Defining Significance: Baseline vs. Component Integrity

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Introduction

The outcome of most environmental assessments (EAs) hinges on the significance of effects of the project being assessed. Explicitly defining the threshold beyond which a residual effect (the effect remaining after the implementation of mitigation) is considered "significant" is becoming an accepted aspect of EA practice in Canada. It increases the transparency of an EA for all stakeholders, by making the basis for the assessment conclusions clear. This paper examines a potential shortcoming in a commonly used approach to significance determination that may result in underestimation of cumulative effects, and, to overcome the challenge, advocates the use of significance threshold definitions based, where possible, on the continued integrity or viability of the component being assessed. The problematic approach and recommended practice are illustrated using actual cases of EAs in Canada.

Legislative Basis for Determination of Significance

Since it first came into force in 1995, the federal *Canadian Environmental Assessment Act* (CEAA)[2] has included a legislative requirement to take into account the significance of environmental effects (including cumulative effects) of the project being assessed. The EA legislation for most Canadian provinces and territories also includes a requirement to consider the significance of project (and cumulative) effects. While the legislative authority to determine significance remains with the statutory decision-maker of each jurisdiction, it has become common practice for the practitioner to make a significance determination in EA documentation. Indeed, the requirement for the proponent to determine significance of residual effects is typically specified by the EA process administrator in guidelines, terms of reference, or similar documents that establish the scope of assessment.

The Importance of Defining a Significance Threshold

The potential for a project to cause significant adverse effects is a key consideration in making a statutory decision following an EA. It is therefore important to ensure the determination of significance is clearly documented and explained in the assessment. In particular, the assessment should clearly define how the term 'significance' has been used, including the threshold or point beyond which an adverse effect is considered significant. This principle was recently incorporated into the Government of British Columbia's EA methodological guidance

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[2] Replaced in 2012 with the *Canadian Environmental Assessment Act, 2012*.

(EAO 2013), and has been incorporated into Application Information Requirements for several projects in British Columbia since then[3].

Thresholds are particularly important for assessing potential cumulative effects, when multiple smaller effects, which in isolation may be considered not significant, together exceed the limit of acceptable change of a specific component of the natural or human environment.

Existing guidance material in Canada (FEARO 1994, EAO 2013) recommends using government-established environmental protection standards, guidelines, or objectives to determine significance. However, these guidelines acknowledge that standards, guidelines, and objectives do not exist for most environmental components. This is due in part to a lack of adequate scientific data and to the reluctance of governments to establish thresholds that may be perceived to be a cap on development. Consequently, practitioners may use a qualitative approach based on professional judgment to determine an appropriate threshold for the purposes of EA (FEARO 1994, Hegmann et al. 1999). Barnes *et al.* (2012) described emerging approaches to significance determination; this paper focuses on two of those approaches.

The Baseline Problem

In EA practice in Canada, the changes to an environmental component caused by a project are usually compared against existing conditions, and residual effects characterized using criteria specified in guidance documents (*e.g.*, FEARO 1994, EAO 2013), including magnitude, extent, duration, frequency, and reversibility. While any or all of these criteria may be important factors in determining residual effect significance[4], magnitude is often a key driver of significance.

Magnitude refers to the expected size or severity of the residual effect, and typically takes into account the proportion of the environmental component that is affected within the spatial boundaries of the assessment, as well as the scale of the effect relative to natural (or, in the case of components of the human environment, historic) variation. Magnitude is often defined in terms of a degree of change from a baseline; the existing conditions of the component being assessed are usually used as the baseline for this purpose. This approach enables the reader to understand the scale of the change caused by the project relative to a directly observable, quantified condition documented in the EA. While that understanding is inherently valuable, and may be adequate to inform the determination of significance of the effect of the project alone, it is not adequate to consider the significance of the cumulative effect of the project in combination with the effects of other projects and activities that have been carried out, as explained below.

The assessment of potential cumulative effects requires the consideration of how the effects of the project being reviewed will combine with the effects of other projects and activities that both *have been* and *will be* carried out. It is common practice in Canadian EA to rely on the documentation of existing conditions to inform the first part of the cumulative effects

[3] For example, see Section 4.1.4.6 of the Application Information Requirements for the Pacific Northwest LNG project, available on-line at the British Columbia Environmental Assessment Office's Project Information Centre, here (accessed February 10, 2015): http://a100.gov.bc.ca/appsdata/epic/documents/p396/1392924114383_64fa66d9682a0b746f9ad04ef89ece5bfa5f6de34f0aaa171255faf9a32dc756.pdf

[4] See Barnes *et al.* 2000, cited in Barnes *et al.* 2012, for a discussion of the relevance of these standard criteria to defining significance thresholds.

assessment, recognizing that existing conditions reflect the effects of past projects and activities. This is consistent with existing guidance (Hegmann *et al.* 1999, CEAA 2014, IFC 2013). A key benefit of this approach is that existing conditions can be directly observed and measured, whereas documentation of conditions in the past is often absent or incomplete, and reliable information about the specific effects of past projects and activities is often not available[5]. The cumulative effects to date are therefore considered to be integrated into the analysis of the project effects, because the effects of the project combine with, and are evaluated in the context of, existing conditions. Consequently, most project-specific cumulative effects assessments in Canada focus on the residual effects of the project being assessed in combination with the effects of other projects and activities that *will be* carried out.

Figure 1 shows a simplified trend of degradation in the condition of an environmental component from pre-disturbance conditions in the past (point A) to an existing condition (point B) to a forecast condition in the future with the project (point C1) and in the future with the project and other projects and activities that will be carried out (point C2). Based on current practice, the EA normally describes the project effect as the change caused by the project relative to existing conditions (ΔP) and the cumulative effect as the combined change caused by the project and other future projects and activities, also relative to existing conditions (ΔCE).

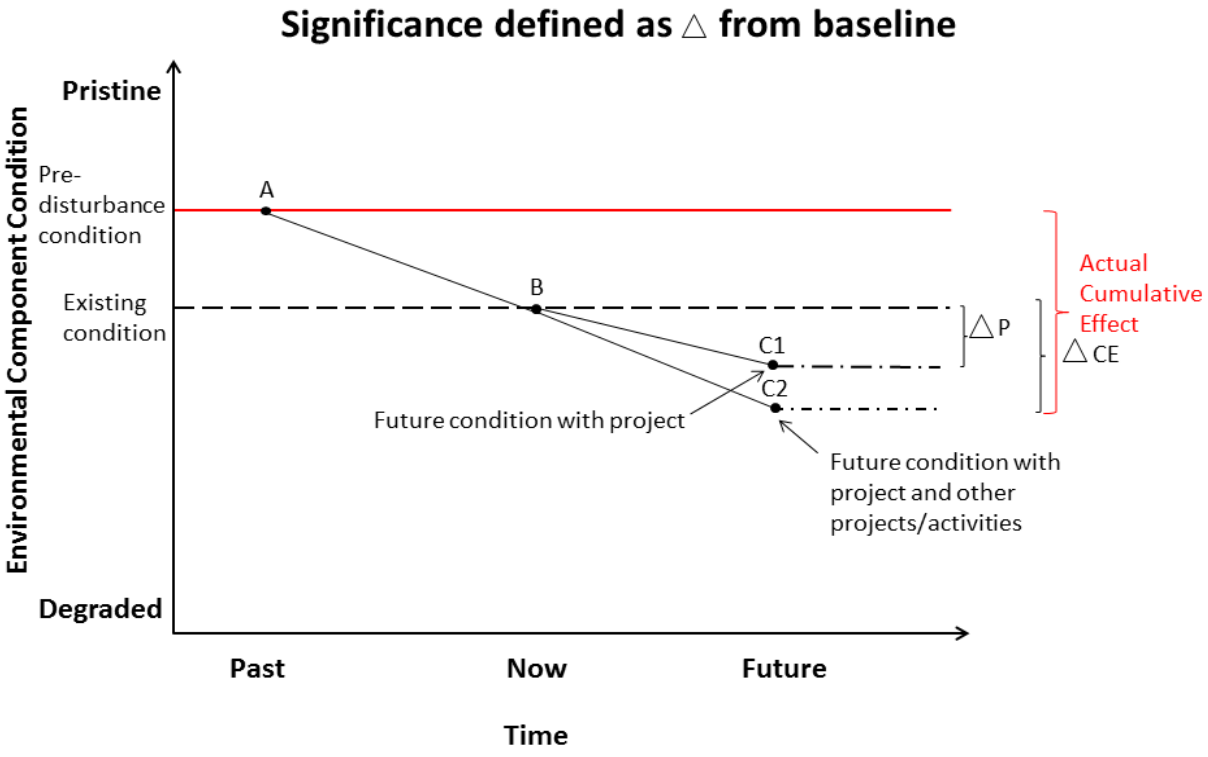

Figure 1. Hypothetical degradation trend of environmental component over time.

[5] These data gaps generally worsen the farther back in time one looks.

If the significance of cumulative effects is determined based on the degree of change relative to a baseline of existing conditions (ΔCE in Figure 1), which most often occurs when magnitude is used as the key factor in determining significance, the actual total cumulative effect, including the effects of ***past*** projects and activities, will be underestimated. This is exacerbated when successive EAs refer to existing conditions that change/degrade over time (shifting baseline). The Joint Review Panel for the Joslyn North Mine Project in Alberta observed this problem in relation to the evaluation of cumulative effects of wildlife habitat loss (JRP 2011) (which was measured as a percentage of habitat remaining), and concluded the assessment should have been conducted against a pre-industrial, rather than an existing conditions, baseline case.

Defining Significance in Terms of Component Integrity

To overcome the problem of underestimating total cumulative effects when determining significance, the use of significance threshold definitions based, where possible, on the continued integrity or viability of the environmental components being assessed is recommended. For example, in their framework for environmental impact analysis (which continues to be reflected in methodological frameworks in use today), Conover *et al.* (1985) emphasized that population integrity comprises the threshold of concern for biological components. They established a definition for "major impact" on biophysical components as follows:

> "A major impact is defined as one affecting a whole population or species in sufficient magnitude to cause a decline in abundance and/or change in distribution beyond which natural recruitment … would not return that population or species, or any population or species dependent on it, to its former level within several generations."

The concept of population integrity continues to be integrated into significance threshold definitions, as illustrated by these recent examples from the Upper Lillooet Hydro Project in British Columbia (Creek Power Inc. and SNC Lavalin Environment 2012):

Component	Significance Threshold Definition
Bull trout	A significant residual environmental effect on bull trout is one where the project causes mortality or reduced productivity at any life stage, either directly or through habitat loss or degradation, that is likely to reduce the integrity of the population.
Avifauna	A significant residual environmental effect on avifauna is one that results in direct mortality or affects terrestrial habitat upon which avifauna depend, including nest sites, in such a way that the regional avifauna population is likely to suffer a decline in abundance or change in distribution over one or more generations that is beyond natural variation.

The utility of using thresholds of (ecological) integrity to inform environmental decision-making has been articulated previously by others (*e.g.*, Guntenspergen *et al.* 2014, Bennetts *et al.* 2007, Groffman *et al.* 2006).

By assessing the significance of project effects and cumulative effects in terms of the integrity or viability of the environmental component being assessed, the assessment more fully considers the cumulative effects to date of past projects and activities. This point is most easily

understood in relation to species at risk. The status of a species reflects the effects it has experienced from past projects and activities (as well as, perhaps, natural factors); the viability of a threatened species is understood to have been compromised to some degree. The incremental effect of a new project, if measured only as a degree of change from existing conditions, may not appear to be significant, but, when measured in terms of its effect on the viability of the threatened species, may be determined to be significant, particularly if it results in an elevation of risk to the survival or recovery of the species.

This approach can also be applied to socio-economic components, especially those with capacity attributes, such as emergency services, medical and health services, and infrastructure and utilities. The capacity of such systems can be used as a measure of system integrity, and therefore serves as a useful threshold for determining significance. Examples summarized from ongoing environmental assessments in British Columbia are provided below:

Component	Significance Threshold Definition
Community Services and Infrastructure	A significant residual effect on community services and infrastructure will occur when the incremental demand on services and infrastructure due to the project will exceed the existing and future capacity of those services and infrastructure such that the needs of the community cannot be met.
Health	A significant residual environmental effect on health is one that affects one or more population health indicators in a manner that erodes the collective ability of the community to maintain its state of well-being.

This approach has the added advantage of relying on the existing conditions of the components being assessed, which can be directly observed in field studies before and after the EA, instead of more speculative re-construction of conditions at some historic point in time that would be required if significance is defined in terms of a degree of change from pre-disturbance or pre-industrial conditions. This approach will be most efficient where component status is well understood and thresholds, benchmarks, or management targets have already been defined through a regional land use planning process, strategic environmental assessment, species recovery plan, or similar integrated system evaluation. British Columbia, for example, is currently working on establishing management targets for priority environmental, economic, and social values in that province, through regional cumulative effects assessments (FLNRO 2014).

In the absence of pre-defined limits, the practitioner must apply professional judgment to define an appropriate threshold based on available science and other information, ideally in consultation with the EA process administrator and other technical experts. In any case, the rationale for the threshold should be clearly articulated in the assessment to enable informed discourse during the EA process.

Basing the determination of significance on the continued viability of environmental components will help to ensure the cumulative effects to date of past projects and activities are not inadvertently overlooked, while maintaining the use of existing conditions as a reliable foundation for assessing the effects of the project and its contribution to cumulative effects.

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