THE STATE OF KNOWLEDGE REGARDING SIGNIFICANCE DETERMINATION

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ACRONYMS

CCME	Canadian Council of Ministers of the Environment
CEAA	Canadian Environmental Assessment Agency
CEQA	California Environmental Quality Act
EA	Environmental Assessment
EEA	European Economic Area
FONSI	Finding Of No Significant Impact
LSA	Local Study Area
NEPA	National Environmental Protection Agency
RIAM	Rapid Impact Assessment Matrix
RSA	Regional Study Area
SIR	Supplemental Information Requests
UNESCO	United Nations Educational, Scientific and Cultural Organization
YESAB	Yukon Environmental and Socio-economic Assessment Board

1. INTRODUCTION

The Yukon Environmental and Socio-economic Assessment Board (YESAB) does not have a clearly articulated approach to the determination of significance. In a 16 December 2014 briefing note, Determination of Significance, YESAB reports that there is confusion within YESAB, by First Nations, the public, and proponents about the concept of significance. Further, that YESAB does not currently have a comprehensive and coherent approach to significance determination may, in part, explain many of the criticisms directed at YESAB regarding such matters as overly demanding information requirements, the confusion regarding the regulatory *I* assessment interface, and the difficulty articulating the significance of social and economic effects.

In order for YESAB to identify an appropriate approach to significance determination, there is a need to gather the necessary information to help improve current understanding of significance and the range of approaches to significance determination. Included amongst the key information to help YESAB inform its work on guidelines and practices is a background paper on the state of knowledge regarding significance determinations. In January 2015, Aura Environmental Research and Consulting Ltd. (Aura) was contracted to undertake a state of knowledge review of significance determination.

1.1. PURPOSE AND SCOPE OF WORK

This report presents the results of a state of knowledge review of significance and significance determination in environmental assessment (EA), specifically:

i) principles and approaches promoted for determining significance; and
ii) a scan of approaches adopted for significance determinations in other jurisdictions.

1.2. APPROACH

This report is *not* a guidance document on how to determine significance; neither does it provide specific tools or recommendations on a best approach to significance determination within the context of YESAB. Rather, this is a foundational document that explores the nature of significance and significance determinations based on the state of scholarly discourse on the topic so as to facilitate YESAB's work on determining appropriate principles, approaches and developing guidance for significance determination. This report is based on, first, a review of the scholarly literature on significance and, second, a scan of approaches used in other jurisdictions for significance determinations.

1.2.1 Review of the scholarly literature

We surveyed the scholarly literature using the Scopus database - the largest abstract and citation database of research literature, covering over 19,500 peer reviewed, 400 trade publications, and

5.3 million conference papers from proceedings and journals[1]. Our search of the database was done using various combinations of the terms 'significance' and 'environmental assessment' or 'impact assessment' or 'effects assessment' appearing in a paper's title, abstract, or author-defined keywords. This combination of terms captured scholarly papers on significance within the context of environmental impact assessment, social impact assessment, and strategic and cumulative effects assessment to name a few. The scope of coverage was from 1970 to 2015.

Our initial Scopus search generated over 300 papers. We then narrowed the search to focus only on those papers of direct relevance to environmental assessment within the context of regulatory-based practice or methodological guidance. This narrowed our results to 128 papers. We thus canvassed a considerable body of literature to identify what we believe to be the most relevant papers. After a preliminary scan of all papers, we again narrowed our database and many papers were dropped since they appeared to not add much new information to the discourse. As such, there are more papers on the topic of significance than what we have included in our review. We believe that our selection of papers sufficiently captures the extant of scholarly discourse on the subject. The final database of 68 papers guided our writing process, which focused on identifying common themes or messages – the state of knowledge. Some of the papers we reviewed promote particular methods or tools for significance determination. We have included some of these papers in an electronic database accompanying this report.

1.2.2 Scan of approaches to significance determination in other jurisdictions

We conducted a scan of select EA jurisdictions to examine the range of approaches to, and interpretations of, significance. The objective was to identify a range of approaches or perspectives that exist internationally. The scan was conducted based on information available on the respective jurisdiction's website, and contained in publically available guidance materials. In some cases we contacted the jurisdiction's EA office, where information was not available publically in English.

1.3 REPORT STRUCTURE

This report is presented in three sections, including the Introduction. Section two presents principles and approaches promoted in the scholarly literature for significance determination, including common issues and themes identified by EA scholars. Section three presents the results of a scan of significance determination practices and guidance from 10 international EA jurisdictions.

An electronic database containing a selection of key scholarly papers on the topic of significance is included under separate cover.

[1] See www.scopus.com

2. PRINCIPLES AND APPROACHES PROMOTED FOR DETERMINING SIGNIFICANCE

The need for greater clarity in significance determination has been recognized in the scholarly literature since the early 1980s. Beanlands and Duinker (1983) described significance determination as *the very heart of EA* and identified the need for practical guidance for practitioners and EA participants. In recent years, scholars have shown a renewed interest in the concept of significance in EA (e.g. Weston 2000; Lawrence 2000; Lawrence 2005; Wood and Becker 2005; Wood et al. 2007; Toro et al. 2012); however, there has been only limited research on the way in which significance is determined and effectively communicated in EA practice (Wood 2008; Ehrlich and Ross 2015). As such, despite the centrality of significance in EA, methods for significance determination remain challenging, and the concept itself sometimes unclear (Ehrlich and Ross 2015). Very little has changed since Sippe's (1999) observation that"…despite the prominence of the concept around which decisions turn and the controversy which such decisions attract, the concept remains largely undefined, at least to the point of general consensus amongst decision makers" (p. 74).

Reviewing the scholarly literature on significance suggests several *truths* about significance and significance determination – principles, concepts and practices that <u>are</u> generally agreed-upon amongst the scholarly community:

- Significance determination is not a scientific exercise, and the information contained in EAs is typically not the result of a robust scientific design, but this does not mean that significance determinations should be arbitrary or lack transparency.

- Significance determinations are always made based on incomplete information and under uncertain conditions, and the assumptions on which significance determinations are made are often neither examined nor explained.

- The concept of what is significant is highly subjective and varied based on the values and perceptions of different stakeholders.

- The term 'significance' is used in different contexts (e.g. statistical significance, ecological significance, regulatory significance, social/cultural significance), and there is no accepted interpretation of significance or standard methods for significance determination that will work for all projects or for all impacts.

- Significance is highly context dependent and what is considered significant in one context, or at one particular place and time, may not be so at another.

- Significance is dynamic and its interpretation changes throughout any EA process from determining whether a project requires assessment, to determining what is significant enough to scope into an assessment, to determining whether impacts post-mitigation are important, to determining whether actual impacts realized through monitoring actions warrant a response.

- There is a need for better clarity in significance determination processes, including transparency in how significance determinations are made

Sources: Beattie 1995; Haug et al (1984); Ehrlich and Ross (2015); Lawrence 2000; Lawrence 2005; Cheney and Schleicher (1985); Glasson et al. (2012); Noble (2015); Canter and Canty (1993); Toro et al (2013); Kjellerup (1999); Sadar (1996); Gibson et al. (2005); Sippe (1999); Lyhne and Kørnøv (2013); Wood and Becker (2005); Wood (2008); Beanlands and Duinker (1983); Briggs and Hudson (2013).

2.1 BASIC COMPONENTS OF 'SIGNIFICANCE'

Significance determination has long been noted as the most critical element of EA (Duinker and Beanlands 1986), yet the evaluation and communication of significance remains one of the most contested components of EA practice (Wood 2008). Reviewing significance determinations under the US NEPA, Haug et al. (1984) observed that regulations "provide no clear definition of significance that can be applied objectively and uniformly to environmental issues and the consequences of man's activities" (p. 16). This is not unique to NEPA, as Lawrence (2005) suggests that clear and unequivocal good practice significance determination standards are unlikely to emerge in the foreseeable future and argues that a necessary first step is greater clarity regarding the basic characteristics of significance determination activities.

That said, based on our review of the literature there appears to be two common, though variably defined, components to significance and thus significance determination in EA: *first,* the characteristics of the impact (e.g. magnitude, spatial extent, duration, etc.); *second*, the context within which those characteristics are viewed and interpreted (e.g. regulatory, social, ecological, sustainability, etc.). For example:

- Canter and Canty (1993): "significantly", as used under NEPA, requires considerations of both intensity and context – whereby intensity refers to the severity of the impact.

- Kjellerup (1999): significance always comprises at least two elements - that which can be measured, which is often referred to as the *magnitude*, *duration*, or *extension* of the measured phenomenon; and the link between the natural, measurable data and the human world, or the social dimension of environmental impacts, often referred to as *importance*.

- Sadar (1996): the first stage of significance determination is based on scientific and/or specialized knowledge, and the second stage is concerned with the relative values of society, or segments of it, which is not necessarily based on scientific knowledge.

- Gangolells et al. (2011): impacts are measured according to their severity, which is related to the magnitude of the change or the size of the impact, however, severity does not always equate

with significance, which is related to the importance placed (by experts or by the public) on the magnitude of the impact.

- Antunes et al. (2001): impact magnitude is the difference in environmental quality, or in the state of a resource, between the with- and without-project situations, while significance is the importance that is given (by the experts or by the public) to that difference.

- Ehrlich and Ross (2015): technical experts are usually engaged in analyzing impact characteristics such as geographic extent, magnitude, etc. (typically described as the technical bases for significance determinations), but whether the predicted change is acceptable, is not a strictly scientific judgment.

2.1.1 Characterizing potential impacts

Andrews et al. (1977), in a report to the Institute of Ecology, proposed several standardized criteria for characterizing impacts in aid of significance determinations during the EA process, namely:

- magnitude of the impact;
- spatial extent of the impact;
- duration of the impact;
- probability of occurrence of the impact; and
- confidence in the impact prediction.

Although these characteristics vary from one jurisdiction to the next, and from project to project, they have found their way into international and Canadian EA systems as fundamentals in significance determination. For example, the US Army Corps of Engineers (see Canter and Canty 1993) have developed a suite of standardized review questions for characterizing impacts, based on Andrews et al. (1977), for the purpose of assessing significance, including whether the impacts are:

- beneficial or detrimental;
- naturally reversible or irreversible;
- repairable via management practices or irreparable;
- short-term or long-term;
- temporary or continuous;
- expected for the construction or operational phase;
- local, regional, national, or global;
- accidental or planned (recognized beforehand);
- direct or primary, or indirect or secondary; or
- cumulative or single.

Under Nova Scotia's Environment Assessment Regulations, made under sec 49 of the *Environment Act*, "significant" is similarly defined as an adverse effect that could occur as a result of its magnitude, geographic extent, duration, frequency, reversibility, or possibility of occurrence (sec 2(1)(l)(i-vi). There are many other examples of EA guidance that identify impact characteristics to aid in significance

determination, which typically include this common suite of impact characteristics. For example: The European Commission (2001); Mackenzie Valley Environmental Impact Review Board (2004); Glasson et al. (2012); The United Nations Environment Programme - Sadler et al. (2002); and the US California Environmental Quality Act 2005, s. 1508.27. In the Canadian federal context, magnitude, geographic extent, duration and frequency, reversibility and ecological context, have long been used as guidance for significance determination in EA, and persist under current Canadian Environmental Assessment Agency (CEAA), 2012 guidance.

The use of impact categorization has become the boilerplate in EA for significance, yet the approach has brought little resolution to the challenges and complexities of significance determination. The scholarly literature does not conclude that there is anything inherently *wrong* with using this suite of criteria as an aid to characterizing impacts, but it does clearly identify two fundamental limitations to relying solely on impact characterization for significance determinations:

First, the criteria used for impact characterization are often poorly explained, contradictory or there is insufficient assessment to determine what is significant

Antunes et al. (2001) report that when an impact scale is used for significance determinations, the impacts are often classified on that scale by experts, considering simultaneously factors such as magnitude, extension of the affected area, sensitivity of the resources, time frame of the impacts, and affected population, without making explicit the rules used for that classification. The result is that the determinations can be difficult, if not impossible to validate or replicate. Wood (2008), Byron et al. (2000), and Thompson et al. (1997) report similar problems with the lack of justification for the level of significance assigned to impacts and the clarity and transparency with which the significance of each impacts are indicated. Briggs and Hudson (2013) report that the determination of significance is in danger of becoming too prescriptive and simply becoming a "handle-cranking" exercise for consultants.

In the European context, Wood (2008) reports on how significance is typically addressed and communicated in a sample of EAs for the valued component, landscape. Two common types of impact characterizations were identified, synthesized here for brevity. In the first approach, using an example of impact magnitude and sensitivity (Figure 1), Wood reports that the level of detail supplied in the descriptors is minimal and, fundamentally, it is not clear what is meant by, for instance, a "moderate" change or "moderate" value, and to whom. Wood suggests that when relying upon a single language or term in the final assessment of significance, a typical characteristic of this type of approach, variance in meaning and interpretation remain deeply entrenched. This results in a final significance determination that is not only open to multiple interpretations, but which is inherently simplistic and with no 'benchmarking' to the more detailed context of the proposal, the environmental setting, or the expert assessor's professional frame of reference.

		LANDSCAPE SENSITIVITY		
MAGNITUDE OF CHANGE		**Low**	**Medium**	**High**
	High	Moderate impact	Substantial impact	Substantial impact
	Medium	Slight impact	Moderate impact	Substantial impact
	Low	Slight impact	Slight impact	Moderate impact

Figure 1. Significance thresholds for landscape receptors (Wood 2008)

In the second common type of approach Wood identified (Figure 2), he concludes that there is no formal attempt to draw together various levels and/or combinations of impact magnitude and receptor sensitivity and instead the emphasis is upon providing definitions of the final impact significance criteria. Wood reports that these definitions of significance provide more detailed insights into the factors that informed the assessor's frame of reference; however, the lack of any explicit framework for combining varying degrees of sensitivity and magnitude reduces transparency.

Major Where the extent of the impact on landscape character is large in scale or magnitude as a result of high sensitivity to change or a high intrinsic value and as a consequence the integrity of that asset will be significantly changed. The impact is of national or regional importance, and will be of long term nature (or very severe short term), irreversible and certain or likely to occur.
Moderate Where the extent of the impact on landscape character is small in scale or magnitude as a result of low sensitivity to change or a low intrinsic value. The impact is of district importance. The impact will be of medium or short-term nature and likely to occur.
Negligible Where the extent of the impact on landscape character is barely noticeable in scale or magnitude as a result of low sensitivity to change or a low intrinsic value. The impact is of local importance. The impact will be of short-term nature and unlikely to occur.

Figure 2. Impact significance criteria (Wood 2008)

Wood (2008) concludes that the sole use of such criteria for characterizing impacts, as shown in these two examples, “has the merit of simplicity” but “this can come at a considerable cost in terms of the degree of transparency achieved.”

These problems are also evident in the Canadian context. In 2013, for example, the Joint Review Panel for the Ontario Power Generation’s deep geological repository project was highly critical of the lack of transparency in significance determinations and required that Ontario Power Generation revisit its significance determination process. The Panel specifically directed that Ontario Power Generation avoid the use of arbitrary categorization of impacts (e.g. low/medium/high) in favor of narrative reasoning that is supported by literature citations and examples from comparable projects. The Panel further recommended that the context for magnitude, for example, include references to the toxicological

literature, risk quotients, or population and community monitoring and modeling from comparable projects, which have similar effects on the biophysical environment or upon Aboriginal interests.

Barnes et al. (2012), writing from the perspective of consultants and practitioners of EA in Canada, are quite clear on the limitations of impact characterization and associated 'scoring' approaches for significance determinations:

> "There are some practitioners who have and continue to base significance determination on a numeric system or ordinal score… There is great risk in such efforts as the scores are often qualitative and poorly supported with rationale. Further, that an environmental effect is of high magnitude (e.g., a 3 on a scale of 1 to 3) or frequent (e.g., continuous and therefore a 5 on a scale of 1 to 5) may not be an indication that it is in any way unacceptable. The summing of such rankings can result in a meaningless high score having little bearing on the significance of the environmental effect. Efforts to codify or template environmental assessment and significance determination in this way are distressing. In the hands of novices these practices can lead to incorrect EIA conclusions and consequent regulatory or project risk."

The current CEAA, 2012 guidance "Criteria for Deciding Whether Environmental Effects are Significant" is clear that the criteria that should be used to inform the consideration of whether the environmental effects of a designated project are significant, but how each criterion is defined and used in the context of a specific valued component may vary and should be clearly documented and rationalized.

Second, impact characteristics such as magnitude, spatial extent or duration are of little use for determining significance in absence of context that illustrates the importance of the impact or the affected component.

> "In our experience, we have observed that technical experts are usually engaged in analysing impact characteristics such as impact geographic extent, magnitude, etc. (typically described as the technical bases for significance determinations). For example, a biologist may predict that a valued component may be affected to a certain degree, over a certain area, over a certain time, with a certain probability. We suspect, however, that if you were to ask that biologist the crucial question of whether or not the predicted change is acceptable, the biologist should respond that the answer is not a strictly scientific judgement." Ehrlich and Ross (2015: 88)

The complexity of significance is exacerbated by context, comprising issues of social and cultural values, ecological sensitivity, economic goals, and institutional and political interests. Baker and Rapaport (2005) suggest that the evaluation of significance based strictly on scientific data (e.g. species populations, habitat metrics, emissions levels) is inadequate in many cases because technical and quantitative approaches often do not capture issues of social or cultural significance. Rowan (2009) agrees, suggesting that characterizing impacts to attribute major, moderate or minor levels of significance all make sense and are useful, but it is important that there is a human element. This human element, or subjectivity, cannot be avoided in significance determinations. Subjectivity arises from the value placed on a receptor (species or habitat) of an impact; it is dependent on the value society places on it (Briggs and Hudson 2013).

This is a view reflected by Canter and Canty's (1993) earlier observations of the US NEPA system, suggesting that such characteristics as size, type, complexity, duration or intensity may be considered as the *impact basis*, which must then be subject to further contextual considerations. Under the US NEPA system, this further assessment is often based on existing guidelines and regulations and based on the discretion of the decision maker (Table 1).

Table 1. Contextual considerations (Canter and Canty 1993)

Impact basis	**Contextual considerations**	
	Guidelines and regulations	**Discretion of the decision maker**
▪ Size ▪ Type: adverse, beneficial, direct or indirect ▪ Complexity ▪ Duration ▪ Intensity	▪ Mandated significance ▪ Categorical exclusion ▪ Established laws or policies	▪ Sensitivity of issue or project ▪ Importance of issue or project ▪ Controversial ▪ Executive authority ▪ Landuse conflict ▪ Precedence setting ▪ Short-term vs. long-term use

2.1.2 Understanding context and the importance of impacts

There is clear consensus in the scholarly literature that context, including value judgments, are, and should be, an important part of significance determinations in EA. Context plays a critical role in significance, and significance determination is described by some as a highly context-sensitive task (Cherp 1983). Beanlands and Duinker (1983) assert that impacts are ultimately measured on the yardstick of human values, and that any comprehensive definition of a significant impact in EA must reflect this value judgement. The magnitude of an impact, for example, concerns the measured difference in an environmental parameter with-versus-without a proposed project; significance relates with the importance assigned to that difference by experts, society, decision makers, etc. (Kennedy and Ross 1992; Duinker and Beanlands 1986). Haug et al. (1984, p. 18) similarly separate the values associated with a predicted impact (referred to as the to as the *meaning* of the impact) from the characteristics of the impact (referred to as the *fact* of the impact).

> "The fact of an environmental impact is the change itself, its magnitude, direction, units, and the estimated probability that it will occur. The meaning of an environmental impact is the value placed on the change by different affected interests. It is the answer to the question: If this impact occurs, so what? The 'so what?' determines how important or 'significant' an environmental issue is, and to whom." (Haug et al. 1984, p. 18)

Ehrlich and Ross (2015) explain that context, in particular applying values to make significance determinations, does not replace considerations of the detailed characteristics of a predicted impact but necessarily compliments such information. They go on to suggest that subjective judgment, informed by a body of evidence and reflective of societal values "…is not only credible, but it is in fact a mainstay of some of the most important decisions made in society [and] the same principles lie at the heart of significance determinations…" Canter and Canty (1993) suggest that the significance of an action must

be analyzed in several contexts, such as society as a whole (human, national), the affected region, the affected interests, and the locality. Guidance under CEAA 2012 is also explicit on the importance of context and values in significance determination:

> "Significance depends on the context within which impacts occur. Considerations may include; whether the VC [valued component] is a unique characteristic of the area (e.g., park lands, ecologically critical areas, valuable heritage resources); how the unique values or customs of a community influence the interpretation of an environmental effect; or the importance of the VC to functioning of the ecosystem, ecological community or community of people, depending on the VC under consideration."

2.2 CONTEXTUAL FACTORS OR PRINCIPLES USED TO UNDERSTAND AND INTERPRET SIGNIFICANCE

Based on our review, several common themes or context-based considerations have been proposed to inform significance determinations. In our view, these are what we believe to be the dominant context-based considerations in significance determination. We do not claim these to be the *only* considerations, and there may be other (even better) ways to classify them. Different scholars from different fields tend to place more or less emphasis on particular approaches. In our view, this list addresses increasingly complex and subjective issues, but certainly no less important ones. We found no single piece of scholarly work that captures all of these, and there is no general consensus as to whether any one is more important than the others. However, Haug et al. (1984) do suggest a priority in the types of criteria used to determine significance: legal thresholds (e.g. laws, regulations) – functional thresholds (e.g. science, ecological limits) – normative thresholds (e.g. social values, acceptable levels).

2.2.1 Legal or regulatory designations or standards

Predicted effects or impacts following mitigation are often compared against environmental standards or regulations—in essence, specified thresholds (Noble 2015). We observed standards and regulations to be amongst the most commonly referenced context-based approach to significance determination, whereby impacts within specified standards or that do not exceed certain regulatory limits are deemed to be insignificant in comparison to impacts that do exceed standards or limits. Such standards or limits may include, for example, Canadian Council of Ministers of the Environment (CCME) water quality guidelines for the protection of aquatic life (CCME 2002), or critical habitat thresholds for caribou populations (Environment Canada 2012). Lawrence (2004) suggests three types of standards or regulatory limits typically used for significance determinations:

- *Exclusionary* - leads to automatic rejection of a proposal
- *Mandatory* - leads to a mandatory finding of significance

- *Probable* - normally significant but subject to confirmation

Guidance for significance determination under CEAA, 2012 similarly indicates that the most common method of determining whether the adverse environmental effects of a project are significant is to use environmental standards, guidelines, or objectives. The guidance indicates that if the level of an adverse environmental effect is less than the specified standard, guideline, or objective, it may be insignificant. If, on the other hand, it exceeds the standard, guideline, or objective, it may be significant.

According to Ehrlich and Ross (2005), an impact should be identified as significant if it exceeds a government-determined limit or does not meet a specified regulatory standard; but the corollary is not necessarily true – an impact may well be within a determined objective, regulation or standard, yet still be significant for other reasons. That an impact does not meet a specified level is not alone sufficient reasoning to deem it insignificant. This was the case argued by Noble and Gunn (2013) in their analysis of Manitoba Hydro's Keeyask generation project. The project's contribution to critical habitat loss for caribou within the project's study area was considered to be within the critical habitat limits as identified by Environment Canada, but any such loss of habitat caused by the project was considered by local Aboriginal populations a significant impact due to potential changes in the distribution of caribou and access to local caribou populations. Compliance with legislation or regulations is not alone a sufficient criterion on which to determine the significance of an effect.

2.2.2 Ecological limits or thresholds

Duinker and Beanlands (1986) suggest that ecological limits or functioning is probably the most difficult interpretation of impact significance on which to develop consensus amongst experts – including the scientific community. Amongst those ecological impacts identified in the scholarly literature that are typically considered significant are those that result in some irretrievable loss of ecosystem components within specified time and space boundaries – including irreversible reductions in primary productivity, the loss of a population, a reduction in genetic variability, or loss of a species (Duinker and Beanlands 1986; Cooper and Zedler 1980; Longley 1979).

Squires and Dube (2012), however, caution that ecological thresholds themselves are of little value for determining significance if they are not linked explicitly to a decision-making process so that if a threshold is approached or exceeded, decision makers know the action they will take. They also note that in today's regulatory environment, thresholds are often called benchmarks. The term threshold usually implies that sufficient scientific knowledge exists to understand when the assimilative capacity of an ecological receptor has been exceeded – such scientific knowledge does not exist for many ecological components. Further, Dube et al. (2013) report that although many thresholds are identified in land use frameworks or planning and policy documents, most such frameworks and documents identify thresholds that are not consistent with those that are actually monitored by the scientific community, industry or regulators, and often have no association to stressor-based development thresholds (Government of Alberta 2008, 2012; Environment Canada 2011).

Most definitions of ecological limits require the use of some non-ecological standard against which to interpret the severity of the impact (Duinker and Beanlands 1986). Ehrlich and Ross (2015), for example, argue that the assertion if an impacted population persists than the impact on that species is not ecologically significant, and therefore there should be a finding of no significant impact, is not reasonable because it excludes the societal values that a local human population may place on the species or biological community. Ehrlich and Ross (2015) state: "While ecological significance must play an important role in determining significance of an impact…, we believe it must not be the only determinant, as societal values should also play an important role in determining what is significant in the overall assessment of a project…" Piper (2002) reflects a similar viewpoint, noting that, traditionally, thresholds have not been based on ecological limits per se, but more commonly on public perceptions of risk.

2.2.3 Vulnerability

The concept of vulnerability (or resiliency) was found to be a relatively recent concept in discussions about significance determination in EA. The focus of attention tended to be on the vulnerability of social systems (or components) or the vulnerability of ecological systems (or components). We found little discussion of socio-ecological vulnerability within the context of significance determination in EA, even though socio-ecological vulnerability is a widely used concept in the scholarly literature outside the EA field (e.g. Adger 2000; Cutter et al. 2003; Folke 2006). An exception was Toro et al. (2012), who propose a method for determining vulnerability importance in EA based on a combination of physical and social indicators and using quantitative and qualitative approaches. Toro et al. (2012) explain that vulnerability can thus be measured by a series of parameters related to the stress to which the factor is exposed because of pre-existing impacts, environmental pollution, vulnerable rare species, sensitive populations, or another type of stressor that reduces the resilience of the socio-ecological system.

Generally, we found that those scholars promoting social vulnerability as a consideration in significance determination tend to focus on such matters as age, income, race or culture – characteristics that determine the relative sensitivity (or vulnerability) of an individual, community or group affected by a development action (e.g. Burdge et al. 1995; Annadale 2001). Rowan (2009), for example, introduces the concept of vulnerability for assessing the sensitivity of social receptors, arguing that people's capacity to cope with change ultimately reflects their vulnerability and, hence, the significance of an impact. The basic notion of vulnerability in social assessment is that some groups are able to adapt more quickly and make use of opportunities arising from infrastructure projects, and other groups are less able to adapt and will bear more of the negative consequences of change (Slootweg et al. 2003). Rowan (2009) thus recommends the need to consider whether impacts will increase or reduce vulnerability by the creation or deletion of landlessness, joblessness, homelessness, marginalization, food insecurity, and so on.

Scholarship focused on ecological vulnerability captures similar concepts. Wood (2008), for example, suggests that the ecological context plays an important role in that a relatively small impact in an ecologically sensitive environment may be considered to have a more significant impact than a far larger

impact located in a more robust setting. Noble (2015) characterizes this relationship as one of vulnerability vs. irreplaceability, suggesting that effects on rare or threatened plants, animals, and their habitat, or on particularly vulnerable species or components of the natural environment that are also irreplaceable in terms of ecological functioning (or in terms of their use value to local communities or cultures), are more likely to be deemed significant impacts than impacts to those components that are not vulnerable or whose functions or roles can be replaced or substituted (Figure 3).

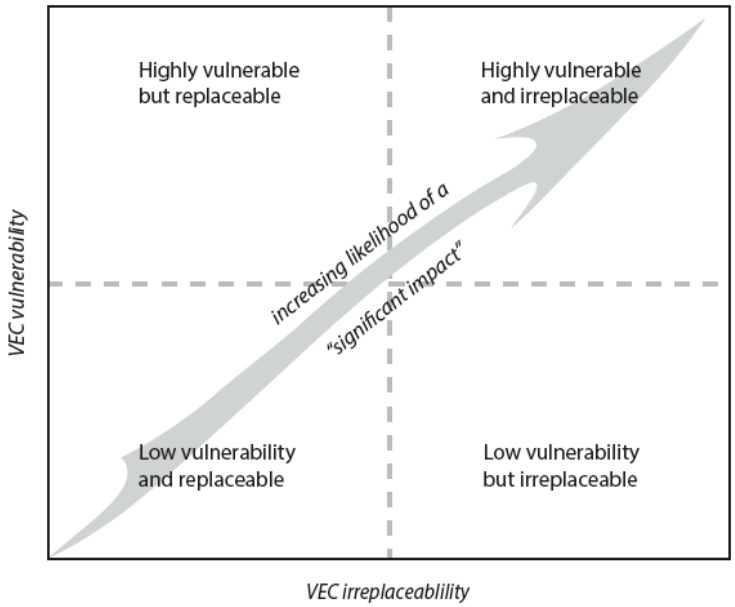

Figure 3. Vulnerability and irreplaceability as context for significance determination

2.2.4 Political context or importance

Weston (2000) suggests that significance-based decisions in EA are "inherently based upon value judgments" (p. 200), and that these value-based decisions will inevitably rely upon, among other things, political context. Toro et al. (2013), for example, refer to the "importance of the project" as one such political determinant in determining whether its impacts are significance. Wood (2008), similarly reports that, for political and economic reasons, a community dominated by high unemployment may be more supportive of controversial development proposals with significance adverse impacts than comparable areas with full employment.

Although political context was often referred to in the literature we reviewed, there was very little explanation or guidance on how to apply this in significance determination. There were some exceptions found in the grey literature. In Ministerial guidance prepared for Aboriginal Affairs and Northern Development Canada for decision under the Nunavut Land Claims Agreement, for example, Noble (2011) recommends several factors that comprise significance determinations that may be considered *political* determinations, including whether the project or its impacts:

- adversely affects matters of sovereignty;
- poses a risk to national security;
- contravenes commitments to international treaties and conventions on such matters as biodiversity or emissions;
- causes trans boundary pollution effects to the coastal or marine environment;
- violates or interfere with Aboriginal treaty rights or land claims agreements;
- are inconsistent or incompatible with authorized policies, land use plans or priorities;
- affects or is likely to affect a structure, feature, place, or area of provincial, territorial or national significance; or
- will generate emissions, wastes, or by-products for which no current regulation or known impact management measures exist.

2.2.5 Cultural context and recognized and expressed rights

Several scholars, particularly in the Canadian context, have addressed First Nations and other Aboriginal rights and practices and their role in EA. That said, aside from legal scholarship focused on the infringement of Treaty rights, or reports from practice[2], there are very few papers that *specifically focus* on matters of significance and significance determination in EA in relation to Aboriginal cultural contexts. Within the scholarly literature, Booth and Skelton (2011) report on the challenges faced by Aboriginal peoples in the EA process, and make specific reference to cultural identity. Concerning the West Moberly First Nation's experience with First Coal Corporation in northwest British Columbia, for example, Booth and Skelton report that not only are the project's potential impact to caribou of significant biodiversity concern, but that impacts to caribou and caribou habitat are significant to who the Moberly are as a Mountain Dunne-za people. Although no specific reference in made to guidance for significance determination, an implied relationship is made between impacts to resources, cultural value placed on those resources, and interpretations of significance.

In examining the grey literature, similar perspectives emerge. In a recent analysis of the significance of the impacts of Spectra Energy's proposed west coast connector project on the Blueberry River First Nation, for example, Noble (2014) proposed that impacts (e.g. disruption to riparian habitat, terrestrial habitat, traditional use and access constraints) that potentially affect the First Nation's ability to use traditional lands and derive benefit (e.g. sustenance, cultural, spiritual, economic) as constituting significant adverse effects on the First Nation. Similarly, in Aboriginal Affairs and Northern Development Ministerial guidance for EA under the Nunavut Land Claims Agreement, included under guidance for significance determinations for the Inuit are whether a project or its impacts will:

[2] For example, assertions of significance based on cultural and spiritual values were posed by the Sambaa K'e First Nation, concerning the impacts of a proposed Imperial Oil Joint Ventures pipeline on the Traynor Lake watershed. The MVEIRB stopped short of disallowing the project, but imposed several management measures based on the concerns.

- pre-empt the use of a natural resource in such a way that will adversely affect the well-being and self-reliance of future generations of the Inuit and other residents of the designated area; or
- affect ecosystem functions in such a way that will adversely affect the well-being and self-reliance of future generations of the Inuit and other residents of the designated area.

2.2.6 Social (public) values and acceptability

Ehrlich and Ross (2015) argue that there is a sound theoretical basis for applying societal values in significance determinations, and best practice includes doing so. Sippe (1999) claims that significance determination in EA uses judgments and values equally, or to a greater extent than, science-based criteria and standards, and goes so far as to assert that the adaptability of the concept of significance to sociopolitical contexts (including values) has been an important part of the international success of EA. We identified social (public) values in our categorization as a *catch-all* – recognizing that each of the above context-based considerations inherently involves some consideration of values.

The majority of literature we surveyed recognized the importance of values in significance determination (Duinker and Beanlands (1986); Gibson et al. (2005); Ijäs et al. (2010); Kotchen and Reiling (2000); Lawrence (2007); Rowan (2012); Sadar (1996); Sadler (1996); Smith et al. (2003); Stern et al. (1993); Weston (2000), Weston (2004)). Much of this did so with reference to the notion of *acceptability* – what is considered by an affected group, community or segment of society to be an acceptable impact or an acceptable level of change (e.g. Beanlands and Duinker (1983); Haug et al. (1984); Sippe (1999); Sadler et al. (2002); Gibson et al. (2005); Lawrence (2007); Glasson et al. (2012)). Noble and Storey (2005), for example, in their review of follow-up and thresholds for the Hibernia offshore oil project EA, report that *maximum allowable effects levels* were determined as part of the social impact assessment process. Communities were involved in setting such levels and for local crime rates, for example, the community established a 0% increase above the current baseline level as the maximum allowable effects level for crime rates due to increased temporary worker-community interactions. Any predicted increase above this level was thus deemed a significant impact and required appropriate mitigation.

The consideration of values or *what is acceptable* is consistent with the International Association for Impact Assessment's Principles of Environmental Impact Assessment Best Practice, which states that the evaluation of significance involves determining the importance and acceptability of impacts (Senecal et al. 1999). Weston (2000) cautions that environmental quality is subjectively experienced and thus the significance of impacts depend upon the value society places upon a particular environmental receptor at a particular point in time. Wood (2008) further explains that when determining significance it is thus important to consider the diversity of values that exist – not relying simply on the values of the regulator, the practitioner or the decision maker. Social values are characterized by plurality, and not simply in terms of the different perspectives of individuals and agencies regarding the desirability of change, but also with respect to values that surround different ethical positions. This was particularly evident in the literature concerning Aboriginal values, whereby seemingly insignificant changes in wildlife habitat or habitat size, for example, may be seen as significant impacts culturally and morally

(e.g. Adger et al. 2004). Perception about what is significant can thus differ greatly, depending on the personal values and attitudes of the interested parties (Torro et al. 2012).

2.2.7 Contributions to, or detractions from, sustainability

Finally, some scholars have suggested that significance determination must consider broader, longer-term sustainability-based criteria. Gibson et al. (2005), for example, provide a package of sustainability-based criteria and trade-off rules for evaluating significance. These criteria draw on Gibson's earlier work (2001), which is the most frequently cited guidance for sustainability-based significance determinations. Gibson (2001) suggests that significance determination is about asking whether a project's impacts make a positive contribution to or detract from sustainability. The 12 generic sustainability-based questions proposed by Gibson for evaluating the significance of environmental impacts are as follows:

- Could the effect add to stress that might undermine ecological integrity at any scale in ways, or to an extent, that could damage life-support functions?
- Could the effect contribute to ecological rehabilitation and/or otherwise reduce stress that might otherwise undermine ecological integrity at any scale?
- Could the effect provide more economic opportunities for human well-being while reducing material and energy demands and other stresses on socio-ecological systems?
- Could the effect reduce economic opportunities for human well-being and/or increase material and energy demands and other stresses on socio-ecological systems?
- Could the effects increase equity in the provision of material security, including future as well as present generations?
- Could the effect reduce equity in the provision of material security, including future as well as present generations?
- Could the effect build government, corporate, and public incentives and capacities to apply sustainability principles?
- Could the effect undermine government, corporate, or public incentives and capacities to apply sustainability principles?
- Could the effect contribute to serious or irreversible damage to any of the foundations of sustainability?
- Are the relevant aspects of the undertaking designed for adaptation if unanticipated effects emerge?
- Could the effect contribute positively to several or all aspects of sustainability in a mutually supportive way?
- Could the effect in any aspect of sustainability have consequences that might undermine prospects for improvement in another?

A sustainability-based context was recently used by a federal-provincial joint review panel in its evaluation of the significance of the Kemess North Copper-Gold Mine Project, British Columbia. In conducting its assessment, the panel consulted mining sector sustainability initiatives and examined the

significance of the project's effects from five key sustainability perspectives: environmental stewardship, economic benefits and costs, social and cultural benefits and costs, fairness in the distribution of benefits and costs, and present versus future generations. The panel recommended to the federal and provincial governments in 2007 that the project not be approved as proposed, noting that "the economic and social benefits provided by the project, on balance, are outweighed by the risks of significant adverse environmental, social and cultural effects, some of which may not emerge until many years after mining operations cease."

In some respects, the sustainability-based context simply captures the full range of considerations identified above under the previous context-based considerations (sec 2.1. 1 – 2.2.6). However, Barnes et al. (2012) express serious reservations about the use of sustainability-based approaches for significance determination. They argue that it is not reasonable for a project proponent to be subjected to policy debates around the broader sustainability of a project. They use the illustration of an application for a natural gas development project, arguing that it is unfair to evaluate or prohibit a proponent from proceeding with a project on the basis of some discussion or evaluation related to the sustainability of hydrocarbon as an energy source or to debate energy policy in general. Barnes et al argue that project EA is not the forum for such policy debate.

2.3 APPROACHES TO SIGNIFICANCE DETERMINATION

There are many guidelines describing criteria for significance determination, but there remains limited guidance to reach significance determinations. In our review, we observed many methods, techniques and frameworks for addressing significance determinations in EA. Thompson (1990), for example, identified 24 different methods or frameworks, but at the same time cautioned that there is no universal method and that the unique nature of the project and local or regional context play an important role in determining how to approach significance determinations.

Lawrence (2005) provides a useful, and broadly accepted, conceptualization of the range of approaches that exist to significance determination in EA, namely technical approaches, reasoned argumentation, and composite approaches. We capture these here, briefly, but defer to Lawrence (2005) for detailed descriptions.

2.3.1 Technical approach

Determining significance typically involves adopting one or more standardized scaled or quantified methods, each of which is based on some characterization of the various dimensions of the anticipated impacts of development, such as impact scale, severity, reversibility, probability, and duration. The technical model captures the most widely used set of standardized methods for significance determination, and adopts such commonly used methods and tools as weighting and scoring, cost-benefit analysis, ranking, impact magnitude matrices, multi-criteria evaluation and fuzzy sets to name a few (see Cloquell-Ballester et al (2007); Ijas et al. (2010) Rapid Impact Assessment Matrix (RIAM); Wood

et al. (2007) fuzzy sets; Ying and Liu (1995) weighting. Examples of technical approaches are also presented in Noble (2015). Thompson (1990), however, concludes that approaches to significance determination that proceed from assigning scores or values through to full aggregation of impacts to derive a final significance score should be avoided. Such approaches may be useful for a practitioner's 'in house' evaluation, but they are *not* recommended for communicating impact significance. Thompson goes on to note that arbitrary weighting schemes that are the product of assessment-team preferences should be avoided, unless they are complemented by a similar weighting scheme that are the product of affected public interests.

2.3.2 Reasoned argumentation

Significance determination is based on reasoned judgments. Lawrence (2005, p. 19) explains that reasoned argumentation starts from the premise that technical models are "too narrow to provide an adequate foundation for value-based significance judgments about what is important and what is not important." Reasoned argumentation is usually qualitative. Such examples might include the arguments presented based on regulatory standards or legislation, which establish certain objectives or priorities, often defining "matters of significance." These are typically used as triggers during the screening process, as opposed to determining the significance of predicted effects during the EA process per se.

For example, New Zealand's *Resource Management Act* 1991 considers issues of national significance when determining the need for an EA. The Act does not define what national significance means, but it does provide indicative guidance (sec. 142, 3) as to the factors that the Minister may consider when making his or her decision, including whether the proposal:

- has aroused widespread public concern or interest regarding its actual or likely effect on the environment (including the global environment);
- involves or is likely to involve significant use of natural and physical resources;
- affects or is likely to affect a structure, feature, place, or area of national significance;
- affects or is likely to affect or is relevant to New Zealand's international obligations to the global environment;
- results or is likely to result in or contribute to significant or irreversible changes to the environment (including the global environment);
- involves or is likely to involve technology, processes, or methods that are new to New Zealand and that may affect its environment;
- is or is likely to be significant in terms of section 8 (referring to certain existing uses of land that is protected);
- will assist the Crown in fulfilling its public health, welfare, security, or safety obligations or functions;
- affects or is likely to affect more than 1 region or district; or
- relates to a network utility operation that extends or is proposed to extend to more than one district or region.

In Saskatchewan, Section 2(d) of *The Saskatchewan Environmental Assessment Act* identifies pre-empting the use, or potential use, of a provincial resource as a matter of significance and a trigger for EA application. The term pre-emptive use is not defined in the provincial Act, but it is broadly interpreted in practice to mean 'acquiring in advance to the exclusion of others.' It is implied under the Act, though not explicitly stated, that a project proposal that would pre-empt the use of a provincial resource for future generations (i.e., significantly degrades the quality of a natural resource (e.g., water) or completely exhausts a natural resource (e.g., forested area) such that future use is excluded) is not in the provincial interest.

Noble (2015) asserts that the reasoned argumentation model is flexible and responsive to context; however, a well-reasoned argument for significance does not ensure that full consideration has been given to scientific data, public values, or existing technical information. The approach is typically limited to significance determinations when triggering an EA, or during legal challenge. In our review of the scholarly literature, we found no guidance, framework or examples of significance determination during the EA process (e.g. for assessing the significance of potential impacts) that was based *solely* on reasoned argumentation.

2.3.3 Composite approach

Technical analysis, using conventional significance determination methods, is supported by public consultation or traditional knowledge systems, which together, based on existing EA regulation or land-use plans, compile a reasoned argument for significance. The composite approach consists of various combinations of technical, collaborative, and argumentative approaches. Lawrence (2005) suggests that, at minimum, effective impact significance determination relies upon:

- use of a variety of technical methods and analytical techniques;
- a range of public consultation methods, including methods that facilitate stakeholder interaction, to support collaborative significance determination;
- use of existing regional, community, or land-use plans or local social surveys to identify values and aspirations against which to compare the proposed development;
- literature analysis and case study reviews of previous, similar proposals and outcomes in comparable environments and situations; and
- exploring the uncertainties and acceptable risks associated with the significance determination.

This is consistent with earlier views of effective approaches to significance determination. Hague et al. (1995), for example, argued that the variable nature of significance (i.e. context) means that administrators and decisions makers can manage the *fact* of an environmental impact or change (e.g. magnitude, direction, probability, etc.) separately from the meaning of an environmental impact (i.e. the value placed on that change) and the worldviews of the stakeholders involved – which determines what are considered valid decision criteria, based on values, experience and knowledge (Hilden 1996).

Beanlands and Duinker (1983), amongst the first in Canada to write about significance in EA, conclude that although there exists a myriad of interpretations of what is a significant environmental impact, the perspectives which they represent are equally valid. They suggest that the concept of significance needs a clear *operational framework* – as opposed to standard, one-size fits-all criteria or methods.

In defining the basis for a significance determination frameworks, Sadler (1996) suggests that good-practice significance determinations:

- use a systematic approach in which the choice of method is clearly defined and related to the problem at hand;
- applies criteria that allow the attribution of significance in a rational, defensible and problem-relevant way;
- identifies the basis on which judgments are made;
- distinguishes between the ecological and the social importance of impacts;
- describes, as necessary, the confidence in predictions and judgments that underlie the attribution of significance;
- provide a straight-forward and non-technical explanation of the approach, including assumptions and qualifications, when complex or technical methods are used; and
- overall, recognizes that the evaluation of significance is subjective, contingent upon values, and dependent upon the environmental and community context.

The composite approach was the most consistently promoted, and recommended, approach to significance determination that we found in our review of the literature. Three such reported examples include:

Aggregated value of the affected receptor (Briggs and Hudson 2013)

The United Kingdom Institute of Ecology and Environmental Management's Guidelines for Ecological Impact Assessment provides a framework within which to assess significance and factors that should be considered. The guidelines propose placing a value on the ecological receptor at a geographic frame of reference, such as a regional or local value. This value is determined using a number of factors, including designations, biodiversity value, habitat value, species value, potential value, secondary or supporting value and social value and economic value. The impact on the receptor is then predicted taking into account the magnitude, extent, duration, reversibility, integrity, timing and frequency of the impact. The impact and value are then combined to establish significance at a geographic level alongside the probability of the predicted impact.

We note, however, that several scholars recommend against aggregation to a single, significance value (e.g. Thompson 1990; Wood 2008).

Range of acceptability (Ehrlich and Ross 2015)

The authors argue that the significance determiner's judgement should be informed by a reasonable

weighing of the evidence, and by the values of society, and, for social and cultural impacts, should consider the rights of, and impacts to, the affected public. Ehrlich and Ross (2015) suggest four steps to significance determination using this model:

- decide where on the spectrum of potential impacts to place the threshold of significance for that particular valued component;
- weigh the evidence (impact predictions);
- decide which side of the threshold the predicted adverse impact falls on; and
- if the impact falls on the unacceptable side, decide if additional mitigation measures will shift the predicted impact to the acceptable side.

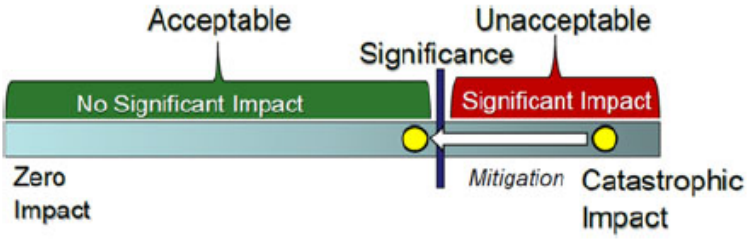

Figure 4. Range of acceptability (Ehrlich and Ross 2015)

As shown in Figure 4, the significance determiner decides where on the spectrum a project's predicted impact (yellow circle) falls, and weighs the effects of mitigation (white arrow) on impact significance. Ehrlich and Ross (2015) note that this model is based on the principle that significance determinations involve the comparison of a predicted change to a limit of acceptable change, which is a case-by- case application of a value-based threshold (Ehrlich 2007).

Decision tree for determining acceptability of impacts (Sippe 1999)

We found the approach suggested by Ehrlich and Ross (2015) to be similar to a much earlier approach, suggested by Sippe (1999), who proposed a conceptual decision tree for determining acceptability when significance decisions must be made (Figure 5). When a potential impact is identified, Sippe suggests that two dimensions must be considered – the impact (the predicted, measurable change and its various characteristics, such as magnitude, duration, extent, reversibility); and then some consideration of how important or significant it is (based on, for example, the character of the receiving environment, resilience of the biophysical and social environment to cope with change, and public interest). Then, Sippe suggests a third component – that these factors need to be interpreted and given further context in terms of what is acceptable, whereby a decision maker applies threshold tests for acceptability – whether qualitative or quantitative.

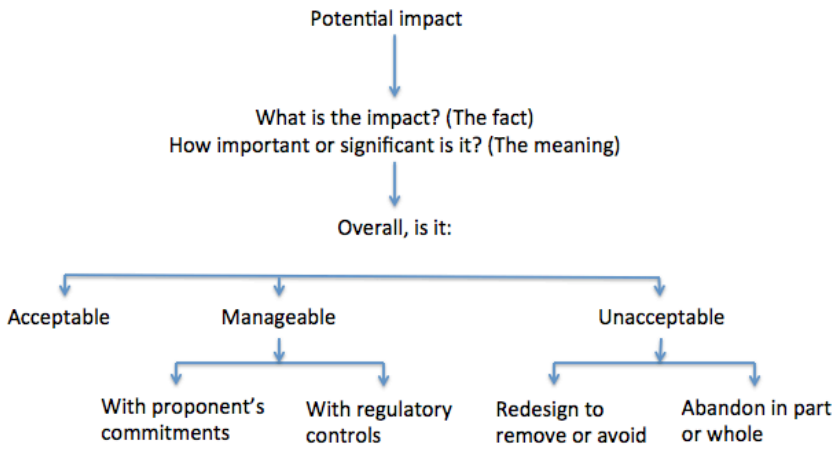

Figure 5. Decision tree for determining acceptability of impacts (Sippe 1999)

Sippe also suggests the use of establishing consistent 'levels of acceptability' to help make such determinations. For example, an *unacceptable* impact may be one that exceeds a legal threshold or quality standard, or that results in loss of critical habitat for a species. An impact may be *normally unacceptable* when it conflicts with existing environmental policies or land use plans, results in loss of species of social importance, or results in large-scale loss of the productive capacity of renewable resources. Other impacts may be deemed *acceptable only with minimization, mitigation or management*.

2.4 KEY PRINCIPLES FOR THE DETERMINATION OF SIGNIFICANCE

Despite the persistent messages about the complexity of significance determination in EA, we did observe some common (albeit high-level) principles that were fairly consistent across the literature we reviewed:

- significance is ultimately a value judgment, regardless of the criteria used to make that determination;
- the 'fact' of impacts (e.g. magnitude, extent, duration, intensity, reversibility, probability etc.) comprises the most basic of significance determination criteria; and
- the importance of those impacts must be considered in terms of both biophysical and socio-economic values and considerations, including what is deemed 'acceptable' to the affected communities and interests.

We also observed a number of other, common messages. Though not addressed equally by all authors or covered in all papers, they did appear frequently in the literature. These principles are irrespective of the particular approach used for significance determination or the context within which determinations are made.

2.4.1 Transparency

Multiple authors indicate the need for transparency in *how* significance determinations are made, and suggest that transparency in how determinations are made is as (if not more) important than the particular methods or approach used to make that determination. Ehrlich and Ross (2015), for example, note that the rationale for significance should be reported in a manner that makes clear the reasoning and judgments that led to the significance determination, in language understandable to EA participants. Briggs and Hudson (2013), Byron et al. (2000) and Thompson et al. (1997) report that the lack of justification for the level of significance assigned to impacts and the clarity with which the significance of each impact is indicated has long been a major shortcoming in EA practice. Wood (2008) emphasizes that, although past research has found that EAs often do not change the final direction of project authorization decisions, information generated during the EA process does influence decisions relating to impact mitigation and project design. As such, achieving a transparent evaluation and communication of impact significance during the EA process is important so that improvements to the environmental performance of development can be maximized and the practical outcomes of EA improved.

2.4.2 Risk and uncertainty

Risk is typically discussed with reference to the probability of an event or impact occurring – and is a fundamental attribute of impact characterization (see sec. 2.1.1). Uncertainty is typically discussed with regard to the communication and disclosure of knowledge gaps. Strictly speaking, based on conventional definitions, risk implies a known unknown – the specific outcome may be unknown but the underlying outcome distribution is known. Uncertainty also implies unknown outcomes, but the underlying outcome distributions are not known. When couched within the context of significance determinations, the seemingly rational concepts of risk and uncertainty are influenced by the many contextual factors (see sec 2.2) that influence the understanding and interpretation of significance. Larsen et al. (2013) notes that there are often large differences between the scientific, policymaking, and non-scientific communities in their understanding of risk and uncertainty.

Risk is often described as the *extent of harm* and the *probability* of occurrence. Many technological risks, such as those associated with nuclear energy, large-scale chemical facilitates, or the failure of a major hydroelectric dam, have the potential for high damage (i.e., the extent of harm is large) but often a very low probability of occurrence. For these types of activities and events the impact assessment literature recommends the use of risk-based assessment to aid in significance determinations – but at the same time cautions that it is necessary to establish *who* determines acceptable risk levels.

Risk is often considered concrete; however, several scholars and international guidance on risk-based approaches note that risk is, in large part, a social construct influenced by economic, psychological, social and cultural frames that subjectively shape the perceived extent of harm as well as the articulation of probabilities (Renn 2008; Short 1989). For significance determinations in EA, the issue

then is not whether a potentially catastrophic event such as a major dam failure is significant – this is of little value to a decision-maker as the extent of harm is almost always considered high; rather, the issue is whether the probability of event occurrence is within a socially acceptable level.

Risk can often be confronted with effective discussion, further research, and public communication. Uncertainty, however, can be much more complex. An event or impact with the potential to cause much harm, but with a very low probability of occurring, is a very different issue than when:

- the probability is uncertain or unknown, but the extent of harm is very high; or
- the probability is uncertain or unknown, and the extent of harm is uncertain or unknown.

Under the first scenario, the potential impact or event is often considered to be significant, given the tradeoff between the extent of harm and the lack of understanding of whether or when it might occur. Under the second scenario, the uncertainty is often postponed – a non-handling strategy, based on the argument that the uncertain issues will be dealt with when more and better knowledge and information is present and thus uncertainty has been reduced (Larsen et al. 2013). The problem, however, is that not all uncertainties can be reduced through more and better knowledge (Walker et al. 2003).

Leung et al. (2015) report an increase in the EA literature in recent years focused on the subject of uncertainty in EA. Uncertainties must be communicated and considered when making significance determinations – uncertainties in baseline data, prediction methods, proposed mitigation, and in the significance determination process itself. Wood (2008) indicates that the degree of uncertainty associated with impact predictions and the effectiveness of mitigation measures is similarly underplayed in EIA and is not given adequate consideration in significance evaluation. Duncan (2008), for example, suggests that project proponents, EA consultants and sometimes regulatory decision makers may have a vested interest in making EAs and their decisions appear defensible and politically palatable, resulting in practices that systematically seek to minimize uncertainty disclosure. Yet, Leung et al. (2015), De Jongh (1988), Duncan (2013) and Ragas et al. (2009) assert the importance of uncertainty consideration and disclosure, and understanding the nature of uncertainty in EA and its implications, as essential to the quality of EA processes. Wood (2008) further reports that although the issue of lexical uncertainty raises serious challenges with regards to the interpretation of assessment criteria, the complexity of impact significance determinations is further compounded by other sources of uncertainty in the EA processes, particularly uncertainty associated with baseline conditions, impact predictions and mitigation.

Many of the papers we reviewed noted the need to better communicate uncertainties in EA and the implications of nondisclosure (e.g., Leung et al. 2015; Duncan, 2013; Tennøy et al. 2006; Wardekker et al. 2008). The lack of disclosure of uncertainties can lead to questions about the legitimacy of a decision maker's conclusion (see Duncan, 2013), including conclusions about significance. How uncertainty should be communicated, however, and who of the many stakeholders involved in EA processes should be responsible for doing so, seems to have received only limited attention. When uncertainty is communicated in EA, Leung et al. (2015) report that there is limited guidance on how to interpret and use this information – particularly when making significance determinations.

In the literature that did address uncertainty communication, the majority focused on the need to explicitly identify uncertainties or knowledge gaps in baseline data, models, predictions, and assumptions. The UK's *Design Manual for Roads and Bridges* (2008-HA 205/08 Vol 11, Sec 2), for example, speaks specifically to uncertainty and indicates that in any assessment process the *sources* of uncertainty and their implications should be clearly identified and documented, usually in qualitative terms. The guidance further suggests that, where it is meaningful to do so, uncertainty should be expressed quantitatively, reflecting the error range associated with a particular prediction. The guidance identifies the following sources of uncertainty as important to disclose in EA and to consider when making significance determinations:

- the validity of baseline data;
- the effect of the passage of time on the validity of data;
- future changes that could affect the conclusions of an assessment; and
- assumptions and predictions

Tennoy et al. (2006), however, argue that effectively considering uncertainty in EA, including in significance determination, requires more than simply requiring that uncertainty is disclosed in the impact statement – it requires understanding the level and nature of uncertainty, and whether appropriate responses are available. The Netherlands Environmental Assessment Agency's *Guidance for Uncertainty Assessment and Communication*[3], for example, focuses on the need to effectively consider and communicate where uncertainties originate, what significance and/or implications they have, if uncertainty may be reduced, and the manner in which uncertainty was dealt with. The guidance was developed primarily for researchers and policy makers, to ensure open and effective communication about uncertainties in relation to policy-relevant research. That said, much of the literature drawn on in the guidance is also of direct relevance to, and widely cited in, the EA scholarly literature.

Walker et al. (2003) suggest that when communicating uncertainty in EA, in addition to describing the *source* of uncertainty it is important to communicate and consider both the *level* of uncertainty and the *nature* of uncertainty. Walker et al. describe the *level* of uncertainty as ranging from:

- no uncertainty;
- functional relationships are reasonably well understood and uncertainty can be expressed in statistical terms;
- conditions where a range of possible outcomes can be identified but what causes these outcomes is not well understood;
- neither functional relationships nor probabilities are known, but we may be able to achieve a better understanding by conducting further research or analysis;
- neither functional relationships nor probabilities are known, and it is unlikely that we can achieve a better understanding by conducting further research or analysis; to
- we do not even know that we do not know.

[3] http://www.pbl.nl/en/publications/guide-for-uncertainty-communication

Examining the level of uncertainty can provide important contextual information for significance determination. Walker et al. (2003) describe the *nature* of uncertainty as being rooted in:

- knowledge (e.g. understanding, data, etc), or
- inherent variability on environmental or socio-economic systems (e.g. inherent indeterminacy and/or unpredictability, randomness, chaotic behavious).

This categorization has significant implications for significance determinations in EA. Knowledge-related uncertainty can typically be addressed with more information, often through more research or baseline assessment. However, uncertainty rooted in inherent variability usually cannot be reduced by more research, additional baseline data, or additional information requests about the nature of a project's design or its potential impacts.

2.4.3 Inclusiveness and diversity

What is significant is inherently value-based. As such, a common theme across the majority of papers we reviewed, regardless of the approach to significance determination, was the importance of an inclusive approach to significance determination. Ehrlich and Ross (2015), Booth and Skelton (2011), Wood (2008), and Ehrlich (2007) suggest that significance determination processes should seek to devise a significance appraisal framework and associated criteria in conjunction with a range of stakeholders, and through dialogue conducted early in the scoping phase of the EA – prior to impact predictions and mitigation proposals. Wood (2008) suggests that such a process would serve to enhance the credibility and legitimacy of significance determinations.

A significant challenge, however, is that social values are characterized by plurality. The affected publics, and even affected communities or interest groups, do not necessarily share the same values or speak with the same voice. Aside from acknowledging this challenge, the literature we examined on significance determination did not contain specific recommendations for addressing this challenge. In the policy analysis literature, however, van der Sluijs (2003) and Fischer (1995) suggest the use of 'value mapping and argumentative analysis' as one means to understand the diversity of views that may exist. Fischer (1995) suggests that different levels of argumentation (i.e., expressed values, voices) can be distinguished:

- *Ideological view*. The most deeply rooted expression of values, and disagreements can lead to very different views of whether there is a problem or what it is.

- *Problem setting and goal searching*. Expressed values may differ because groups may agree on the existence of a problem, but not on identifying precisely what the problem is, how to formulate it, and what the end goal or solution point should be.

- *Problem solving*. Expressed values may differ because groups may agree on the existence of a problem and further agree on broad goals, but disagree on the strategies and instruments required to reach the goal.

- *Outcomes and fairness*. Expressed values may differ because groups often care about the fairness of solutions to problems, but can hold different views on what constitutes fair outcomes.

van der Sluijs (2003) suggests the need to map 'what level of arguments' are put forward by 'what actors' in order to understand social values and context. This approach does not provide a solution for dealing with diversity in values in significance determination contexts (and, likely, one single solution does not exist), but it may help in better understanding the diversity of values that do exist and assist in understanding the significance of any tradeoffs that may result when significance determinations are made.

3. SCAN OF INTERNATIONAL JURISDICTIONS

Below we present the results of a scan of select EA jurisdictions to illustrate the range of approaches to, and interpretations of, significance. Our scan included Alberta, Australia (Commonwealth), Australia (Western Australia), Brazil, Canada (Federal), European Union (EU Directive), Hong Kong, Ireland, Norway, Nova Scotia, Portugal, Saskatchewan, South Africa, United Kingdom, United States California Environmental Quality Act (CEQA) and United States National Environmental Policy Act (NEPA). The scan was based on information available on the respective jurisdiction's website, and contained in publically available guidance materials.

It is *not* our intent to conduct an analysis of the adequacy of significance determination under each jurisdiction, or to undertake a comprehensive inventory or comparative analysis. The objective was to identify a range of approaches or perspectives that exist internationally, relative to the literature surveyed and principles and approaches for significance determination identified in Part I. As such, we report below only on 10 jurisdictions: European Union (EU Directive), Australia (Western Australia), Australia (Commonwealth), South Africa, Norway, Saskatchewan, Nova Scotia, Alberta, United States (NEPA), and United States (CEQA). The jurisdictions that we excluded from this report were found to have either limited guidance on significance, or mirrored the guidance found in other jurisdictions. We also did not include federal guidance under CEAA, 2012, which is currently being developed by the Canadian Environmental Assessment Agency.

Important to note when reviewing the descriptions below is that in most cases the guidance speak to significance within the context of determining the need for assessment. These factors, criteria or considerations, however, are often then translated into the determination of significance based on predicted impacts.

3.1 EUROPEAN DIRECTIVE (2011/92/EU)

The EU Directive, coming into force initially in 1985 (EU Directive 85/337/EEC), applies to EU member states and member states of the European Economic Area. The EU Directive contains two lists of projects to determine the need for EA – Annex I projects are considered as having *significant* effects on the environment and require an EA. Examples include long-distance railway lines, installations for the disposal of hazardous waste, nuclear power stations, dams and pipelines. For most projects, a specific threshold is defined based on the project's physical footprint, resource consumption rate, or emissions rate. Annex II projects contains lists of projects or actions where an EA *may* be required due to the potential for significant environmental effects. For such projects, determinations are made by each member state based on thresholds or criteria set by the member state or based on a case-by-case examination process. Guidance for making determinations regarding Annex II is provided in the Directive and includes three groups of considerations:

A. Characteristics of the project:

- size of the project;
- cumulation with other projects;
- use of natural resources;
- production of waste;
- pollution and nuisances; and
- risk of accidents, having regard in particular to substances or technologies used.

B. Location of the project:

- existing land use;
- relative abundance, quality and regenerative capacity of natural resources in the area;
- absorption capacity of the natural environment, paying particular attention to: wetlands, coastal zones, mountain and forest areas, nature reserves and parks, areas designated with special protection, area were environmental quality standards as specified under legislation have already been exceeded, densely populated areas, landscapes of historical, cultural or archaeological significance.

C. Characteristics of the potential impact:

- extent of the impact (geographic area and size of the affected population);
- transboundary nature of the impact;
- magnitude and complexity of the impact;
- probability of the impact; and
- duration, frequency and reversibility of the impact.

As an example of EU member state guidance for sub-threshold assessment and significance determination, see Ireland's Environmental Impact Assessment (EIA) Guidance for Consent Authorities regarding Sub-threshold Development, available at: http://www.environ.ie/en/DevelopmentHousing/PlanningDevelopment/EnvironmentalAssessment/PublicationsDocuments/FileDownLoad,1804,en.pdf

3.2 GOVERNMENT OF WESTERN AUSTRALIA

Part IV of the *Environmental Protection Act 1986* (the Act) makes provision for the EA of significant proposals, strategic proposals and schemes. The Government of Western Australia uses an objectives-based approach to significance determination, focused on impacts or the likelihood of impacts to listed "environmental factors."

There are 15 listed environmental factors, which have been selected as relevant for the EA process. And, in addition to the 15 environmental factors, there are two integrating factors - rehabilitation and decommissioning, and offsets. Although not environmental factors, they are deemed important considerations in determining the environmental acceptability of proposal. For each listed environmental factor there is an associated objective, against which the Environmental Protection Authority will make judgments on whether the environmental impact of a proposal or scheme may be significant. For example:

> *Factor:* Flora and Vegetation
> *Objective:* To maintain representation, diversity, viability and ecological function at the species, population and community level
>
> *Factor:* Hydrological processes
> *Objective:* To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected

The complete list of environmental factors and objectives is available in Government of Western Australia's Environmental Assessment Guideline for Environmental principles, factors and objectives: http://edit.epa.wa.gov.au/EPADocLib/EAG8-Principles-factors-objectives-RevJan2015.pdf

Proponents are encouraged to use the framework of factors and objectives for considering the impact of their proposal, and all proponents are required to structure their EA documentation against the relevant factors. For many factors, statewide guidance is available that provides direction for assessment, consideration, documentation or interpretation of impacts, including in some cases limits or thresholds. Additional guidance is also available for some factors for specific regional environments. For details, see: http://edit.epa.wa.gov.au/Policies_guidelines/Pages/MajorEPAguidancerelatedtoenvironmentalfactor.aspx?cat=Major%20EPA%20guidance%20related%20to%20environmental%20factors&url=Policies_guidelines

The use of listing factors and objectives is opposite the approach adopted in Canada (federal) or Nova Scotia (provincial) – where the list-based approach in these jurisdictions focuses instead on listing projects or actions and thresholds are based on project size or emissions or production capacity, versus based on the value of the receiving environment irrespective of the size of nature of the project action.

The Environmental Protection Authority uses a 'Significance Framework' (Figure 6) to determine the likely significance of a proposal and to make decisions throughout the EA process – including decisions on whether or not to assess a proposal, whether impacts are likely significant, and in making its recommendations to the Minister regarding approvals and conditions. This significance framework is based on the objectives identified for each of the 15 environmental factors

The basic framework is depicted below:

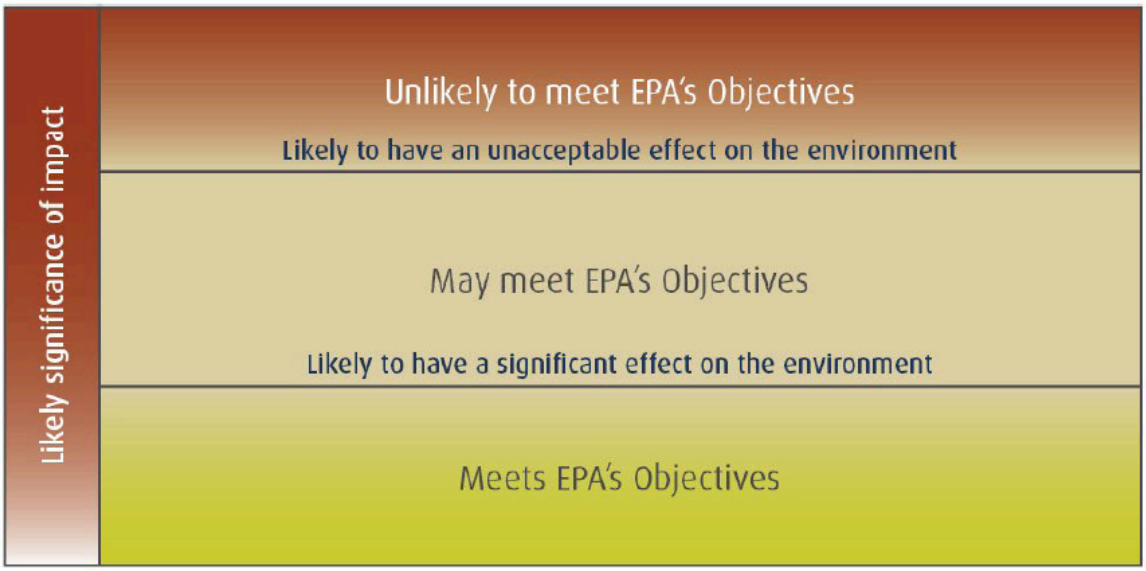

Figure 6. Significance framework, Western Australia EPA

There are two specified threshold levels on the scale of likely significance: where there is 'likely to be a significant effect on the environment'; and where there is likely to be an unacceptable effect on the environment. Using this approach, a likely significant impact does not necessarily mean an unacceptable impact, and project with likely significant impacts on key environmental factors may still be approved provided there is some means to mitigate or offset the impact.

The primary basis for the determination of the likely significance and acceptability is whether the proposal likely to meet EPA's objectives for each environmental factor, including:

- if the proposal meets all objectives for each environmental factor (i.e., below the likely significance threshold), then the proposal is considered unlikely to have a significant impact on the environment;
- if the proposal may or may not meet one or more of the EPA's objectives (i.e., centre zone, above the first threshold), its impact is considered likely to be significant; and
- if a proposal is unlikely to meet one or more objective (i.e., falls in the top zone, above the second threshold) then its effect on the environment is likely to be unacceptable.

Mitigation and offsets are considered in this interpretation (Figure 7):

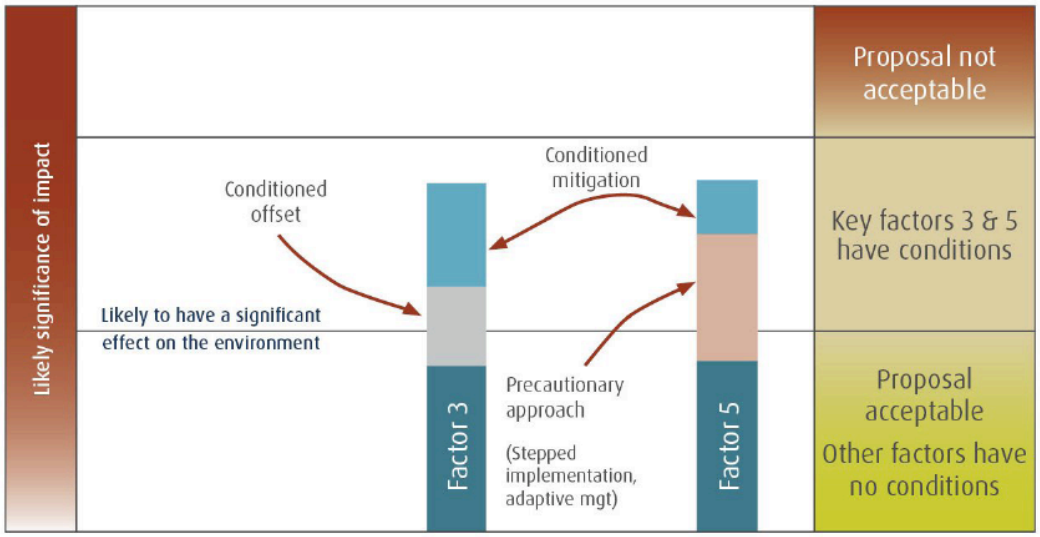

Figure 7. Significance framework with mitigation and offsets, Western Australia EPA

Further, the Environmental Protection Authority may consider that, based on the outcomes of the environmental review or due to uncertainties, the proposal cannot meet certain objectives and is therefore likely to have a significant impact on the environment.

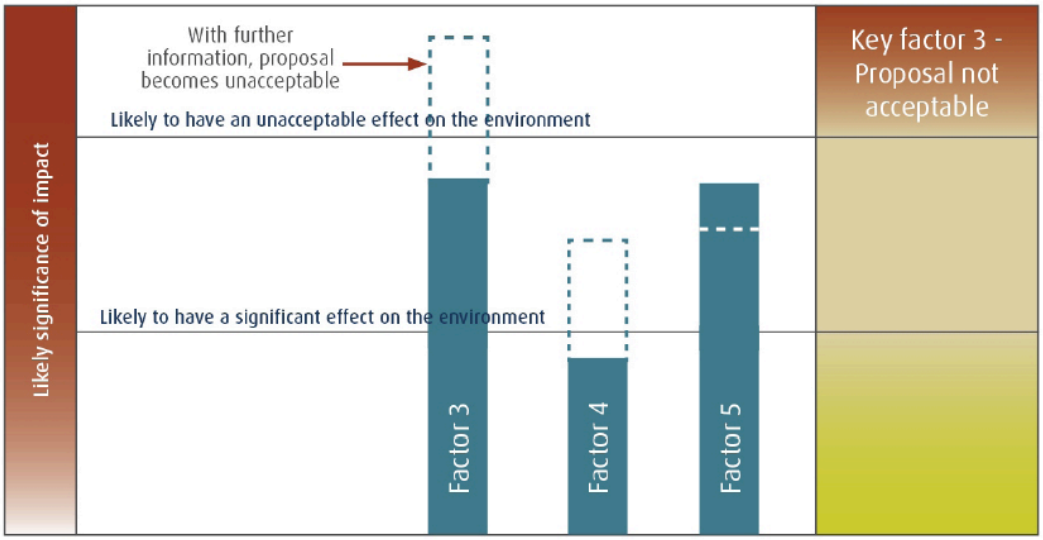

Figure 8. Significance framework showing unacceptable impacts, Western Australia EPA

The above (Figure 8) is a brief summary of the multi-step approach and multi-part guidance for significance determination. Further details on the significance framework can be found in the Environmental Assessment Guideline 9, Application of a significance framework in the EA process (2015), available at:
http://edit.epa.wa.gov.au/EPADocLib/EAG9-Revised%20Significance_frameworkJan2015.pdf

3.3 AUSTRALIA (COMMONWEALTH)

Under the Australian *Environment Protection and Biodiversity Conservation Act* 1999, a significant impact is defined as an impact which is important, notable, or of consequence, having regard to its *context* or *intensity*.

The Act also explains that whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. Whether a significant impact is 'likely' does not require is to have a greater than 50% chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility.

Significance is used primarily to determine the need for assessment, but similar to other jurisdictions internationally the screening criteria for significance carry over to the interpretation of the significance of predicted impacts identified during the EA process. Australia's Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 focuses on matters of 'national environmental significance.' Action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of 'national environmental significance'. As such, whether an impact is considered significant under the Act is determined in large part on the nature and characteristics of the potentially affected component of the receiving environment. Matters of national environmental significance under the Act include:

- world heritage properties;
- national heritage places;
- wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed);
- nationally threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- a water resource, in relation to coal seam gas development and large coal mining development (see http://www.environment.gov.au/system/files/resources/d078caf3-3923-4416-a743-0988ac3f1ee1/files/sig-water-resources.pdf).

Matters of National Environmental Significance – Significant impact guidelines 1.1 are available at http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

Further, actions that are likely to have a significant impact on the environment in general (for actions by Commonwealth agencies or actions on Commonwealth land) or the environment on Commonwealth land (for actions outside Commonwealth land) may also be subject to EA (see Significant impact guidelines 1.2 *Environment Protection and Biodiversity Conservation Act 1999.* Commonwealth of

Australia 2013, available at http://www.environment.gov.au/system/files/resources/a0af2153-29dc-453c-8f04-3de35bca5264/files/commonwealth-guidelines_1.pdf significance determination is approached based on:

Impact characteristics:

- intensity;
- scale;
- impact severity;
- duration; and
- timing/frequency

Uncertainty considerations in the predicted impact:

- Where there is scientific uncertainty the precautionary principle is relevant. Accordingly, where there is a risk of serious or irreversible damage, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on the environment.

The context of the environment that will be impacted, particularly those elements of the environment that are sensitive or valuable, including but not limited to impacts on:

- landscapes and soils;
- coastal landscapes and processes;
- ocean forms, ocean processes and ocean life;
- water resources;
- pollutants, chemicals, and toxic substances;
- pants;
- animals;
- people and communities; and
- heritage.

The Australian Government also provides specific 'significant impact guidance' under the *Environment Protection and Biodiversity Conservation Act* for certain species, namely for water mouse (*Xeromys myoides*) and for 36 species of shorebirds.

3.4 SOUTH AFRICA

Under South Africa's National Environmental Management Act, Environmental Impact Assessment Regulations (2010), a significant impact is defined as "an impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment."

The regulations governing EA reports provides little additional guidance, but specifies that:

- the methodology used in determining the significance of potential environmental impacts must be documents in the EA report; and
- an assessment of each identified potentially significant impact must include consideration of:
  - cumulative impacts;
  - the nature of the impact;
  - the extent and duration of the impact;
  - the probability of the impact occurring;
  - the degree to which the impact can be reversed;
  - the degree to which the impact may cause irreplaceable;
  - loss of resources; and
  - the degree to which the impact can be mitigated.

Further, when considering significant impacts, any assumptions, uncertainties and gaps in knowledge must be documented.

For reference, see http://www.environment.co.za/documents/legislation/EIA/2010-eia-legislation-regulations-south-africa/EIA-Environmental-Impact-Assessment-Regulations-South-Africa-2010-South-Africa.pdf

3.5 NORWAY

EA legislation in Norway was implemented in 1990, as part of the Planning and Building Act. As a member of the European Economic Area (EEA), the provisions of the EU Directives have also been adopted in Norway. However, the Svalbard Islands, which was excluded from the EAA agreement, has its own EA procedure enacted by Norway.

Norway adopts a criterion-based approach to significance interpretation. Regulations on Environmental Impact Assessment under the Planning and Building Act identify the Plans and projects that are subject to assessment, and identify the criteria to be used for assessing significant effects on the environment, natural resources and community. The criteria consist of a combination of project-based/activity-based characteristics, reference to specific regional environments, concerns specific to Aboriginal peoples, and transboundary matters. Specifically, consideration must be given to whether a project:

a. is located in or in conflict with areas with particularly valuable landscapes, natural environments, cultural monuments or cultural environments that are protected or preserved, temporarily protected or preserved of which the protection or preservation has been proposed, or where there are or there is a strong likelihood of finding automatically preserved cultural monuments that are part of a cultural environment that goes far back in time;
b. is located in or in conflict with important natural areas on which there has been no encroachment, or pose a threat to directly endangered or vulnerable species and their habitats or to other areas of particular importance for biological diversity;
c. is located in large natural areas that are particularly important for the pursuit of recreational activities, including forests bordering urban areas, and in important areas close to watercourses that have not been set aside for physical development and in major green structures and important recreation areas in towns and urban areas, and where the plan or project conflicts with outdoor recreational interests;
d. is within the scope of the National Policy Guidelines (NPG) for planning in coastal and marine areas in the Oslo Fjord region, NPG for protected watercourses and NPG for coordinated land-use and transport planning and, at the same time, conflict with the purpose of these guidelines, or which conflict with guidelines for the development of shopping centres that have been laid down in county sub-plans;
e. may conflict with the pursuit of Sami commercial activities in uncultivated areas, or are located in areas of special value for reindeer husbandry or limited seasonal pasture and may conflict with reindeer husbandry interests, or may in other ways conflict with the land-use needs of reindeer husbandry;
f. entails the substantial reallocation of agricultural, natural or outdoor recreational areas or areas that have been zoned for agriculture and that are of significant importance for agricultural activities;
g. may result in a significant increase in the number of persons who are exposed to high levels of air pollution or noise, or may lead to significant pollution of soil, water and sediments, or entail a risk of serious accidents, radiation, landslides and flooding;
h. may have consequences for public health due to significant changes in the composition of the population, the housing market, housing needs or the need for services;
i. may have significant consequences for the population's access to outdoor areas, buildings and services; and
j. may have significant negative consequences for another state.

The regulations are available at: https://www.regjeringen.no/en/dokumenter/regulations-on-environmental-impact-asse/id512075/

3.6 SASKATCHEWAN

Environmental assessment in Saskatchewan was revised in recent years in accordance with the Province's results-based approach/regulatory framework to manage environmental issues. EA focuses only on those projects characterized as having "unusual, unique or potentially significant risks that require special attention". Section 2(d) of the EA Act lists the criteria used to identify such impacts that are of concern, namely:

Effects on any unique, rare or endangered feature of the environment

The stated intent of this criterion is to preserve features of the environment that could not be replaced if damaged or destroyed, or whose restoration or replacement would involve considerable costs. Features are generally natural in origin, but may include built or constructed features such as properties with heritage or cultural value. Unique refers to a specific feature of the environment of value to Saskatchewan, even if the feature may be common elsewhere – e.g. sand dunes, cultural sites. Rare or endangered is in reference to actions that may affect rare or endangered species in Saskatchewan, including disruption of habitat, reductions in numbers, changes in behavior, introduction of harmful substances, or activities that occur within proximity to important species or habitat.

Likely to substantially utilize any provincial resource and, in so doing, pre-empt the use, or potential use, of that resource for any other purpose

The intent is to ensure that resources are managed in accordance with provincial resource development policies and priorities, and access to resources by other potential users, now or in the foreseeable future, is not unreasonably restricted.

Cause the emission of any pollutants or create byproducts, residual or waste products, which will require handling and disposal in a manner that is not regulated under any other Act or regulation

Likely to cause widespread public concern about potential environmental changes

In addition to local, regional or provincially-expressed concerns, this includes also any conditions or impacts that a project produces about which the public may be concerned that cannot be addressed through the design of the project, and whether the same or similar projects have proceeded in similar circumstances without widespread public concern.

Likely to involve a new technology that is concerned with resource utilization and that may induce significant environmental change

Likely to have a significant impact on the environment or necessitate a further development which is likely to have a significant impact on the environment

This criterion ensures that significant impacts not covered by previous criteria may still be subject to assessment. Recommended factors for consideration include: whether environmental impacts may affect human health, public safety quality of life, Treaty and Aboriginal rights and traditional uses, or

abundance and quality of wildlife and wildlife habitat; any indirect impacts on the environment; any impacts of a significant scale, such as effects that exceed guidelines or ministry standards; and whether significant negative impacts will result in any impacts that are intensive or concentrated, frequent or long-lasting, widespread in occurrence, irreversible or requiring costly and difficult remediation, or involve cumulative effects.

Under the province's *Technical Proposal Guidelines*, directions are provided to a proponent for self-assessment – to gauge whether there is a legal obligation to seek ministerial approval for a proposed project. In doing so, proponents are asked to undertake a preliminary assessment of the expected impacts of the proposed project and their relative significance. The *Technical Review Guidelines* indicate that this assessment of "relative significance" requires an assessment of:

i) the sensitivity of the local environment;
ii) the intensity of impacts (e.g. the type, extent, magnitude and duration of the impacts); and
iii) the importance of those impacts to communities.

The guidelines indicate that significance requires a judgment of:

- the environmental context;
- the intensity of impacts (type, extent, magnitude, duration of the impacts;, and
- their importance to communities.

Saskatchewan's *Technical Proposal Guidelines* (Government of Saskatchewan 2014 – Guidelines to assessing projects and preparing proposals under The Environmental Assessment Act) are available at: http://www.environment.gov.sk.ca/EATechnicalProposalGuidelines

3.7 NOVA SCOTIA

Under the *Environment Act*, (Part IV) and the Environmental Assessment Regulations, developments are grouped into two categories, Class I or Class II, depending on their potential for "significant" environmental impacts.

Significant, with respect to an environmental effect, is defined in Nova Scotia's EA Guide for Proponents as: "an adverse impact in the context of its magnitude, geographic extent, duration, frequency, degree of reversibility, possibility of occurrence or any combination of the foregoing." The guidance is available at: http://www.novascotia.ca/nse/ea/docs/EA.Guide-Proponents.pdf

No further guidance is provided on assessing significance beyond these standard impact characterization criteria, and there is no specific reference to the consideration of context.

Separate guidance for addressing wildlife species and habitat in EA registration does make explicit reference to context, referring to "significant habitats" as "sites where species at risk or other species of conservation concern can be found and/or sites where unusually large concentrations of wildlife occur

and/or habitats that are rare in the province" (http://www.novascotia.ca/nse/ea/docs/EA.Guide-AddressingWildSpecies.pdf). Guidance for preparing EA registration for mining proposals also makes reference to "significant habitats" as a particular contextual consideration when assessing the project's potential impacts, as well as identifying sites that are of "ecological significance". The definition of an 'environmental effect' under the Act includes "…structure, site or thing including those of historical, archaeological, paleontological or architectural significance."

As such, although no specific reference is made to context when defining significance under the Act, there is reference to specific contextual factors or principles, suggesting that context does indeed factor into significance determinations.

3.8 ALBERTA

Under Alberta's Environmental Protection and Enhancement Act, the significance of an effect is defined as "A measure of the magnitude, duration, frequency, timing, probability of occurrence, ecological and social context, geographic extent, and degree of reversibility of an effect on a Valued Ecosystem Component."

Aside from this definition, we found limited guidance in terms of how significance determination is approached. The province's Guide to preparing environmental impact assessment reports in Alberta, 2013, does refer to "effects and their significance", and emphasizes that proponents include in their assessment a "description of the techniques used to identify and evaluate the environmental effects and criteria used to determine the significance of those effects". It also indicates that impact significance "will be quantified where possible and assessed including consideration of spatial, temporal and cumulative aspects."

The proponent has considerable discretion in their approach, but the guidelines indicate that

> *Proponents should explain the scientific rationale for their impact rating system, and clearly identify the different impact rating systems for each Valued Ecosystem Component or Key Indicator Resource. Proponents should be aware that ratings based on a percentage of the Local Study Area (LSA) or Regional Study Area (RSA) affected often generate a considerable number of Supplemental Information Requests (SIRs) related to the appropriateness of the rating (e.g., rating can be affected by changing size of LSA or RSA).*

Specific reference is also made to the consideration of direct effects or transboundary effects on special protected areas, such as National Parks, National Historic Sites, National Marine Conservation Areas, Canadian Heritage Rivers, UNESCO World Heritage Sites, Ramsar Convention Wetlands of International Importance, Provincial Parks, Provincial Wilderness Parks, as well as the transition zones around these areas.

In those cases, the guidelines direct proponents to use the relevant objectives, management plans, principles, criteria, targets, and thresholds for those areas in determining effects. *http://esrd.alberta.ca/lands-forests/land-industrial/programs-and-services/environmental-assessment/documents/GuidePreparingEIAReportsAlberta-2013.pdf*

3.9 UNITED STATES – NEPA

CEQ regulations (40 CFR ch. 1508.7 and 1508.8) define the impacts and effects that must be addressed and considered by US Federal agencies in satisfying the requirements of the NEPA process, which includes direct, indirect and cumulative impacts. Under the NEPA process, an environmental report is prepared to determine whether a project will have a significant impact on the environment and, if no un-mitigable significant impact would occur, then a Finding of No Significant Impact (FONSI) is made.

The determination of significance under NEPA is based on two main factors – *context* and *intensity.*

Context refers to the geographic, biophysical, and social context in which the effects will occur. The regulations refer to "society as a whole", the "region" in which the project is proposed, and "affected interests" as examples of context. The regulations also explain that considering context does not mean giving greater attention to, for example, effects on society as a whole versus effects on a local area.

Intensity refers to the severity of the impact, regardless of the context in which it occurs. The regulations require that a number of variables be addressed in measuring intensity:

1. impacts that may be both beneficial and adverse;
2. the degree to which the proposed action affects public health or safety;
3. unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas;
4. the degree to which the effects on the quality of the human environment are likely to be highly controversial;
5. the degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks;
6. the degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration;
7. whether the action is related to other actions with individually insignificant but cumulatively significant impacts: significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment; significance cannot be avoided by terming an action temporary or by breaking it down into small component parts;

8. the degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources;
9. the degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act; and
10. whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.

3.10. UNITED STATED – CEQA

Use of the term "significant" differs under the California Environmental Quality Act (CEQA) vs NEPA. CEQA requires that an environmental impact report include a determination of significant impacts – under NEPA an EA is prepared to determine whether a project will have a significant impact on the environment.

CEQA requires that an environmental impact report identify the significant environmental effects of the project, but does not identify specific thresholds for significance. CEQA Guidelines Section 15064(b) simply states that "the determination...calls for careful judgment on the part of the public agency involved..." and that "an ironclad definition of significant effect is not possible because the significance of an activity may vary with the setting."

The underlying definition of a significant effect under CEQA is "a substantial adverse change in physical conditions." This criterion underlies the evaluation of environmental impacts for most issues. Exceptions are when specific thresholds or standards have been established by regulatory agencies. CEQA does not require a discussion of socioeconomic effects except where they would result in physical changes, and states that social or economic effects shall not be treated as significant effects (CEQA Guidelines Sections 15064(f) and 15131).

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