ministers of the Environment.

CHAPTER SIX:
CONCLUSION

The need to improve uncertainty treatment and communication in EIA has been highlighted by many researchers and scholars, both internationally and in Canada (Duncan, 2008; Tennøy et al., 2006; Leung et al., 2015; Lees et al., 2016). Many authors agree that the disclosure and consideration of uncertainty help make EIA processes more transparent and improve EIA decisions (see, for example, Tennøy et al., 2006; Lees et al., 2016). However, much of the literature on the topic focuses on the acknowledgment of uncertainty as a phenomenon; describing different types, sources and potential effects of uncertainty; and stresses the need for its communication. Very little attention has been paid to the analysis of current guidance, procedures or requirements for uncertainty treatment in current EIA practice, and without this information, the extent to which uncertainty treatment in EIA practice is influenced or neglected by these cannot be known. Adequate requirements and standards are of paramount importance for maintaining good EIA practice, including the management of uncertainty.

In Canada, the federal, provincial and territorial governments are responsible for EIA, and each jurisdiction has its own EIA regime (Carver et al., 2010). The results of this research show that the requirements and recommendations for addressing uncertainty in EIA greatly vary among jurisdictions in many aspects. First, among the 14 assessed jurisdictions, one jurisdiction (Manitoba) does not have any provision for uncertainty disclosure and consideration; in each of three other jurisdictions (New Brunswick, Prince Edward Island, and Newfoundland and Labrador) only one uncertainty related provision was identified; at least some requirements and recommendations for uncertainty treatment were presented in eight jurisdictions (Canada, Alberta, Saskatchewan, Nova Scotia, Ontario, Yukon, Inuvialuit Settlement Region, and Nunavut); and the most provisions were found in British Columbia and in the Mackenzie Valley of the Northwest

Territories. Second, the significant variability of the provisions for addressing uncertainty should be highlighted. All provisions for uncertainty disclosure and consideration, identified in Canadian EIA systems, were categorized as ten different types of provisions. Each of these provisions was applied differently among jurisdictions: the same type of provisions was required or recommended in some jurisdictions to address uncertainty in different stages of EIA; and vice versa, in some jurisdictions various provisions were used to deal with uncertainty in the same stage of EIA. Third, it was hard to track where and what is required for addressing uncertainty because of inconsistency in the location of requirements (legislation, regulation, and guideline). In addition, although the most of the requirements for uncertainty disclosure and consideration are provided in guidelines in the majority of jurisdictions, provisions were found in different sections of EIA guiding documents. Fourth, many provisions are only implicit and represented by some approaches, which are referred in the literature as tools to manage uncertainty in EIA (e.g., the application of a precautionary principle; or the development of contingency and emergency plans). Finally, a lack of consistency among different jurisdictions associated with uncertainty disclosure and consideration in different stages and components of EIA was found. Some of the EIA stages were covered better than others, but none of the jurisdictions provided requirements and recommendations for addressing uncertainty in all stages of EIA.

Although the variability of requirements was not surprising, the great inconsistency in provisions for uncertainty disclosure and consideration among different jurisdictions may confuse project proponents and EIA practitioners, who operate in multiple jurisdictions, and create discrepancies in uncertainty addressing practice in different jurisdictions, that even for a similar project with similar effects uncertainty may be treated differently in different jurisdictions.

In addition to the variety of provisions, the overall insignificance of the requirements and recommendations for uncertainty treatment was identified in Canadian EIA regimes, which was

unexpected. Practicing EIA for over 40 years and being recognized as a great contributor to EIA development, Canada also plays a leading role in steering international EIA practice (Noble, 2015). However, uncertainty addressing practice in EIA is covered inadequately in a majority of Canadian jurisdictions.

In the Canadian context, the relatively strong requirements and recommendations for addressing uncertainty in a particular jurisdiction - British Columbia and the Mackenzie Valley of the Northwest Territories - may not be considered in inter-jurisdictional joint assessments (including federal-provincial/territorial and inter-provincial/territorial EIAs), if they are carried out under the leadership of a jurisdiction with weak requirements for uncertainty treatment or a lack of such requirements. This poses an additional threat to the uncertainty addressing practice in Canadian EIA. Therefore, the development of national, standardized best practices is, at a minimum, needed to ensure that uncertainty is properly addressed and communicated in EIA across EIA jurisdictions.

6.1 Practical recommendations for improving guidance and procedures for uncertainty treatment in Canadian EIA practice

Based on the findings of this research, several opportunities for the improvement of uncertainty reporting practice in Canada may be explored. First, requirements and recommendations for uncertainty communication should be systematic: uncertainty should be addressed in all stages of EIA; more specific and explicit requirements and recommendations should be provided. A specific section in EIA guidelines, or a separate guideline, may be developed in each jurisdiction to provide information about uncertainty in EIA and its

implications, and to communicate to all stakeholders the need for and benefits of uncertainty addressing in EIA practice.

Second, adequate guidance for uncertainty disclosure and consideration in each jurisdiction should be available for EIA practitioners. The strengthening of requirements and recommendations for uncertainty communication is not enough by itself; explicit guidance and procedures for addressing uncertainty would be beneficial for EIA practitioners as well as for the reviewers of the EIS documents and decision-makers. Addressing uncertainty in EIA is a complicated process; therefore, a best practice model or set of standards need to be developed to support uncertainty treatment in EIA practice.

Third, there is a need to establish national EIA standards and guidelines for how to communicate and address uncertainty. The national standards may minimize great disparities in the perception and understanding of uncertainty in EIA, and attention to the matter that now exists among Canadian jurisdictions, and reduce confusion among all interested parties on how to manage uncertainty in EIA. The attempt of the Canadian Standards Association to develop EIA standards in the form of a best practice for Canadian EIA was initiated in the 1990s, but was not completed due to inadequate interest exhibited by provincial and territorial authorities (Carver et al., 2010). However, this initiative may be renewed – with a specific focus on standards and guidelines for addressing uncertainty. Definitely, such an initiative may face the same issues as the previous one – authorities may choose to not participate in the development of the standards. Preliminary work should thus be done to sensitize the benefits of a national standard for addressing uncertainty in EIA for all jurisdictions, perhaps highlighting the potential benefits on a jurisdiction-by-jurisdiction basis, and in terms of federal and inter-jurisdictional EIA processes. The Canadian Council of Ministers of the Environment might lead the work, representing the various provincial and territorial EIA jurisdictions. The national standards may be adopted by all

Canadian jurisdictions as the minimum accepted standards for addressing uncertainty in EIA practice.

Fourth, guidance for proper communication of uncertainty directly to decision-makers and the public need to be developed and made available. Logical connection between practitioners and decision-makers for relevant information about uncertainties should be maintained to insure that the latter (decision-makers) will get the information they need. Effective decision-making based on EIA results requires an understanding of uncertainty in EIA (Rowe, 2006). The awareness of decision-makers about uncertainty, which is present in all stages of the EIA process, should be increased. Some authors (e.g. Tennøy et al., 2006; Wood, 2008) observe that even if uncertainty is outlined and expressed in prediction documents and reports, it will not necessarily reach decision-makers. Options in this regard include, for example, more extensive and detailed education of EIS reviewers and decision-makers about uncertainty. Better understanding of its implications and effects on the assessment would be valuable for improving uncertainty management. Similarly, presentations regarding uncertainty in EIA to the public, as part of any single EIA process, will help to build knowledge and understanding of the matter, enhance dialogue, and transparency generally. A greater understanding of uncertainty among all stakeholders involved in the EIA process, in turn, will increase the acceptance of uncertainty in EIA, and help reduce any perceived need of practitioners and project proponents to hide uncertainty in their assessments (Leung et al., 2016).

Finally, greater public involvement in addressing uncertainty in EIA may help to maintain the transparency and credibility of the EIA process in those instances where uncertainty exists. Field & Olewiler (2011) argue that the environmental legislation in Canada is based on the "co-operative" approach, which allows negotiations between government agencies and proponents. Often decision-making is subject to political influence that transforms EIA into a bureaucratic

process intended for project authorization (Weston, 2000). As a result, public interests can be compromised. Strengthening public participation in the EIA in general, and particularly strengthen uncertainty communication, will help increase the legitimacy of EIA and, as the result, influence the decisions being made and help ensure that impacts are properly mitigated.

6.2 Recommendations for further research

The results of this study indicate that the importance of addressing uncertainty in EIA was ignored or underestimated in a majority of Canadian EIA jurisdictions. In cases of virtual absence or lack of requirements, and little to no guidance for addressing uncertainty, it would be interesting to examine what motivates EIA practitioners and project proponents to consider and communicate, or ignore or hide uncertainty. Such an investigation would be valuable for the improvement of uncertainty communication practice. On another hand, an even bigger question is why some governments and EIA authorities include, or omit, provisions for addressing uncertainty in their EIA guiding documents given that the importance of uncertainty consideration is well established. The lack or shortage of requirements for the treatment of uncertainty in EIA in the majority of the Canadian jurisdictions may indicate that EIA regulatory authorities are lacking awareness, knowledge and understanding of the importance and role of uncertainty in EIA, or see more explicit attempts to address uncertainty as unhelpful to decision-making or risky for development decisions. Perceptions about uncertainty in EIA, its significance and implications, should be explored.

In a number of Canadian jurisdictions, the implementation of follow-up programs, such as monitoring and adaptive management, were required or recommended as means to address

uncertainty. Without follow-up programs, the EIA process is not complete (Noble, 2015). EIA follow-up is the link between EIA (the pre-decision stage) and project implementation (the post-decision stage) (Morrison et al., 2001) to determine the real effects of projects - the accuracy of predictions and the effectiveness of mitigation measures. In doing so, follow-up can help reveal the overall effectiveness of EIA as a planning, decision-making and environmental management tool (Ortolano & Shepherd, 1995; Noble, 2015). Thus, notwithstanding the potential of EIA to address issues related to uncertainties about a proposed project (Arts et al., 2001), further research is needed to understand the extent to which follow-up programs actually uncover uncertainties; whether and how new information about uncertainties improves project impact management practices; whether that information is communicated to the public; and whether it is used to inform future project assessments.

Finally, in some Canadian jurisdictions the authorities responsible for EIA issue project-specific guidance, such as guidelines for the preparation of the EIS, and/or Terms of Reference (ToR) to provide requirements and direction to project proponents. A quick search of several randomly selected project-specific guidelines and ToRs during the course of this research indicated that the majority of them contain some uncertainty related provisions, which vary from document to document. Many such guidelines for the preparation of impact statements have been issued by the Ontario Ministry of Environment, and possibly other provincial governments. Although Ontario was the first jurisdiction in Canada to establish a legislation-based EIA process in 1975 (Hanna, 2009); this research identified very limited provisions for uncertainty disclosure and consideration in the Ontario EIA system. Despite that it was not the focus of this research to analyze project-specific guidance, one of them, the “Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the Canadian Environmental Assessment Act and

Ontario Environmental Assessment Act for the Marathon Platinum Group Metals and Copper Mine Project, August 2011, Prepared by: Canadian Environmental Assessment Agency and Ontario Ministry of Environment - Environmental Assessment and Approvals Branch", was checked for the presence of the main search term "certain" in the text. Many provisions for uncertainty disclosure and consideration were identified in this project-specific guideline. Through project specific guidelines, authorities may establish different requirements and recommendations for similar projects with similar effects in the same jurisdiction. This approach increases even more the variability of the requirements and recommendations available to project proponents and EIA practitioners on how to address uncertainty, and, as the result, contributes to unevenness in the extent to which uncertainty is addressed and communicated in EIA practice. Inconsistent project-specific requirements may create discrepancies in uncertainty addressing practices for similar projects with similar effects in the same jurisdiction. Further research is needed to analyze project-specific guidelines and ToRs for uncertainty provisions, and to determine if this approach results in better uncertainty management practices in comparison to requirements provided in legislation, regulations and guidelines.

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APPENDIX A

REQUIREMENTS AND PROVISIONS FOR UNCERTAINTY DISCLOSURE AND CONSIDERATION IN CANADIAN EIA SYSTEMS

Table A-1. *Legislated* requirements and provisions for uncertainty disclosure and consideration

Jurisdiction	Legislation
Canada (Canadian Federal Government)	**CEAA 2012:** • 4. (1) The purposes of this Act are (b) to ensure that designated projects that require the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament other than this Act to be carried out, are considered in a ***careful and precautionary manner*** to avoid significant adverse environmental effects; (g) to ensure that projects, as defined in section 66, that are to be carried out on federal lands, or those that are outside Canada and that are to be carried out or financially supported by a federal authority, are considered in a ***careful and precautionary manner*** to avoid significant adverse environmental effects (CEAA 2012, Section 4 PURPOSES; Subsection 4(1) Purposes; pages 5-6). • 4. (2) The Government of Canada, the Minister, the Agency, federal authorities and responsible authorities, in the administration of this Act, must exercise their powers in a manner that protects the environment and human health and applies the ***precautionary principle*** (CEAA 2012, Section 4 PURPOSES; Subsection 4(2) Mandate; page 6). • 8. (2) If the Agency is of the opinion, after receiving the ***description of the designated project*** from the proponent, that a decision cannot be made under paragraph 10(b) because the ***description is incomplete*** or does ***not contain sufficient details***, the Agency may, within 10 days after receiving it, ***require*** the proponent to provide an ***amended description*** that includes the information and details that the Agency specifies (CEAA 2012, Section 8 SCREENING; Subsection 8(2) Additional information; page 9). • 19. (1) The environmental assessment of a designated project must take into account the following factors: (a) the environmental effects of the designated project, including the ***environmental effects of malfunctions or accidents*** that may occur in connection with the designated project and any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out (CEAA 2012, Section 19 FACTORS TO BE CONSIDERED; Subsection 19(1) Factors; page 12)
British Columbia	-
Alberta	**Environmental Protection and Enhancement Act:** • **49** An environmental impact assessment report must be prepared in accordance with the final terms of reference issued by the Director under section 48(3) and shall include the following information unless the Director provides otherwise: (j) the ***contingency plans*** that have been or will be developed in order to respond to unpredicted negative impacts; (Section 49 Contents of environmental impact assessment report; pages 44-45).
Saskatchewan	-
Manitoba	-
Ontario	-
New Brunswick	-
Nova Scotia	**Environment Act:** • **2** The purpose of this Act is to support and promote the protection, enhancement and prudent use of the environment while recognizing the following goals: (b) maintaining the principles of sustainable development, including (ii) the ***precautionary principle*** will be used in decision-making so that where there are threats of serious or irreversible damage, the lack of full scientific certainty shall not be used as a reason for

	postponing measures to prevent environmental degradation (PART I, INTRODUCTION, Section 2: Purpose of Act).
Prince Edward Island	-
Newfoundland and Labrador	-
Yukon	-
Northwest Territories - Mackenzie Valley Region	-
Inuvialuit Settlement Region	-
Nunavut	**Nunavut Planning and Project Assessment Act:** • **89.** (1) The Board must be guided by the following considerations when it is called on to determine, on the completion of a screening, whether a review of the project is required: (a) a review is required if, in the Board's opinion, (iii) the project involves ***technological innovations***, the ***effects of which are unknown***; (SCREENING BY BOARD, Section 89: Project to be reviewed; page 36). • **101.** (1) The Board must issue guidelines in respect of the preparation by the proponent of a statement of the ecosystemic and socio-economic impacts of the project. (3) The guidelines must specify which of the following types of information the proponent is required to include in the impact statement: (b) the anticipated effects of the environment on the project, including effects associated with natural phenomena, such as meteorological and seismological activity, and climate change; (d) the measures proposed by the proponent to (i) avoid and mitigate adverse ecosystemic and socio-economic impacts, including ***contingency plans***, (REVIEW (BOARD), Section 101: Content of impact statement; page 43). • **103.** (1) In conducting a review of a project, the Board must take into account the following factors: (h) the measures, including those proposed by the proponent, that should be taken to (i) avoid and mitigate adverse ecosystemic and socio-economic impacts, including ***contingency plans***, (REVIEW (BOARD), Section 103: Factors to consider; page 46).

Table A-2. Provisions for uncertainty disclosure and consideration identified in EIA *regulations*

Jurisdiction	Regulation
Canada (Canadian Federal Government)	- (Only regulations under CEAA 2012 have been reviewed)
British Columbia	**Concurrent Approval Regulation B.C. Reg. 371/2002:** • 8 (1) If a ministry receives a notice under section 6 (1) (b) [executive director must notify ministry that application for concurrent review accepted] of this regulation, the ministry ***must*** (b) within 75 days of the date on which the proponent's application for an environmental assessment certificate was accepted under section 16 (4) [accepting application for review] of the Act, ***notify the proponent*** and the environmental assessment office in writing of any ***additional information*** that the ministry anticipates it will require from the proponent in order to complete its review and consideration (8. Duties of the ministry that has authority to issue the eligible approval; page 4). • (2) For the purposes of the notification required under subsection (1) (b), the ministry may ***take into account*** and ***make note*** of ***project design uncertainties*** that exist at this stage of the review (8. Duties of the ministry that has authority to issue the eligible approval; page 4).
Alberta	-
Saskatchewan	- (Regulations don't exist under The Environmental Assessment Act in Saskatchewan)
Manitoba	-
Ontario	-
New Brunswick	-
Nova Scotia	-
Prince Edward Island	- (Regulations don't exist under ENVIRONMENTAL PROTECTION ACT, CHAPTER E-9 in Prince Edward Island)
Newfoundland and Labrador	**Environmental Assessment Regulations, 2003, N.L.R. 54/03:** • **24.** (1) Where the minister determines that there is ***insufficient detail*** to determine the significance of the environmental effects of an undertaking, he or she shall ***require*** an ***environmental preview report*** for that undertaking. (2) In making a determination under subsection (1), the minister may consider (c) ***unknown or experimental technology*** intended to be used with respect to the undertaking (24. Screening criteria for environmental preview report).
Yukon	-
Northwest Territories - Mackenzie Valley Region	-
Inuvialuit Settlement Region	- (Regulations don't exist under THE WESTERN ARCTIC CLAIM Inuvialuit Final Agreement)
Nunavut	- (Regulations don't exist under The Nunavut Planning and Project Assessment Act)

Table A-3. Provisions for uncertainty disclosure and consideration identified in EIA *guidelines*

Jurisdiction	Guidelines
Canada (Canadian Federal Government)	(Only guidelines under CEAA 2012 have been reviewed) **Operational Policy Statement: Assessing Cumulative Environmental Effects under CEAA 2012:** • CEAA 2012 aims to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a designated project, including cumulative environmental effects. In addition, CEAA 2012 ensures that a designated project is considered in a ***careful and precautionary manner*** to avoid significant adverse environmental effects, when the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament is required for the designated project to be carried out (Relevant Provisions of CEAA 2012 for Assessing Cumulative Environmental Effects; page 2). • Paragraph 19(1)(a) also requires the assessment of the environmental ***effects of accidents and malfunctions*** that ***may occur*** in relation to the designated project. Accordingly, the environmental effects of accidents and malfunctions must be considered in the assessment of cumulative environmental effects if they are likely to result from the designated project in combination with other physical activities that have been or will be carried out (Relevant Provisions of CEAA 2012 for Assessing Cumulative Environmental Effects; page 2). • The methodologies used to predict cumulative environmental effects must be clearly described. With this information, reviewers of the EIS will be able to examine how the analysis was conducted and what rationale supports the conclusions reached. Any ***assumptions*** or ***conclusions*** based on ***professional judgement*** should be clearly ***identified and described*** (Consideration of Cumulative Environmental Effects under CEAA 2012; Step 2: Analysis; page 5). • Data collection and/or generation are important components of a cumulative environmental effects assessment. At times, it may be challenging to obtain or generate data to support the analysis. Potential cumulative environmental effects should be considered, as appropriate, in the analysis even when there is ***little supporting data*** or there is ***predictive uncertainty***. Reviewers of the EIS should be presented with a complete picture of the potential types and scale of cumulative environmental effects. In all cases, ***uncertainties*** and ***assumptions*** underpinning an analysis should be described and ***information sources*** clearly documented (Consideration of Cumulative Environmental Effects under CEAA 2012; Step 2: Analysis; page 5). **Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012:** • CEAA 2012 aims to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a designated project. In addition, CEAA 2012 ensures that a designated project is considered in ***a careful and precautionary manner*** to avoid significant adverse environmental effects, when the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament is required for the designated project to be carried out (Relevant Provisions of CEAA 2012; page 2). **Note:** This quote is equal to the quote published in the Guideline "Assessing Cumulative Environmental Effects under CEAA 2012". • …selecting a ***scenario*** that represents the ***worst case of potential environmental effects*** would provide ***increased confidence*** that the predictions in the project EA are applicable to any of the alternative means (Considerations in Addressing "Alternative Means" of the Designated Project, Case b: Bringing forward multiple alternative means; pages 6).
British Columbia	**Guideline for the Selection of Valued Components and Assessment of Potential Effects:** • If the selected VC was chosen to best represent potential effects on similar components (candidate VCs) or to facilitate the assessment of potential effects on another component, these ***assumptions*** should be noted in the VC selection rationale (2.0 IDENTIFICATION AND SELECTION OF VALUED COMPONENTS, 2.4 DOCUMENTATION; page 14).

	• …***contingency plans***, ***emergency response plans***, and other general practices assumed or proposed to be implemented by the proponent should also be ***described*** (3.0 ASSESSING POTENTIAL EFFECTS ON SELECTED VALUED COMPONENTS, 3.4 MITIGATION; page 23). • Any ***uncertainty*** associated with the ***effectiveness of proposed mitigation measures*** should be ***noted*** in the assessment (3.0 ASSESSING POTENTIAL EFFECTS ON SELECTED VALUED COMPONENTS, 3.4 MITIGATION; page 23). • A proponent may take a conservative approach, particularly if ***data gaps*** exist, and assess a ***'worst-case' impact scenario*** (3.5 EVALUATING RESIDUAL EFFECTS, 3.5.2 LIKELIHOOD; page 31). • Certain mitigation measures, such as ***contingency*** and ***emergency prevention*** and preparedness planning, will reduce the likelihood that ***unintentional events*** will occur. However, the assessment must still consider the potential effects that could result from ***unintentional project-related events*** (3.5 EVALUATING RESIDUAL EFFECTS, 3.5.2 LIKELIHOOD; page 31). • Once the residual effect prediction has been described in terms of significance and likelihood, it is important to ***explain*** the ***level of confidence in each prediction***. The ***level of confidence*** is typically based on ***expert judgment***, and should characterize the ***level of uncertainty*** associated with both the significance and likelihood determinations. Specifying the ***level of confidence*** associated with these determinations allows the decision-maker to better evaluate the risk associated with the project. …limitations in the available data may make residual effect predictions difficult. Where there are such ***data gaps***, the residual effect prediction may have a lower ***level of confidence*** (3.5.4 CONFIDENCE AND RISK; page 33). • Thus, it is important to clearly describe the ***sources and nature of uncertainty*** associated with any residual effect prediction in the assessment to provide the basis for the stated ***level of confidence***. In particular, the practitioner should articulate how any identified ***uncertainty*** may affect either the significance or the likelihood of the predicted residual effect (3.5.4 CONFIDENCE AND RISK; page 34). • In most cases, ***uncertainty*** (particularly low to moderate uncertainty) can be ***adequately addressed through monitoring or other follow-up programs*** that confirm actual residual effects are as predicted, that mitigation measures are implemented as described in the Application (and are required by conditions of the Environmental Assessment Certificate and/or other authorizations), and that mitigation measures are effective. ***Adaptive management programs*** that facilitate action when ***unforeseen effects occur*** or the ***need for new or modified mitigation*** is identified can serve to effectively manage low to moderate levels of ***uncertainty***. The assessment should ***describe*** the need for and scope of ***monitoring or other follow-up programs***, ***including adaptive management*** programs, ***to address*** any ***identified uncertainty*** (3.5.4 CONFIDENCE AND RISK; page 34). • In certain situations, it may be appropriate to ***conduct additional risk analysis*** to more fully characterize the potential risk associated with ***uncertain outcomes***, particularly if there is a ***low level of confidence*** coupled with the possibility of a significant residual adverse effect and ***follow-up program***s are ***not considered sufficient*** to manage the potential risk. For example, more detailed risk analysis (in terms of likelihood and consequence) may be warranted if the ***level of confidence*** associated with the characterization of a residual effect is such that the significance of the residual effect could change as a result of either an incorrect characterization of the residual effect or the consequence of an ***unintentional project-related event*** (including ***mitigation failure***). The focus of any ***additional risk analysis*** should be ***on the source of the uncertainty***. For example, if the ***uncertainty*** is associated with unproven mitigation, the risk analysis should focus on mitigation failure. ***Additional risk analysis*** may also ***identify*** the ***need for additional mitigation to manage identified risk and uncertainty***. The residual effect predictions, including significance and likelihood determinations, and any ***additional mitigation*** or ***follow-up*** arising from the risk analysis should be documented in the assessment. ***Additional risk analysis*** should only be considered when there is ***a high degree of uncertainty*** and potential for a significant adverse residual effect that ***cannot be sufficiently managed by follow-up programs*** (3.5.4 CONFIDENCE AND RISK; pages 34-35).

	• As above, the need for and scope of ***monitoring and follow-up programs to address the uncertainty*** should ***be documented*** (3.5.4 CONFIDENCE AND RISK; pages 35). **Application Information Requirements Template:** • The Proponent must commit to provide the following in the Application: – Identification of ***potential accidents, malfunctions and unplanned events*** that could occur in any phase of the proposed project; the likelihood and circumstances under which these events could occur; and the ***environmental effects and/or consequences*** that may result from such events, assuming ***contingency plans*** are ***not fully effective***; and – Description of how each ***potential accident, malfunction or unplanned event*** would be ***managed or mitigated*** (10. Accidents or Malfunctions; page N/A). AND – Environmental ***effects of malfunctions or accidents*** that may occur in connection with the proposed project: – Demonstrate how potential effects of ***malfunctions or accidents*** in relation to environmental effects defined in section 5 of the CEAA 2012 have been ***taken into account*** as part of the assessment (APPENDICES, Sample substitution summary table; page N/A). • The requirements of the ***follow-up program*** in respect of the proposed project: – Summarize any proposed ***follow-up program*** activities in relation to environmental effects as defined in section 5 of the CEAA 2012, particularly in areas where ***scientific uncertainty*** exists ***in the prediction of effects***. The ***follow-up program*** may include ***monitoring plans***, and ***contingency*** or ***adaptive management*** provisions to be implemented if monitoring results indicate corrective action is required. – The summary may point to proposed ***follow-up program*** elements and how the proponent intends to implement them, and provide an explanation of why these ***follow-up programs*** are recommended (APPENDICES, Sample substitution summary table; page N/A).
Alberta	**Alberta's Environmental Assessment Process:** • The purpose of the review is to identify any project-related ***uncertainties*** or ***risks*** and determine if the information provided by the Proponent meets the requirements of the Terms of Reference. If the ***information*** provided ***is unclear or insufficient*** to meet these objectives, the Director may ***ask*** the Proponent for ***additional information*** (Technical Review; page 3). **Guide to Preparing Environmental Impact Assessment Reports in Alberta:** • ***Assumptions***, ***model inputs*** and ***data sets*** used to obtain modeling ***predictions*** in the EIA report must be documented, a ***rationale for their selection*** provided and a discussion of the potential implications of their use in terms of ***confidence*** in the resulting impact ***predictions*** (2.4 Modeling; page 4). • The EIA report must clearly identify the ***limitations*** of the models including sources of error and relative accuracy. The EIA report should also indicate what statistical ***confidence limits*** or ***other quantitative measurements of uncertainty*** were used to describe the relative accuracy of the model (2.4 Modeling; page 4). • ***Discussion of uncertainties*** related to the conceptual reclamation plan should include information on the ***success of the proposed methods in other projects*** (3.2.5 Conservation and Reclamation; page 6). • Soils surveys should be done at an adequate level of detail to determine effects of the project's emissions (with emphasis on PAI) on soil quality […] Proponents must provide a rationale for the level of survey (or other methods) used and an indication of their ***confidence in the predictions*** based on the level used (3.3.9 Terrain and Soils; page 11). **Guide to Reviewing Environmental Impact Assessment Reports:**

	• The regulators and the public need to fully understand the position of the company, have an understanding of the project and how the conclusions from the assessment were reached. Through the review of the EIA, answers to the following questions should be provided: – How likely is it that environmental objectives can be met? – What is the ***level of confidence*** to meet the objectives? – What are the ***key uncertainties***? – Are ***follow-up*** or ***contingency plans*** proposed that ***increase the confidence*** in meeting the objectives? (Appendix 4: Hierarchy of Questions for Integrated Application; Level Three – EIA Report Questions – Non-Technical; page 17). – Assessment Methodology: – Is ***scientific uncertainty acknowledged*** and how is it ***addressed*** (quantitative vs. qualitative assessment)? (Appendix 4: Hierarchy of Questions for Integrated Application; Level Four – EIA Report Questions – Technical; pages 19). – Confirmation of the accuracy of EIA report predictions: – Were the assessment ***results conclusive or vague*** and generalized? – Is there ***uncertainty*** about the impacts on the environment, are ***confidence limits*** and ***worst case scenarios*** described? – Did the Proponent ***discuss uncertainties***, provide data and management strategies? – Does the EIA ***address*** the degree to which the possible ***effects*** on the environment may be ***uncertain or involve unique or unknown risks***? – Are there ***follow-up*** or ***contingency plans*** that ***increase confidence*** in predicted outcomes? (Appendix 4: Hierarchy of Questions for Integrated Application; Level Four – EIA Report Questions – Technical; pages 20). – Environmental and resource management goals/plans: – Does the EIA report describe mitigation, reclamation and ***contingency plans***? (Appendix 4: Hierarchy of Questions for Integrated Application; Level Four – EIA Report Questions – Technical; pages 20). **Preparing Disclosure Documents For Environmental Assessment Screenings:** • ***Discuss*** the Proponent's ***certainty*** about the proposed project and factors that may influence ***uncertainty*** about future development (Disclosure Document Content, General Information; page 2).
Saskatchewan	**Technical Proposal Guidelines. A Guide to Assessing Projects and Preparing Proposals under The Environmental Assessment Act, 2012:** • The proposed design should realistically consider the effectiveness of the proposed protection measures and incorporate appropriate ***contingency measures*** and ***emergency response plans***. (3.1 General Principles for Preparing a Technical Proposal; page 13). • …any special risks or hazards posed by wastes and byproducts should be described together with ***contingency plans*** to deal with ***emergency situations*** (e.g., spills or plant malfunctions) (3.4.4 Potential Impacts and Mitigation Measures; page 17). • ***Monitoring programs*** for minimizing impacts during the construction and operation phases ***should be outlined***. Address planned programs for ongoing ***monitoring of the mitigation practices***. ***Monitoring*** and ***follow-up*** studies include: – ***Monitoring*** for ***risk management***, ***accidents and contingencies***; – ***Monitoring*** valued ecosystem components ***to ensure unforeseen impacts are not occurring*** (3.4.5 Monitoring; page 18). • …where the specific circumstances of individual projects may ***involve new impacts*** that are ***not anticipated***, or are incompletely addressed under existing legislation, ***review and approval*** under the Act may still be required (APPENDIX 'A' – SELF-ASSESSMENT CHECKLIST, Question 3; page 25). • …the use of ***new technology*** does not require review and approval if there is little likelihood of inducing environmental changes. The most reliable basis for this conclusion is experience with the technology elsewhere in conditions similar to the proposed application in Saskatchewan. Other evidence for this conclusion may include results of tests or pilot projects, expert review of design

	and proposed operation, and proposed safeguards and ***contingency plans*** (APPENDIX 'A' – SELF-ASSESSMENT CHECKLIST, Question 5; page 27). **Guidance for the Preparation of the Terms of Reference. A Guide to Developing the Terms of Reference for a Proposed Project (or 'Development') under The Environmental Assessment Act, 2012:** • …the proponent should commit to including, in the EIS, a ***contingency plan***, addressing impacts that the natural environment could have on the project, as well as other ***accidents or malfunctions*** that may occur during all phases of the proposed development. In the EIS, any adverse impacts resulting from the project that cannot be mitigated must be explained (3.3 Impact Mitigation and Monitoring; page 14). **SECTOR SPECIFIC GUIDELINES:** **Environmental Review Guidelines for Oil and Gas Activities:** • Types of information and level of detail required in an OGP *[Oil and Gas Project Proposal]* depends on several factors including: project nature, size and location; availability of existing information; significance of potential impacts and the ***degree of uncertainty*** associated with these impacts; and the level of public concern (APPENDIX A, Guidelines for the Preparation of an Oil and Gas Project Proposal, 1.0 Background; page 5). • The OGP should detail how the following types of mitigative measures will be incorporated (as appropriate) by describing in detail: – how you will identify and mitigate ***impacts*** that were identified in the Project Impacts section as being ***not adequately understood***. Plans for collecting any additional information required to properly understand project impacts should be outlined. – how you will deal with ***unexpected events*** such as: • spills • fire • unpredictable weather (e.g., heavy rain, flooding, breakup, severe cold, drought, wind) (2.5 Impact Management and Protection Measures (Mitigation); page 11).
Manitoba	-
Ontario	**Code of Practice: Preparing, Reviewing and Using Class Environmental Assessments in Ontario:** • The ministry uses a ***precautionary***, science-based ***approach*** in its decision-making to protect human health and the environment (3.3 Statement of Environmental Values and Ministry Decision-making; page 25). • Use quantitative scientific data to draw conclusions whenever possible. The proponent is expected to articulate the ***level of uncertainty*** associated with ***data*** and ***conclusions***, along with the ***risk*** of serious or irreversible environmental harm associated with the project (3.3 Statement of Environmental Values and Ministry Decision-making; Page 27). **Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario:** • The ministry uses a ***precautionary***, science-based ***approach*** in its decision-making to protect human health and the environment (3.3 Statement of Environmental Values and Ministry Decision-making; page 15). • Use quantitative scientific data to draw conclusions whenever possible. The proponent is expected to articulate the ***level of uncertainty*** associated with ***data and conclusions***, along with the ***risk*** of serious or irreversible environmental harm associated with the project (3.3 Statement of Environmental Values and Ministry Decision-making; Page 17). • Where the ***environmental effects*** are ***uncertain***, proponents should ***explain why*** and fully explain the factors that cause the problem and how it has been addressed in the evaluation. For example, a proponent may not be able to ***precisely predict*** an effect because a ***new process or technology*** is being proposed. In this case, the proponent should discuss why the effect may vary, identify the expected range of effects, and the ***level of certainty*** of these predictions (4. Environmental Assessment Process; 4.2 Planning Process; 4.2.4 Assessment and Evaluation; Page 30).

	Code of Practice: Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario: • The ministry uses a ***precautionary***, science-based ***approach*** in its decision-making to protect human health and the environment (4.3 Statement of Environmental Values and Ministry Decision-making; page 18). • Use quantitative scientific data to draw conclusions whenever possible. The proponent is expected to articulate the ***level of uncertainty*** associated with ***data and conclusions***, along with the ***risk*** of serious or irreversible environmental harm associated with the project (4.3 Statement of Environmental Values and Ministry Decision-making; page 20).
New Brunswick	**A Guide to Environmental Impact Assessment in New Brunswick:** • Describe the mitigation measures proposed to minimize the environmental impacts identified in the previous section… Examples of mitigation include but are not limited to the following: – … – ***Contingency plans*** (e.g. spill notification and clean-up, evacuation, etc.) (REGISTRATION GUIDE, 5.0 SUMMARY OF PROPOSED MITIGATION; page xxii).
Nova Scotia	**Guide to Considering Climate Change in Project Development in Nova Scotia:** • ***Uncertainty***, however, does not mean project proponents should not be pro-active. Rather, ***climate change-related uncertainty needs to be understood*** by decision makers; and the ***steps*** taken ***to address this uncertainty must be demonstrated***. Potential climate change impacts, ***addressing uncertainty***, and ***adaptation planning*** at a project level can be determined by taking the following steps. Detailed guidance is provided in Section 3.4 (3.0 ADAPTATION, 3.3 Uncertainty in Climate Change Projections; page 12). • While there is broad agreement on the general trends and global effects of climate change, a significant amount of ***uncertainty*** remains in relation to the projection of specific future climate parameters for given locations. As such, ***risk management techniques*** have been developed with climate change applications specifically in mind e.g., Bruce et al. (2006). These techniques provide order to the process of considering the vulnerability of a location or project to changing climate, and assessing adaptation options in light of a range of climate outcomes and their probability of occurrence within a given time period. A ***risk management-based approach can be used*** to guide the identification of project responses to climate projections including an initial assessment of the extent to which climate change factors may or may not be of concern (3.0 ADAPTATION, 3.4 Guidance, 3.4.1 Risk Management Approach; page 14). • When identifying viable adaptation options to be included in an Adaptation Plan (Step 5), a cost-benefit analysis can be undertaken to determine the economic feasibility of proposed adaptation measures. *[…]* Assign weighting to the costs and benefits of the adaptation options, and choosing the preferred option(s) ***taking account*** of the ***risks and uncertainties*** (Appendix A-4, Guidance on Cost-Benefit Analysis; page 44). **Proponent's Guide to Wind Power Projects: Guide for preparing an Environmental Assessment Registration Document:** • The proponent should consider addressing, but not be limited to, the following aspects and activities: risk management (e.g. ***contingency plans for malfunctions and accidents***, ***emergency response plans***) – *[During Site preparation and construction]* (5. Description of the Undertaking, 5.3 Site Preparation and Construction; page 5). – *[During Operation and maintenance]* (5. Description of the Undertaking, 5.5 Operation and Maintenance; pages 5-6). NOTE: This guideline is too specific and strictly related to the wind power projects.
Prince Edward Island	**Environmental Impact Assessment Guidelines:** • If ***impacts*** are ***not completely understood***, it may be necessary for the proponent to undertake ***additional evaluation*** and to ***prepare specific contingency plans*** to be implemented if the impacts occur (6. Environmental Impact Statement, Content of the Report, Mitigation of Any Impacts; page N/A).

Newfoundland and Labrador	-
Yukon	**Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; v. 2005.11:** • *[Dealing with gaps in the environmental baseline data and information:]* - ***Identify*** any existing ***environmental data gaps*** relevant to the proposed project. - ***Develop*** and present ***a study program*** to address identified environmental data gaps, or demonstrate how the project has modified its approach in a ***precautionary manner***, in response to identified environmental data gaps (INFORMATION GAPS AND UNCERTAINTY; page 6). • ***Describe*** any ***uncertainties*** or public concerns. (1.0 PROJECT INTRODUCTION AND OVERVIEW, 1.1 EXECUTIVE SUMMARY; page 9). • Provide detailed information on the degree to which ***technologies*** being proposed ***are proven*** to be viable in northern environments, including any ***uncertainties***. Include plans for proving the feasibility of the technologies, as appropriate (5.3 TECHNOLOGIES; page 22). • Reference ***risk management plans, contingency responses***, or approaches to address ***accidents, malfunctions, and emergency response measures*** specific to this phase of the project, as applicable (5.4 PROJECT PHASES AND SCHEDULING; 5.4.2 Construction Phase; page 24). • Reference ***risk management approaches*** including ***accidents, malfunctions and emergency response plans*** that will be in place during operations and temporary shutdowns (5.4 PROJECT PHASES AND SCHEDULING; 5.4.3 Operation/Modification Phase; page 26). • Reference environmental protection, ***contingency***, and ***monitoring plans*** for the operations phase. These should include environmental attributes that may be impacted by the ongoing operations of the project such as affected water resources, aquatic resources, wildlife, and physical structures monitoring programs (5.4 PROJECT PHASES AND SCHEDULING; 5.4.3 Operation/Modification Phase; page 26). • Provide a list of sources for the information on the values map(s), including identification of the methodologies used for data collection, and identification of those components for which ***data*** is recognized as being ***incomplete or missing*** (6.0 ENVIRONMENTAL AND SOCIO-ECONOMIC EFFECTS ASSESSMENT; 6.1.1 Environmental Values & 6.1.2 Physical Socio-economic Values; page 30). • Provide any proposed ***emergency response and contingency plans*** for dealing with ***accidents and malfunctions*** including: – Fuel and other hazardous material spills – Accidents on access and transportation routes – Accidents and malfunctions of key project components/constructions – General emergency situations such as fire and natural disasters – Include a discussion (6.4 MITIGATION MEASURES, 6.4.1 Managing Accidents and Malfunctions, page 39). • Residual effects are effects of the project that remain subsequent to the application of mitigation measures. – Describe any anticipated residual effects of the project (i.e. effects anticipated to occur subsequent to the application of mitigation measures). Any ***assumptions or uncertainty*** surrounding the ***implementation of mitigation measures*** and the ***prediction*** of residual effects should be clearly outlined (6.4 MITIGATION MEASURES, 6.4.3 Residual Effects; page 40). • Indicate the ***level of confidence*** associated with each ***assessment of significance*** (6.5 DETERMINATION OF SIGNIFICANCE; page 41). • Describe any anticipated residual cumulative effects in a manner similar to the project effects. Any ***assumptions or uncertainty*** surrounding the ***implementation of mitigation measures*** and the ***prediction*** of residual effects should be clearly outlined (7.5 RESIDUAL CUMULATIVE EFFECTS; page 47).

	• Indicate the ***level of confidence*** associated with each assessment of significance (7.6 SIGNIFICANCE; page 48). **Rules for Screenings Conducted by the Executive Committee:** • … the Executive Committee may conclude its screening and require a review of a project at any time after the expiry of the 30-day period referred to in paragraph 42(b) if, – it determines that the project ***involves technology*** that is ***controversial*** in Yukon or the ***effects of which are unknown*** (Part 5 Conduct of Screenings, including Participation of Interested Persons, the Public and, Others. 67 Project requires a review; page 13).
Northwest Territories - Mackenzie Valley Region	**Environmental Impact Assessment Guidelines:** • Preliminary screeners should refer a development to an environmental assessment if: - there are ***uncertaintie***s about the ***potential impacts*** or the ***effectiveness of proposed mitigation measures*** that require analysis to be resolved (2.7 Performing the "Might Test", How can the "might" test be practically applied?; page 18). • **Impact Predictions:** Using a clear methodology, the developer will describe how the predicted impacts are expected to arise from the proposed development. This will include describing the mechanisms for cause and effect and providing supporting references (including where traditional knowledge was used). Where ***professional judgment*** has been used in determining impacts, ***this must be made clear***. An ***explicit account*** of the ***level and nature of uncertainties*** involved in each prediction ***is required***[70]. For each predicted impact, the developer will also describe: - the ***likelihood*** and ***certainty*** of the impact[71]. [70] For example, providing ***statistical confidence intervals***, or rating ***levels of certainty*** as high, medium-high, medium, medium-low, or low. [71] In this sense, likelihood is based on the probability of an event (such as an early frost) occurring, while ***certainty*** refers to the limits of our theoretical accuracy in predicting (3.11 Preparing Developer's Assessment Report, Impact Predictions; page 30). • Developers are not expected to see the future, but are expected to make the best reasonable predictions they can. Like all prediction in EIA, this involves uncertainty but is necessary for the Review Board to reach the best decisions about a development. The Review Board will accept less detail and more predictive ***uncertainty*** the further in the future or the less certain the reasonably foreseeable development is (Appendix H: Additional Cumulative Effects Guidance, B. Determining what other developments to include; page 81). • The degree to which adaptive management may be involved depends, in part, on the degree of ***uncertainties*** in the assessment. Appendix H: Additional Cumulative Effects Guidance, B. Determining what other developments to include; page 82). **Socio-Economic Impact Assessment Guidelines:** • Considering the following is important when conducting and reviewing SEIA: 3. Using the ***"Precautionary Principle"*** and other internationally-recognized SEIA principles (2.2 Considerations for Conducting SEIA; page 8). • The following are overall requirements for characterizing and predicting potentially significant impacts: - Transparent identification of ***assumptions*** and ***information gaps***, as well as any ***uncertainties about the predictions*** (3.4.4 Tools for Characterizing and Predicting Impacts on the Wage Economy; page 37-38). • ***Limited baseline data and insufficient documented information*** about traditional and cultural activities ***can create uncertainty*** about the developer's impact prediction. … for characterizing and predicting potentially significant impacts: Transparent identification of ***assumptions and information gaps***, as well as any ***uncertainties*** about the predictions *[is required]*. (3.4.4 Tools for Characterizing and Predicting Impacts on the Wage Economy; page 38). • *[…]* preliminary screeners may ask reviewers to identify whether: 5. There is ***general uncertainty*** about socio-economic issues 8. There are ***gaps*** in the ***initial impact prediction or determination of significance*** (4.3 Application Completeness and Review; page 46).

	• The Review Board bases its determination on evidence in the public record, and goals, standards, guidelines and/or defined limits of manageable change. When ***making*** its ***determination*** of significance, the Review Board may consider the questions in Table 13. Likelihood of occurrence - How was the impact predicted? How ***certain is this prediction***? - How ***certain*** are the predictions of severity and the ability to manage impacts, given mitigation proposals in place? - If the ***predictions are uncertain***, the Review Board will use the ***"Precautionary Principle."*** (5.6 Determining Significance, TABLE 13 Determining Significance in SEIA; pages 54-55). • The Review Board may consider the following when determining if mitigation is appropriate/adequate: - Is the mitigation reliable enough to effectively reduce or avoid the impact for which it was intended? What is the ***level of certainty*** the ***mitigation will be effective***? Will the mitigation reduce impacts below a recognized threshold of manageable change? - Does the mitigation have an ***adaptive management mechanism*** to deal with ***unforeseen impacts*** or varying degrees of impact? (5.6 Determining Significance, Choosing appropriate mitigation; page 56). • While specific methods used by assessors can vary, good SEIA should attempt to adhere to these considerations. 3. Use the ***"Precautionary Principle"*** and other international SEIA principles - In ***absence of acceptable certainty***, use a ***precautionary approach when collecting data*** (err on the side of additional primary data collection), and when determining impact significance ("likelihood" rather than "full certainty" that impacts will occur is the test for whether mitigation measures are required) (APPENDIX B Considerations for Conducting SEIA; page 69). • In cases where the ***impacts*** are as ***uncertain or unknown***, the ***precautionary principle*** should apply (APPENDIX G Digging Deeper, (G6) Cumulative Impacts and SEIA; page 98).
Northwest Territories - Inuvialuit Settlement Region	**Environmental Impact Screening Guidelines:** • Best practice principles for determining the significance of environmental effects include *[only uncertainty-related key components were captured]*: – Describe as necessary, the ***confidence levels*** in ***impact prediction and judgement*** that underlie the determination of significance. – Use a ***"negotiated" approach*** when ***factual information is limited***, there is a ***high degree of uncertainty or controversy*** regarding potential impacts. This can be science- or expert-based, or involve a broader cross-section of affected and interested parties. There is also an array of social impact assessment tools which can help to determine significance from a community perspective (Appendix E: Determination of Potential for Significant Negative Environmental Impact, Best Practices; page 47). • Proposed Mitigation Measures to Address Potential Impacts – Describe the proposed mitigation measures to address potential negative environmental impacts, impacts on wildlife and impacts on resource harvesting. – Describe the mitigation that is required to manage the cumulative impact(s). – These should include: • ***Contingency plans*** (this should include but not limited to: fuel spills, blowouts, permafrost degradation, accidents or malfunctions) (Appendix F: Project Description Content Guide; page 53). **Environmental Impact Review Guidelines:** • ***Contingency plans***, including ***countermeasures and adaptive management***, should be incorporated in mitigation and remedial measures (6. Guidance on Mitigative and Remedial Measures; 6.1 Defining Mitigative and Remedial Measures; page 27). • To properly address the requirement for mitigative and remedial measures, a development proposal submission should include:

	– An outline of ***emergency response plans*** and any management and monitoring plans proposed and/or required for the development to proceed (e.g., clean-up, reclamation, disposal, decommissioning, contingency, wildlife management, adaptive management, follow-up and monitoring) (6. Guidance on Mitigative and Remedial Measures; 6.2 What a Developer Should Consider; page 28). • 8.2.10 ***Worst Case Scenario*** Describe potential and realistic "Worst Case Scenario" associated with the proposed development and the proposed action plan(s) to adequately control the situation(s) (8. Environmental Impact Statement; 8.2 Submission Requirements; page 46).
Nunavut	**Authorizing Agencies' Guide – DRAFT 2;** **Intervenors' Guide – DRAFT 2;** **Proponents' Guide – DRAFT 2:** • The NIRB may determine that a ***review is required*** when in its judgment: d. The project ***involves technological innovations*** for which the ***effects are unknown*** (Authorizing Agencies' Guide; 4.0 Non-Exempt Project Proposals Referred to the NIRB for Screening; 4.5 The Possible Outcomes of Screening; page 26 & Intervenors' Guide; 4.0 Non-Exempt Project Proposals Referred to the NIRB for Screening; 4.5 The Possible Outcomes of Screening; page 15 & Proponents' Guide; DETERMINATION AND RECOMMENDATION; page 15). **Authorizing Agencies' Guide – DRAFT 2;** **Intervenors' Guide – DRAFT 2;** • In developing project certificate terms and conditions, the goals of the NIRB are to: – support ***adaptive management*** by requiring that ***unanticipated effects*** or changes to the magnitude of predicted impacts be identified and that mitigation measures and regulatory instruments be adapted to ***address unanticipated effects*** or ***changes to predicted impacts***; and – adopt ***audit and process evaluation measures*** to examine and transparently report on the ***accuracy of predictions***, the ***success or failure of mitigation measures*** and overall levels of environmental and socio-economic performance of the project and effectiveness of the impact assessment and regulatory processes in supporting environmental performance (Authorizing Agencies' Guide; 6.0 Project Certificate; 6.1 Introduction; pages 48-49 & Intervenors' Guide; 6.0 Project Certificate; 6.1 Introduction; pages 36). • For projects where there is a ***high degree of uncertainty*** regarding potential effects and where the ***precautionary approach is applied***, ***project-specific monitoring*** also plays a crucial role in ***addressing uncertainty*** regarding project effects and ***enabling*** all parties ***to adapt mitigation measures*** on an ongoing basis to ensure negative project effects are prevented or limited to the extent possible (Authorizing Agencies' Guide; 7.0 Project Monitoring; 7.1 Co-ordinating Project Monitoring between an AA and NIRB; page 53 & Intervenors' Guide; 7.0 Project Monitoring; 7.1 Co-ordinating Project Monitoring between an AA and NIRB; page 40).

APPENDIX B

SUMMARY OF THE ANALYSIS OF THE REQUIREMENTS AND PROVISIONS FOR UNCERTAINTY DISCLOSURE AND CONSIDERATION IN CANADIAN EIA SYSTEMS

Table B-1. Requirements and provisions for uncertainty disclosure and consideration in EIA Legislation

EIA LEGISLATION						
Type of Provision	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
TYPE 1	Apply ***Precautionary Principle*** (“a careful and precautionary manner”)	• To protect the environment and human health. • For all developments to be carried out: - by a federal authority under any Act of Parliament other than CEAA 2012; - on federal lands; or - carried out or financially supported by a federal authority.	Decision-makers; Project proponents	Federal	CEAA 2012; Sec. 4(1), 4(2)	Unspecified
	Apply ***Precautionary Principle***	• Promoting Precautionary principle as the integral part of sustainable development principles.	Decision-makers; Project proponents	Nova Scotia	Environment Act; Part I, Sec. 2(b)(ii)	Unspecified
TYPE 6	Assess/take into consideration the environmental effects of potential ***malfunctions and accidents***, including cumulative environmental effects in combination with other physical activities.			Federal	CEAA 2012; Sec. 8(1)	Unspecified
TYPE 7	Develop ***contingency plans*** in order to respond to unpredicted negative impact		Project proponents	Alberta	Environmental Protection and Enhancement Act; Sec. 49(j)	Impact Management
	Propose the ***mitigating measures***, including ***contingency plans***	• to mitigate impact predictions, including effects associated with natural phenomena (meteorological and seismological activity, climate change,	Project proponents	Nunavut	Nunavut Planning and Project Assessment Act;	Impact Management

		etc.)			Sec. 101(1), 101(3)(b), 101(3)(d)(i) & Sec. 103(1)(h)(i)	
TYPE 9	Request ***additional information*** and details	• ***incomplete*** project description; • ***lack*** of sufficient details.	Decision-makers	Federal	CEAA 2012; Sec. 8(2)	Screening
	Request/Conduct ***further review***	• If the project includes the implementation of the ***technological innovations***, the ***effects*** of which are ***unknown***	Decision-makers	Nunavut	Nunavut Planning and Project Assessment Act; Sec. 89(1)(a)(iii)	Screening

Table B-2. Analysis of the requirements and provisions for uncertainty disclosure and consideration in EIA Regulations

EIA REGULATIONS						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
TYPE 2	Record (take into account and make note of) ***uncertainty in project design*** and notify the proponent about it.	When the proponent's application for an environmental assessment certificate was accepted	Decision-makers	British Columbia	Concurrent Approval Regulation; Sec. 8(2)	Screening
TYPE 9	Request from the proponent ***addition information*** that could be required for project assessment review and consideration	The ministry must notify the proponent and the environmental assessment office in writing of any additional information that the ministry anticipates it will require from the proponent in order to complete its review and consideration.	Decision-makers	British Columbia	Concurrent Approval Regulation; Sec. 8(1)(b)	Screening
	Request an Environmental ***preview report***	If: • ***insufficient details*** of the description of a project/ development, which results in impossibility to determine interconnections between the development and the environment and the possible ***environmental impact*** of the development and ***its significance***; • ***unknown or experimental technology*** is proposed.	Decision-makers	Newfoundland and Labrador	Environmental Assessment Regulations; Sec. 24(1), Sec. 24(2)(c)	Screening

Table B-3. Analysis of the requirements and provisions for uncertainty disclosure and consideration in EIA Guidelines

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
TYPE 1	Apply ***Precautionary Principle*** ("a careful and precautionary manner")	• For projects to be carried out on land within federal legislative authority under any Act of Parliament; • to avoid significant adverse environmental effects	Decision-makers; Project proponents	Federal	Assessing Cumulative Environmental Effects under CEAA 2012; p. 2; and Addressing "Purpose of" and "Alternative Means" under the CEAA 2012; p. 2	Unspecified

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	The ministry uses a ***precautionary***, science-based ***approach*** in its decision-making to protect human health and the environment		Decision-makers	Ontario	Code of Practice: Preparing, Reviewing and Using Class Environmental Assessments in Ontario; p. 25 & Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario; p. 15 & Code of Practice: Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario; p. 18	Unspecified
	Demonstrate how the project has modified its approach in a ***precautionary manner***, in response to identified environmental data gaps	• Dealing with ***gaps*** in the environmental ***baseline data and information***.	Project proponents	Yukon	Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; p. 6	Scoping (Baseline Studies)
	Use the ***"Precautionary Principle"*** and other internationally-recognized Socio-Economic Impact Assessment (SEIA) principles	• When conducting and reviewing Socio-Economic Impact Assessment (SEIA),	Decision-makers; Project proponents	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 8	Unspecified

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Use the ***"Precautionary Principle"***	• If the ***predictions are uncertain***. • Responsibility of the Review Board.	Decision-makers	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 54-55	Review and Decision
	Use the ***Precautionary Principle*** and other international Socio-Economic Impact Assessment (SEIA) principles when conducting and reviewing	• For good Socio-Economic Impact Assessment (SEIA)	Decision-makers; Project proponents	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 69	Unspecified
	Employ the ***precautionary approach***, when ***collecting data*** and ***determining impact significance***	• In lack of acceptable certainty	Project proponents	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 69	Scoping; Impact Significance Evaluation
	Apply the ***precautionary principle*** if the impacts are uncertain or unknown.		Decision-makers; Project proponents	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 98	Impact predictions; Review and Decision
TYPE 2	Clearly identify and describe any ***assumptions*** or ***conclusions*** based on ***professional judgement***.	• When predicting cumulative environmental effects. • To support the review of the environmental impact assessment process that has been conducted and to support the conclusions reached.	Project proponents	Federal	Assessing Cumulative Environmental Effects under CEAA 2012; p. 5	Impact predictions; Impact Significance Evaluation
	Describe ***uncertainties and assumptions*** underpinning an analysis and clearly document ***information sources.***	• For cumulative environmental effects assessment (potential types and scale). • Potential cumulative environmental effects should be considered, as appropriate, in the analysis even when there is little supporting data or there is predictive uncertainty.	Project proponents	Federal	Assessing Cumulative Environmental Effects under CEAA 2012; p. 5	Impact predictions; Impact Significance Evaluation

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Clearly describe the ***sources and nature of uncertainty*** associated with any residual effect prediction in the assessment to provide the basis for the stated ***level of confidence***. Explain how any identified ***uncertainty*** may affect either the significance or the likelihood of the predicted residual effect.		Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 34	Impact predictions; Impact Significance Evaluation
	If the selected VC was chosen to best represent potential effects on similar components (candidate VCs) or to facilitate the assessment of potential effects on another component, note these ***assumptions*** in the VC selection rationale.		Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 14	Scoping
	Clearly document all ***assumptions, model inputs and data sets*** used to obtain modeling predictions, including a rationale for their selection and the potential effects of their use on the level of confidence in impact predictions.		Project proponents	Alberta	Guide to Preparing Environmental Impact Assessment Reports in Alberta; p. 4	Impact predictions (Modeling)
	Clearly identify the ***limitations*** of the models including sources of error and ***relative accuracy***.		Project proponents	Alberta	Guide to Preparing Environmental Impact Assessment Reports in Alberta; p. 4	Impact predictions (Modeling)
	Describe ***certainty*** about the proposed project and factors that may influence ***uncertainty*** about future development.		Project proponents	Alberta	Preparing Disclosure Documents For Environmental Assessment Screenings; p. 2	Screening

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Provide the types of ***information*** and level of detail in conformity with the degree of ***uncertainty*** in ***impact predictions***.	• Required in an Oil and Gas Project Proposal or OGP.	Project proponents	Saskatchewan	Environmental Review Guidelines for Oil and Gas Activities; p. 5	Impact predictions
	Project proponent must explain climate change-related ***uncertainty*** and describe approaches to address it; this type of uncertainty should be understood by decision-makers.		Project proponents	Nova Scotia	Guide to Considering Climate Change in Project Development in Nova Scotia; p. 12	Unspecified
	Take into account the ***risks*** and ***uncertainties***, when assign weighting to the costs and benefits of the adaptation options, and choosing the preferred option(s) for a cost-benefit analysis.	• Undertake a cost-benefit analysis for determining the economic feasibility of proposed adaptation options, included in an Adaptation Plan.	Project proponents	Nova Scotia	Guide to Considering Climate Change in Project Development in Nova Scotia; p. 44	Impact Management
	Identify any existing environmental ***data gaps*** relevant to the proposed project; and develop a study program to address identified environmental ***data gaps***.	• Dealing with gaps in the environmental baseline data and information.	Project proponents	Yukon	Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; p. 6	Scoping (Baseline Studies)
	Described any ***uncertainties*** or public concerns.		Project proponents	Yukon	Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; p. 9	Unspecified

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Provide detailed information on the degree to which technologies being proposed are proven to be viable in northern environments, including any ***uncertainties***. Include plans for proving the feasibility of the technologies, as appropriate.		Project proponents	Yukon	Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; p. 22	Project description/ design
	Provide a list of ***sources for the information*** on the Environmental value components, including identification of the methodologies used for data collection, and identification of those components for which ***data*** is ***incomplete or missing***.		Project proponents	Yukon	Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; p. 30	Scoping (Baseline Studies)
	Clearly identify the ***lack of information*** related to traditional and cultural activity.	• As limited baseline data and insufficient information related to traditional and cultural activity can create ***uncertainty in impact predictions.***	Project proponents	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 38	Scoping (Baseline Studies)
	Identify general ***uncertainty*** related to socio-economic issues	• Responsibility of reviewers, on the request of the preliminary screeners.	Decision-makers	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 46	Screening; Review
	Make the best reasonable prediction.	• The Review Board will accept less detail and more predictive ***uncertainty*** the further in the future or the less certain the reasonably foreseeable development is	Project proponents	Northwest Territories - Mackenzie Valley Region	Environmental Impact Assessment Guidelines; p. 81	Impact predictions

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
TYPE 3	Note/report ***uncertainty*** in effectiveness of proposed ***mitigation measures***.		Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 23	Impact Management
	When discussing ***uncertainties*** related to the conceptual ***reclamation plan***, include information on the success of the proposed methods in other projects.		Project proponents	Alberta	Guide to Preparing Environmental Impact Assessment Reports in Alberta; p. 6	Impact Management
	Where the ***environmental effects are uncertain***, ***explain why*** and fully explain the factors that cause the problem and how it has been addressed in the evaluation.	For example, if a ***new process or technology*** is being proposed; discuss why the effect may vary, identify the expected range of effects, and the ***level of certainty*** of these predictions.	Project proponents	Ontario	Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario; p. 30	Impact predictions
	Clearly outline any ***assumptions*** or ***uncertainty*** surrounding the ***implementation of mitigation measures*** and the ***prediction*** of residual effects (including residual cumulative effects).		Project proponents	Yukon	Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; p. 40 & p. 47	Impact predictions; Impact Management
	Identify ***gaps*** in the initial ***impact prediction*** or ***determination of significance***	• Responsibility of reviewers, on the request of the preliminary screeners.	Decision-makers	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 46	Screening; Review

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Make clear where ***professional judgment*** has been used in ***determining impacts.***		Project proponents	Northwest Territories - Mackenzie Valley Region	Environmental Impact Assessment Guidelines; p. 30	Impact predictions
	Identify ***assumptions***, ***information gaps***, and all ***uncertainties*** related to the ***predictions***.	• For characterizing and predicting potentially significant impacts.	Project proponents	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 37-38	Impact predictions
	When determining impact significance, consider ***how certain*** are the ***predictions*** of severity and the ability to manage impacts, given mitigation proposals in place.	• Responsibility of the Review Board.	Decision-makers	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 54-55	Review (Impact Significance Evaluation)
	Be explicit regarding the level and nature of ***uncertainty*** for each ***prediction***	• e.g., provide statistical confidence intervals, or rate levels of certainty as high, medium-high, medium, medium-low, or low.	Project proponents	Northwest Territories - Mackenzie Valley Region	Environmental Impact Assessment Guidelines; p. 30	Impact predictions
	Describe the likelihood (the probability of an event) and certainty (the limits of our theoretical ***accuracy*** in predicting) for each ***predicted impacts***		Project proponents	Northwest Territories - Mackenzie Valley Region	Environmental Impact Assessment Guidelines; p. 30	Impact predictions
TYPE 4	Explain/specify the ***level of confidence*** for the significance and likelihood of the residual adverse effect ***for each prediction***.	• The ***level of confidence*** is typically ***based on expert judgment***, and should characterize the level of uncertainty associated with both the significance and likelihood determinations. • The ***level of confidence*** allows the decision-maker to better evaluate the risk associated with the project. • Where data gaps exist, the residual effect prediction may have a lower ***level of confidence***.	Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 33	Impact predictions; Impact Significance Evaluation

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Indicate what statistical ***confidence limits*** or other quantitative measurements of uncertainty were employed to describe the ***relative accuracy*** of the model.		Project proponents	Alberta	Guide to Preparing Environmental Impact Assessment Reports in Alberta; p.4	Impact predictions (Modeling)
	Indicate the ***level of confidence*** in the ***predictions*** of the effects of the project's emissions on soil quality.	• Based on the level of survey used.	Project proponents	Alberta	Guide to Preparing Environmental Impact Assessment Reports in Alberta; p. 11	Impact predictions
	Articulate the ***level of uncertainty*** associated with data and conclusions, along with the risk of serious or irreversible environmental harm associated with the project		Project proponents	Ontario	Code of Practice: Preparing, Reviewing and Using Class Environmental Assessments in Ontario; p. 27 & Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario; p. 17 & Code of Practice: Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario; p. 20	Unspecified

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Indicate the ***level of confidence*** for each ***assessment of significance***.	• For each assessment of significance of the environmental and socio-economic effects.	Project proponents	Yukon	Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; p. 41 & p. 48	Impact Significance Evaluation
	Consider the ***level of certainty*** that the mitigation will be effective.	• When the Review Board is determining if the proposed mitigation measures are appropriate.	Decision-makers	Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 56	Review (Effectiveness of mitigation measures)
	Describe the ***confidence levels*** in ***impact prediction*** and judgement in the determination of ***significance***.	• This is one of the uncertainty-related key components of the best practice principles for determining the significance of environmental effects.	Project proponents	Northwest Territories - Inuvialuit Settlement Region	Environmental Impact Screening Guidelines; p. 47	Impact predictions; Impact Significance Evaluation
TYPE 5	Select the "***worst case scenario***" of potential environmental effects.	• To increase the confidence that the predictions are applicable to any of the alternative means presented in EA.	Project proponents	Federal	Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012; p. 6	Impact predictions
	Assess the ***"worst case" impact scenario***.	• If gaps in data collection.	Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 31	Scoping (Identification of VECs); Impact predictions
	Describe potential and realistic ***"Worst Case Scenario"*** associated with the proposed development and the proposed action plan(s) to adequately control the situation(s)	• The "worst case scenario" approach was recommended for estimating of the Developer's potential liability for wildlife compensation.	Project proponents	Inuvialuit	Environmental Impact Review Guidelines; p. 46	Impact predictions; Impact Significance Evaluation

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
TYPE 6	Assess/take into consideration the effects of potential/possible ***accidents and malfunctions***	• The environmental effects of accidents and malfunctions must be considered in the assessment of cumulative environmental effects if they are likely to result from the designated project in combination with other physical activities.	Project proponents; Decision-makers	Federal	Assessing Cumulative Environmental Effects under CEAA 2012; p. 2	Impact predictions
	Identify potential ***accidents, malfunctions and unplanned events***, including the likelihood and circumstances under which these events could occur.	• That could occur in any phase of the proposed project.	Project proponents	British Columbia	Application information requirements template; Section 10: Accidents or Malfunctions	Impact predictions
	Describe the ***potential impact*** and/or consequences of the ***accidents, malfunctions and unplanned events***	• Assuming that contingency plans are not fully effective.	Project proponents	British Columbia	Application information requirements template; Section 10: Accidents or Malfunctions	Impact predictions; Impact Significance Evaluation
	Consider the ***potential effects*** that could result from ***unintentional project-related events***.		Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 31	Impact predictions
	Demonstrate how ***potential effects*** of ***malfunctions or accidents*** in relation to environmental effects have been taken into in the assessment.		Project proponents	British Columbia	Application information requirements template; Section 10: Accidents or Malfunctions	Impact predictions; Impact Significance Evaluation

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Describe how each potential ***accident, malfunction or unplanned event*** would be managed or mitigated.		Project proponents	British Columbia	Application information requirements template; Section 10: Accidents or Malfunctions	Impact Management
TYPE 7	Describe ***Contingency plans*** and ***emergency response plans***.		Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 23	Impact Management
	Propose ***contingency measures*** and ***emergency response plans***, and consider their effectiveness.		Project proponents	Saskatchewan	A Guide to Assessing Projects and Preparing Proposals under The Environmental Assessment Act, 2012; p. 13	Impact Management
	Describe special risks or hazards together with ***contingency plans*** to deal with ***emergency situations***.	• For wastes and byproducts.	Project proponents	Saskatchewan	A Guide to Assessing Projects and Preparing Proposals; p. 17	Impact Management
	Propose ***contingency plans*** to address possible impacts of the natural environment on the project, as well as other ***accidents or malfunctions*** that may occur.		Project proponents	Saskatchewan	A Guide to Developing the Terms of Reference for a Proposed Project (or 'Development'); p. 14	Impact Management

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Propose/describe in details ***mitigation measures***, including the mitigation of the unexpected events such as spills, fire, unpredictable weather (e.g., heavy rain, flooding, breakup, severe cold, drought, wind).		Project proponents	Saskatchewan	Environmental Review Guidelines for Oil and Gas Activities; p. 11	Impact Management
	Propose/describe in details ***mitigation measures***, including the mitigation of the impacts identified as being not adequately understood.		Project proponents	Saskatchewan	Environmental Review Guidelines for Oil and Gas Activities; p. 11	Impact Management
	Describe in the EIA report the ***contingency plans*** (e.g. spill notification and clean-up, evacuation, etc.) along with others ***mitigation measures***		Project proponents	New Brunswick	A Guide to Environmental Impact Assessment in New Brunswick; p. xxii	Impact Management
	Employ a ***risk management***-based approach.	• For: - identification of the vulnerability of a location or project to changing climate; - evaluation of the extent of the concern related to climate change; - assessment of the ***adaptation options***. • Due to the significant ***uncertainty*** inherent in the projection of future climate parameters.	Project proponents	Nova Scotia	Guide to Considering Climate Change in Project Development in Nova Scotia; p. 14	Scoping (Baseline Studies); Impact Management
	Consider risk management, such as ***contingency plans*** for ***malfunctions and accidents***, and ***emergency response plans***.	• During: - Site preparation and construction; - Operation and maintenance. • Specific requirement for the wind power projects.	Project proponents	Nova Scotia	Proponent's Guide to Wind Power Projects: Guide for preparing an Environmental Assessment Registration Document; p. 5-6	Impact Management

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Undertake additional evaluation and prepare specific ***contingency plans*** to be implemented if the impacts occur.	• For ***impacts*** that are ***not completely understood***.	Project proponents	Prince Edward Island	Environmental Impact Assessment Guidelines; Section 6	Impact Management
	Refer/provide ***risk management plans***, ***contingency responses***, or any other approaches to address ***accidents, malfunctions***, and ***emergency response*** measures.	• During construction phase of the project; • During operations and temporary shutdowns.	Project proponents	Yukon	Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; p. 24; p. 26 & p. 39	Impact Management
	Refer/provide environmental protection, ***contingency***, and ***monitoring plans***	• For the operations phase.	Project proponents	Yukon	Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions; p. 26	Impact Management
	Included ***contingency plans*** in proposed ***mitigation measures*** to address potential impacts, such as fuel spills, blowouts, permafrost degradation, accidents or malfunctions.		Project proponents	Northwest Territories - Inuvialuit Settlement Region	Environmental Impact Screening Guidelines; p. 53	Impact Management
	Incorporate ***contingency plans*** in mitigation and remedial measures, including ***countermeasures and adaptive managemen***t.		Project proponents	Northwest Territories - Inuvialuit Settlement Region	Environmental Impact Review Guidelines; p. 27	Impact Management

EIA GUIDELINES						
Group of Requirements/ Recommendations	**Detailed Requirement/ Recommendation**	**Goals/Conditions/Prerequisites/ Explanations**	**Responsible Party**	**Jurisdiction**	**Document**	**Stage of EIA**
	Include in a development proposal submission the outline of ***emergency response plans*** and any management and monitoring plans proposed and/or required for the development to proceed (e.g., clean-up, reclamation, disposal, decommissioning, contingency, wildlife management, adaptive management, follow-up and monitoring).	• To properly address the requirement for mitigation and remedial measures.	Project proponents	Northwest Territories - Inuvialuit Settlement Region	Environmental Impact Review Guidelines; p. 28	Impact Management
TYPE 8	Document/apply ***monitoring*** or other ***follow-up programs***.	• For addressing ***low to moderate uncertainty*** in EIA; • To confirm ***actual residual effects*** are as predicted, that mitigation measures are implemented as described in the Application, and that ***mitigation measures are effective***.	Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 34-35	Impact Management; Follow-up programs
	Apply ***adaptive management*** programs.	• To effectively manage low to moderate levels of uncertainty; • To facilitate action when ***unforeseen effects*** occur or the need for new or modified mitigation is identified.	Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 34	Impact Management; Follow-up programs
	Describe the need for and scope of ***monitoring*** or other ***follow-up programs***, including ***adaptive management*** programs.	• To address any identified uncertainty. • Explain why the follow-up programs are required; • Describe how they will be implemented.	Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 34	Impact Management
	Summarize any proposed ***follow-up programs*** (e.g., monitoring plans, contingency or adaptive management).	• As required under section 5 of the CEAA 2012; • Particularly in areas where ***scientific uncertainty*** exists in the ***prediction of effects.*** • Explain why these follow-up programs are recommended.	Project proponents	British Columbia	Application information requirements template; Appendices	Impact predictions; Impact Management

EIA GUIDELINES						
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	Outline ***monitoring programs*** for minimizing impacts during the construction and operation phases.	***Monitoring*** and ***follow-up*** studies include: • Monitoring for ***risk management, accidents and contingencies***; • Monitoring for valued ecosystem components to ensure ***unforeseen impacts*** are not occurring.	Project proponents	Saskatchewan	A Guide to Assessing Projects and Preparing Proposals; p. 18	Impact Management; Follow-up programs
	Consider ***adaptive management*** mechanism to deal with ***unforeseen impacts*** or varying degrees of impact.			Northwest Territories - Mackenzie Valley Region	Socio-Economic Impact Assessment Guidelines; p. 56	Impact Management
	Propose project-specific ***monitoring program*** to address uncertainty and to base ***adaptive management***.	• For projects with a high degree of uncertainty in impact predictions and where the ***precautionary principle*** is applied	Project proponents	Nunavut	Authorizing Agencies' Guide; p. 53; & Intervenors' Guide; p. 40	Impact Management
	Support ***adaptive management*** by requiring that ***unanticipated effects*** or changes to the magnitude of predicted impacts be identified and that mitigation measures and regulatory instruments be adapted to address ***unanticipated effects*** or ***changes to predicted impacts.***	• In developing project certificate terms and conditions.	Decision-makers	Nunavut	Authorizing Agencies' Guide; p. 48-49; & Intervenors' Guide; p. 36	Impact Management; Review and Decision
	Adopt ***audit and process evaluation measures*** to examine and transparently report on the ***accuracy of predictions***, the ***success or failure of mitigation measures.***	• In developing project certificate terms and conditions.	Decision-makers	Nunavut	Authorizing Agencies' Guide; p. 48-49; & Intervenors' Guide; p. 36	Review and Decision; Follow-up programs
TYPE 9	Conduct ***additional risk analysis***. Focus the ***addition risk analysis*** on the ***source of uncertainty*** (e.g. mitigation failure should be assessed if unproven mitigation is proposed to be implemented). Document if ***additional mitigation*** is needed ***to manage*** the ***risk and uncertainty*** identified in the additional risk analysis.	• To more fully characterize the potential risk associated with ***uncertain outcomes***. • For projects: – with ***high degree of uncertainty*** and the ***low level of confidence***; – where is a possibility of a significant residual adverse effect; and – where ***follow-up programs*** are ***not considered sufficient*** to manage the potential risk.	Project proponents	British Columbia	Guideline for the selection of valued components and assessment of potential effects; p. 34-35	Impact predictions; Impact Management; Follow-up programs

EIA GUIDELINES						
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	Request ***additional information***.	If the information provided by the project proponent is ***unclear or insufficient*** to identify ***uncertainties or risks*** associated with a project or activity.	Decision-makers	Alberta	Alberta's Environmental Assessment Process; p. 3	Review
	Review and approval may be required for the specific projects, which may involve ***new impacts*** that are not anticipated or completely addressed under existing legislation.	***New impacts***	Project proponents	Saskatchewan	A Guide to Assessing Projects and Preparing Proposals; p. 25	Screening
	Conduct a ***project review***, if project involves ***technology*** that is ***controversial*** in Yukon or the ***effects of which are unknown***	• ***New technology*** • Responsibilities of the Executive Committee.	Decision-makers	Yukon	Rules for Screenings Conducted by the Executive Committee; p. 13	Screening
	Conduct an ***environmental assessment*** if the ***potential impacts*** of a proposed development or the ***effectiveness of proposed mitigation measures are uncertain.***	• If it has been determined during the preliminary screening.	Decision-makers	Northwest Territories - Mackenzie Valley Region	Environmental Impact Assessment Guidelines; p. 18	Screening; Review
	The ***review*** for the project is required, if the project involves ***technological innovations*** for which the effects are unknown.	***Technological innovations***	Decision-makers	Nunavut	Authorizing Agencies' Guide; p. 26; Intervenors' Guide; p. 15; & Proponents' Guide; p. 15	Screening
TYPE 10	Apply a ***"negotiating" approach*** for projects with the limited information and high degree of ***uncertainty or controversy*** regarding ***potential impacts***.	• This is one of the ***uncertainty***-related key components of the best practice principles for determining the ***significance of environmental effects***.	Project proponents	Northwest Territories - Inuvialuit Settlement Region	Environmental Impact Screening Guidelines; p. 47	Impact predictions; Impact Significance Evaluation