Unlocking the promise of 'integrated' regional and strategic environmental assessments based on a realist review of the scholarly literature

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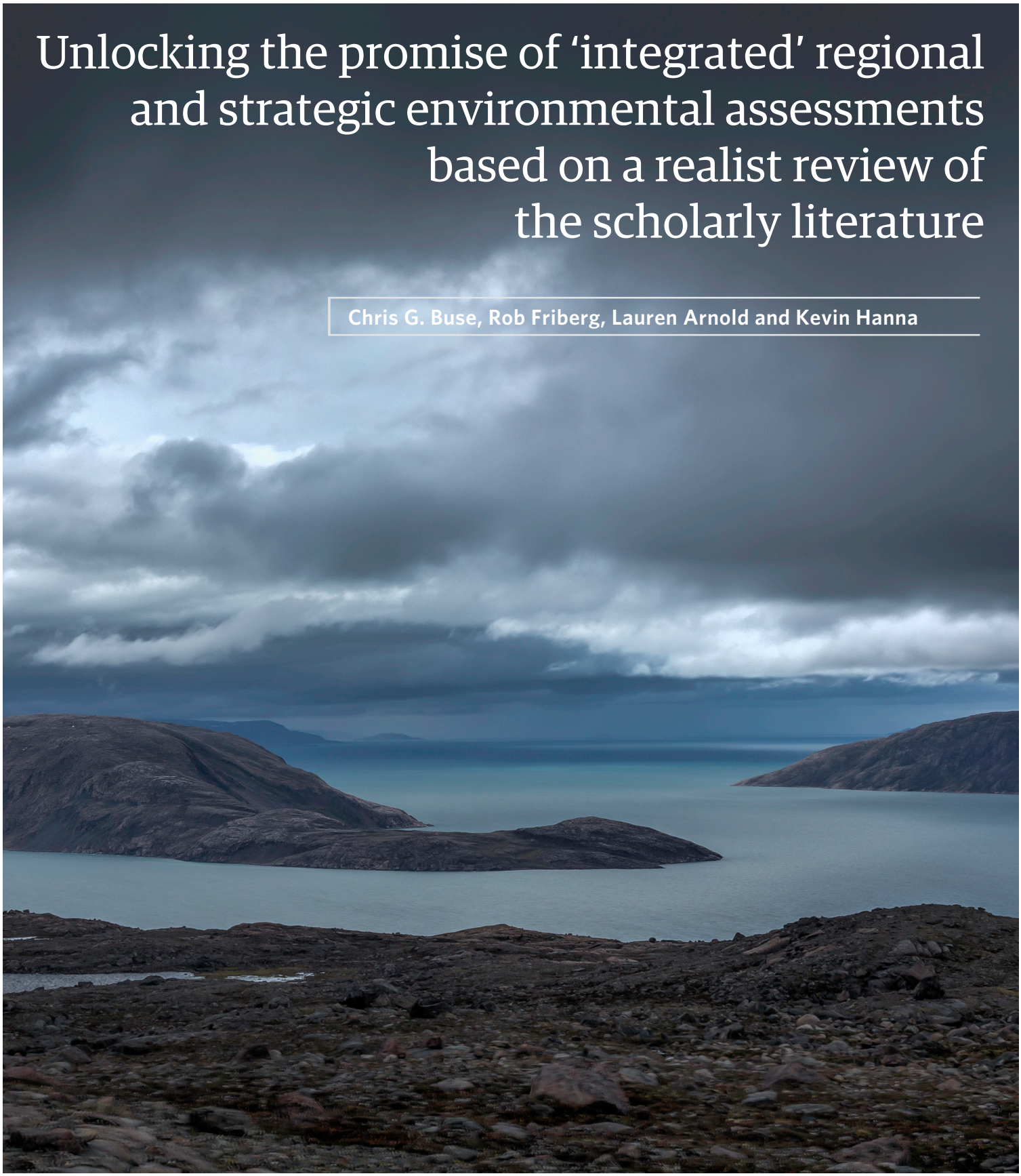

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EXECUTIVE SUMMARY

Background: Regional and strategic environmental assessments (RSEAs) have been forwarded as useful methodologies to overcome the limitations of project-specific environmental impact assessment. RSEAs are an important part of Canada's new Impact Assessment Act. The Act provides new guidance on how to trigger an RSEA, and significantly expands the purview of impact assessors and proponents to be assessing a variety of land-use values across environmental, community (e.g. cultural, socioeconomic) and health domains. In order to realize this integrative imperative, we require a contemporary picture of what integration looks like in the context of RSEA, and sets of criteria to assist decision-makers weigh tradeoffs between seemingly disparate, but interconnected, land-use values.

Objectives: This report shares results from the first phase of a two-phase knowledge synthesis project focused on RSEA. The goals of this project are to investigate the degree to which diverse land-use values (e.g. environmental, community, and health) are incorporated in RSEA protocols, and to identify practical ways in which decision-makers can make complex trade-offs in land-use decision-making processes.

Methodology: This study reviewed evidence published in peer-review journals from 2010-2019 focused on OECD countries and RSEA implementation. A realist review methodology was deployed to understand the contexts, mechanisms and outcomes of RSEA implementation, paying particular attention to methodological innovation that can help drive values integration and decision-making between seemingly 'competing' values.

Results: Our review surfaced two discrete bodies of literature: one on practical examples of integrated RSEA, and a second on methodological approaches to achieve integration. In both cases, community and health impacts were rarely conceptualized in so-called 'integrated assessments'. Among our practice-based case studies, the literature reviewed is relatively weak on practical advancements in RSEA despite widespread conceptual support, and provided limited information on decision-making processes and core outcomes. Descriptions of context and outcomes were relatively light in the peer-reviewed literature on RSEA, which will be remedied by Phase 2 of this study. 'Mechanisms' however, received significant attention, elucidating multiple and sometimes competing definitions of 'integration'. Methodological contributions further highlighted the centrality of quantitative approaches to conceptualizing valued ecosystem components, and there are a number of frameworks emerging to account for integration of temporal and spatial impacts, and to move towards a wider selection of community/health values. However, more attention is needed to understand how these can be adapted to practice-based assessments in different contexts.

Key messages:

- RSEA protocols are largely being advanced in the EU, Canada and the United States.
- There are few case studies of integrated assessments which account for a full array of environmental, community and health values. This is largely a result of RSEA growing out of the field of environmental impact assessment.
- Despite considerable developments in social impact assessment, economic impact assessment, and health impact assessment, the logics and methods underpinning these assessments have yet to be fully incorporated into RSEAs.
- Several promising methods for weighing tradeoffs between values are available to impact assessment practitioners, including compliance analysis and multi-criteria analysis
- The limited attention to extra-environmental values may reinforce inequities driven by different PPPs.

1.0 INTRODUCTION

Canada's *Impact Assessment Act* requires the federal government to document, describe and analyze the impacts of major projects from environmental, social, economic and health perspectives. This is in response to increasing calls for public consultation, the recognition of Indigenous rights and title, and an acknowledgment that social license to operate for a proposed project is intricately related to a variety of pre-existing projects and associated infrastructure, and multiple competing land-use values (Gillingham et al., 2016). (Duinker & Greig, 2005; Gillingham et al., 2016). It is now understood that project-based environmental assessment (EA) has fallen short of integrating more diverse land use values beyond valued ecosystem components (B. Noble, 2008), and may be ineffectual at fostering sustainability due to 'insignificant' and arbitrary thresholds for such components (Murray et al., 2018).

Numerous questions exist around best and promising practices for assessing the impacts of multiple projects across time and space, and associated governance and sustainability challenges (Buse et al., 2018; Parkes et al., 2019; Sinclair et al., 2008; Therivel & Ross, 2007). For example, managing the so-called 'cumulative impacts' of multiple resource development projects—that is, the impacts of past, present and future projects on environmental, socioeconomic and health values—are a significant concern in Canada and there are limited practice-based responses. In light of these limitations regional and/or strategic environmental assessments (RSEAs) have been advocated as an approach to redress the shortcomings of project-based EA (Lee & Walsh, 1992). Often considered as a complement to project-based EA, RSEAs have been characterized as systematic and holistic processes for evaluating environmental, social, economic and health considerations of a proposed initiative, policy or program (Brown & Thérivel, 2000; Fischer, 2010; Sadler & Dalal-Clayton, 2012).

This review examines examples of RSEA in practice, with an eye to examples of integrated assessment that explicitly measure and link the environmental, socioeconomic and health impacts of diverse land uses and/or specific projects. Phase 1 reviews the scholarly, peer-reviewed literature from the past 10 years that reports on implementation of integration (i.e. bridging environmental, socio-economic and health impacts) within established or on-going RSEAs in OECD countries. The goal of this phase is to better understand what works, for whom and in what contexts when attempting to understand trade-offs between diverse land-use values. Phase 2 examines practice-based documents (e.g. assessment reports, policy briefs, grey literature) of RSEAs identified in phase one, and using a case study approach, will extract practical indicators and lessons for achieving more robust integration of land-use values in RSEA to help inform the implementation of Canada's *Impact Assessment Act.* This report presents preliminary findings from the first phase of this study.

1.1 BACKGROUND AND POLICY CONTEXT

1.1.1. What are Regional and Strategic Environmental Assessments?

Regional and Strategic Environmental Assessments (RSEA) are typically part of formal regulatory EA processes. The 'regional' component of RSEA responds to the need to account for a broader geographic area than any one project's footprint, while also considering the influence of past, present and future developments in an assessment area (Sadler, 2011; Therivel, 2012). In order for a RSEA to be 'strategic', the assessment must be proactive in considering alternative development pathways in the context of a broad vision for a project, or collection of projects, that can be evaluated through goals and objectives (Noble, 2000; Stoeglehner, 2019; Unalan & Cowell, 2019). Strategic EAs are typically conceptualized as reviews of specific policies, plans or programs (PPP) of a particular industry or sector, whereas regional assessments typically comprise all industrial activities within a defined region. Confusion arises because strategic EAs can be regional in scope, having been bound by a certain geographic boundary (e.g. jurisdictional), and regional EAs can be strategic (e.g. scoping impacts from a specific sector).

Through its earliest iterations to the present, RSEAs attempt to leverage insights from environmental, social and health impact assessment methods in order to understand the impacts of projects to their respective values (Sadler & Dalal-Clayton, 2012). Following this logic, RSEAs provide unique opportunities to integrate numerous land-use values into a single assessment architecture while explicitly accounting for past, present and future projects on a wider land base (Bidstrup et al., 2016).

The state of knowledge surrounding RSEA is growing. This includes reviews of current methods and guidance for implementation (Fischer & Onyango, 2012; Gunn & Noble, 2009; Noble et al., 2012; Therivel, 2012; White & Noble, 2013; Zhang et al., 2013); and jurisdictional reviews of policies supporting RSEAs have been completed at the national and international level (Chaker et al., 2006; Harriman & Noble, 2008). However, to date, there are no evaluations of RSEA protocols in use that systematically account for the contexts in which they are implemented, nor are there structured reviews of the effectiveness of specific methods and/or best practices in data and indicator use for tracking interrelated environment, socioeconomic and health impacts over time (Loomis & Dziedzic, 2018; Runhaar et al., 2019). Moreover, despite the global proliferation of RSEA protocols and frameworks, practice-based evidence is typically outdated (Chaker et al., 2006; Noble, 2000) and may not be reflective of contemporary global priorities or land use values (e.g. climate change, current debates over criteria for social license to operate, Indigenous rights and title).

1.1.2 RSEA's Relationship to the *Impact Assessment Act*

The Canadian federal government has made fledgling commitments to assessing the impacts of PPPs since at least the establishment of the 1984 *Environmental Assessment and Review Process Guidelines Order,* which were clarified and reiterated under subsequent cabinet directives on EA reform through to the present (Gibson et al., 2010). This has laid a foundation for the notion of strategically assessing one or more PPPs across multiple sectors in the Canadian context, despite never being formalized in legislation. In terms of its relevance of to Canada under the new legislation, RSEAs present considerable opportunity to improve the

efficiency, effectiveness and fairness of assessments and decision-making processes. This is because RSEAs support collaborative governance across jurisdictions and government agencies, help address existing policy gaps, and support a precautionary approach to development (Doelle & Sinclair, 2018).

The relevance of our review to the *Impact Assessment Act* (the Act) is twofold. First, the Act requires proponents and environmental assessment review boards to document, describe and monitor not only valued ecosystem components that may be impacted by proposed development, but also diverse socioeconomic and health values. This integrative imperative responds to calls in the literature to move beyond a focus on valued ecosystem components and toward a more holistic understanding of the impact(s) of a PPP in the context of anthropogenic environmental change (Buse et al., in press; Cairns, 2013; Chapman & Maher, 2014; Gillingham et al., 2016; Tardieu, 2017). However, while the integrative approach in the new Act represents a significant advancement, there is limited practice-based evidence on how to realize this goal in the Canadian context. This review contributes to closing this gap by drawing lessons from RSEAs and associated methods implemented in other OECD countries to understand tradeoffs in value selection and decision-making, and to unpack what works, for whom, in what contexts.

Second, the Impact Assessment Agency of Canada (IAAC) recently finalized their policy guidance on how to request a regional and/or strategic environmental assessment. RSEA intersect with several policy guidelines in the act[1]:

1. Sections 92 and 93 of the Act enable the Minister of Environment and Climate Change Canada to authorize a regional assessment of existing or future physical activities on a region. In cases where a regional assessment is required, but the region does not entirely comprise federal lands, the Minister may develop collaborative agreements with lower order jurisdictions to conduct the assessment;
2. Section 95 allows the Minister to establish a committee or authorize a strategic assessment of any proposed policy, plan or program relevant to impact assessment; and
3. Section 97(1) lays out the requirement for the minister to respond within 90 days of receiving any request for RSEA, which must be posted on the Canadian Impact Assessment Registry.

Under the new legislation, anyone (person or organization) can request a regional or strategic assessment, and IAAC is required to acknowledge receipt of the request, undertake analysis of the request, and then make a recommendation to the Minister about whether or not the assessment should be done. According to the policy, recommendations as to whether regional versus strategic assessment should be implemented have slightly different considerations, but are largely related to the ability of assessments to meet federal goals, support an understanding of impacts on diverse communities and regions, create opportunities to collaborate with other jurisdictions, and satisfy public interest around perceived or actual impacts (Government of Canada, 2020). Advocates of RSEA purport it can enhance the

[1] More information including how to submit a request to undertake RSEA can be found at: https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/requesting-regional-strategic-assessment-iaa.html

efficiency and effectiveness of project-based decision-making across time and space, and yet implementation of robust RSEA has primarily been fledgling and inconsistent in the Canadian context (Doelle & Sinclair 2018). Even less clear is the existing degree of values integration in regional and/or strategic environmental assessment, and how Canada can benefit from knowledge of leading practices in RSEA implementation from other contexts.

1.2 OBJECTIVES

This project reviews case studies in the peer-reviewed and grey literatures of international and Canadian-relevant RSEAs in order to critically appraise the state of practice-based evidence on integrative application. We articulate of what integration means in the context of the RSEA literatures, and identify best practices to support the Canadian government's renewed interest in integrated impact assessment methodologies. To that end, the principle research question motivating this investigation is: "What are the leading practices for integrated RSEAs and how can those practices be contextualized to benefit future development in Canada and beyond?" This question addresses three intersecting knowledge synthesis objectives (SOs):

- SO1: Evaluate how integration is interpreted or conceptualized in nascent literature, and where possible, comment on how RSEAs manage complex trade-offs in meeting environmental, socioeconomic and health goals;
- SO2: Assess what works, for whom and under what conditions to identify challenges and opportunities for RSEA implementation in the Canadian context; and
- SO3: Examine the utility of RSEA for characterizing socio-ecological systems, and identify best practices for assessment (e.g. indicator and data use).

2.0 METHODS

RSEAs can be thought of as complex interventions, a policy approach that necessarily involves numerous sectors, multiple natural resource projects and pre-existing land uses, and a diverse array of land use values (e.g. environmental, community, health). Knowledge synthesis methods, such as realist reviews, have been developed to evaluate complex interventions with a high level of certainty to drive evidence-informed policy (Pawson, 2006). To understand the contextual mechanisms that drive successful RSEA implementation, we deploy a two phased review strategy. Phase 1 includes a realist review of the scholarly literature to identify examples of suitable RSEA case studies, and to identify how practice-oriented peer-review literature conceptualizes integrated approaches to RSEA. Phase 2 involves a review of original source documents, project summary statements, and grey literature supporting actual RSEA. This report focuses on findings from Phase 1.

2.1 STUDY DESIGN

Realist reviews are a form of knowledge synthesis that analyze the context(s), mechanism(s) and outcome(s) (CMOs) for social and public policy issues characterized by a high degree of complexity (Pawson et al., 2005). A realist review adds an explanatory focus to a systematic review (Pawson & Bellamy, 2006) by building an understanding what works, to what degree, for whom, and in what circumstances (Greenhalgh et al., 2011; Pawson et al., 2005). The 'realist' aspect of the 'realist review' is rooted in a social science paradigm that recognizes objective realities are always mediated by human perspective and the meanings attached to certain research objects are best viewed relationally (Olsen, 2010). Realist reviews therefore embrace methodological pluralism—combining both quantitative and qualitative reporting—and support comparative research by analyzing the contextual features of particular cases that may be of relevance to context(s) of interest (Edgley et al., 2016). To that end, realist reviews can articulate the underlying assumptions about how an RSEA is meant to work, what its intended outcomes are, and empirical analysis of evidence that supports, contradicts or modifies these assumptions (Pawson et al., 2005).

Procedurally, realist reviews follow several steps, although authors tend not to prescribe linear analysis pathways, opting instead for approaches that stress flexibility and inter-contextual comparison to best understand the CMO relationship(s) present in the data (Edgley et al., 2016). Our approach first defined project goals and convened our team of co-authors and research analysts. Next, we developed a key word search strategy to be applied alongside inclusion and exclusion criteria for the case studies.

2.1.1 Inclusion/Exclusion Criteria

We analyzed English language peer-reviewed journal articles of RSEAs published in the last ten years. Three databases were searched (Web of Science, GEOBASE and GREENFILE) using a common search string of key words (see also, Figure 1):

> "strategic environmental assessment" OR "strategic environmental impact assessment" OR "regional environmental assessment" OR "regional environmental impact

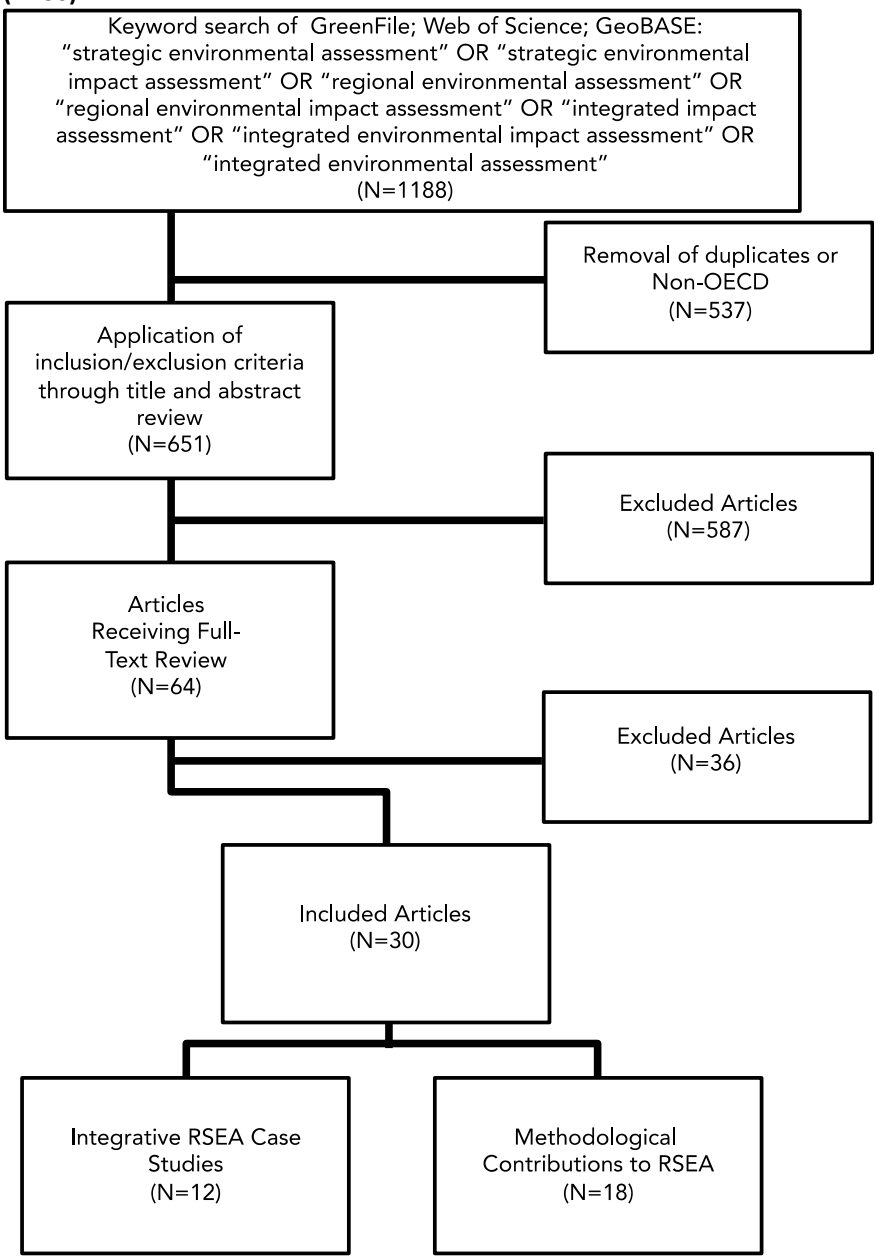
assessment" OR "integrated impact assessment" OR "integrated environmental impact assessment" OR
"integrated environmental assessment"

Once our initial database of articles was established we removed duplicate and non-OECD articles. This resulted in 651 articles that received title and abstract review to determine suitability for a full-text review. Inclusion criteria for title and abstract review included the following:

- English language
- OECD countries only (to enhance relevance to Canada)
- Published between 2010-2019
- Peer-reviewed articles in scholarly journals
- Some form of values integration, preferentially engaging with articles describing environmental, community and health values
    - Environment was defined as anything related to ecosystems or physical environments; community pertained to any socioeconomic, cultural, heritage, infrastructure or service delivery impact; and health was conceived of as a complete state of physical, emotional and mental health that is influenced indirectly by a multitude of 'determinants of health'
- 'Regional' in scope (i.e. consideration of impacts beyond a PPP's immediate project footprint)
- An element of practical assessment, providing links to practice-based evidence, with methodological guidance where possible

We reviewed the last 10 years of scholarly literature on RSEA to assess the measurement of multiple land-use values in policy contexts similar to Canada. Similar to the approach articulated by (Porter et al., 2013), our search strategy was designed to identify case studies of RSEA implementation from which our analysis of the CMO relationship(s) across each 'case' could begin.

Figure 1. Search Strategy to Identify Examples of Integrated Regional and Strategic Environmental Assessment (N=30)



2.1.2 Analysis Strategy

Analytically, realist reviews are meant to unpack the explicit and implicit assumptions of the CMO relationship found in empirical evidence, and to explore and explain differences in findings by attending to differences in context(s) (Gough, 2013). Procedurally, this was difficult to apply to the scholarly literature due to a lack of 'thick description' of the context and outcomes. However, 'mechanisms' of assessment were typically well-specified and documented in detail. Recognizing this limitation, our analysis unfolded in several iterative steps.

First, a draft excel file was created to 'chart' data. Data charting was designed to capture key information about the article, including the year published, the country in focus (and sub-jurisdictions), the name of the practice-based RSEA if supplied, the scale of analysis (e.g. nation-wide, within a state or provincial boundary, or some other form of regional boundary), whether environment/community/health values were measured and how, and the type of environment/community/health integration that was achieved in the article. Second, we created draft annotation documents that posed reflective questions for analysts to answer as they were completing full text reviews. These included title/author/year for each article; links to related documents (such as links to RSEA practice-based documents); the principle contribution of each article (e.g. its thesis statement); responses to prompts regarding the context(s)/mechanism(s)/outcome(s) from each study; and any general observations and comments on how integration played out within in the context of the article.

Each of these tools was then applied by three team members to a random selection of five articles from the 64 articles identified for full-text review. Team members met to discuss results including inclusion/exclusion criteria and individual judgements about whether each article was in scope. In the one case where analysts disagreed, a decision to include/exclude was made by a simple 2/3 majority decision. Analysts also compared their notes and reflections at this time to ensure intercoder consistency and to standardize, as much as possible, the process of annotating articles. Two analysts then conducted the remaining full text reviews, identifying 30 articles as in scope and contributing to the objectives of this review.

In a subsequent step, we re-read our annotations and realized we had two distinct samples in our included literature. The first group were applied case studies of RSEA that utilized integrative indicators in their assessment (N=12), and the second were cases of methodological integration in RSEA methods that were not part of a formal RSEA process, but which purport to strengthen existing methods through the use of integrative research strategies (n=18). We report on findings below, with particular attention to how this pool of resources can strengthen RSEA protocols moving forward.

2.2 LIMITATIONS

Some limitations should be noted regarding the results of this first stage of the review. First is that while this first of two phases is meant to elucidate scholarly understandings of integration in practical RSEA studies it is the second phase that takes a deeper dive into original source material for specific RSEA case studies. In Phase One we found a lack of consistent and thick description in many scholarly articles as to the context and outcomes of RSEA implementation.

Important lessons can still be derived from the first phase review of scholarly literature, particularly in terms of methodological innovation to achieve values integration across environmental, community and health domains. However, the reporting on actual mechanisms, particularly in terms of indicators and evaluated outcomes, is relatively light in the scholarly literature. Thus, the 'realist' component of this review we anticipate to be more significant in the forthcoming review of associated/ancillary case study documents in Phase 2.

Second, we found that much scholarly literature is dedicated towards the conceptualization of RSEAs, with limited practice-based evaluations of actual studies. Our study surfaced 328 references that were conceptual contributions, rather than practice-based

contributions to the RSEA discourse. The limited practical focus in these articles is one of the gaps this project sought to fill at the outset, recognizing the need to build better practice-based evidence. We plan to utilize these conceptual works to help inform our discussion in this report, and to serve as a roadmap or 'checklist' for future work as we dive into practice-based grey literatures linked to applied case studies.

Third, we found a significantly greater focus on strategic environmental assessment relative to regional environmental assessment. However, we found that of our included studies, most strategic environmental assessments are typically regional in scope anyways. However, it does imply a degree of muddiness between the 'regional' and 'strategic' nature of assessment in practice, whereby a regional assessment may not necessarily have to be strategic in terms of measuring the impacts of a specific PPP, but strategic assessments typically have a requirement to play out across geographically bounded scales, perhaps making the regional aspect a necessary component.

3.0 RESULTS

The search strategy identified 30 articles relevant for inclusion in Phase II (see Figure 1). Of the original 651 articles with an OECD-focus receiving title and abstract review, 410 were in the EU context and 158 in North America. Upon further applying our inclusion/exclusion criteria through the process described above, we identified approximately 64 articles to receive full-text review. This yielded 30 articles that were separated into two distinct groupings of literature: [1] case examples of integrated RSEA (N=12); and [2] methodological contributions to RSEA (N=18).

3.1 GEOGRAPHIC DISTRIBUTION OF INCLUDED ARTICLES

Across all included articles (N=30) 10 focused on a local scale (e.g. specific city, town or neighbourhood) and 16 were regional (e.g. a specific ecosystem or another bounded geographic area comprising multiple townships or governance jurisdictions). Only one article pertained to a nationally-scoped RSEA (see Table 1). Many of our articles were EU-specific, where there are existing policy directives to support the assessment of environmental, community and health values in SEA, and RSEAs have seen considerable integration into local and regional planning processes. Three articles had no specified geography but share methodological contributions that could be relevant across a wide variety of countries and spatial/temporal scales.

Table 1. Geographic distribution of peer-reviewed articles on integrated regional and/or strategic environmental assessment

Literature Groupings	N Articles	Local	Regional	National	No Geography Specified	Countries Included
Integrated RSEA Case Studies	12	5	6	1	0	Australia (2); Canada (2); Italy; Ireland; Portugal; Scotland; Switzerland; Spain; United Kingdom; EU focus
Methodological Innovation to Achieve Integration in RSEA	18	5	10	0	3	No national focus (3); United States (2); England (2); Spain (2); Australia; Canada; Chile; Ireland; Italy; Mexico; Portugal; South Korea; Sweden
Total	30	10	16	1	3	

3.2 DEGREE OF INTEGRATION BETWEEN ENVIRONMENT, COMMUNITY AND HEALTH VALUES

A principle objective of this review is to understand how integration is conceptualized in a sample of literature focused on 'integrated' RSEA. Our assumptions around regional and/or

strategic assessment are that they are necessarily integrated across dimensions of time and space. All included articles maintain such an integrated focus, with the core thrust of our research to understand how diverse land-use values are attended to in RSEA implementation, versus a merely conceptual focus.

Among our integrated RSEA case studies our literature charting process identified that no articles had a sole community and health focus on integration. Some integrated environmental and human health concerns (N=2), and others integrated across environment and a wide variety of 'community' values (e.g. socioeconomic, cultural, heritage, behaviors, infrastructure, service delivery, etc.) (N=8). Only two articles integrated across environmental, community and health domains (see Table 2).

Of those articles that had a principally methodological focus, there were 10 articles focused solely on the evaluation of multiple environmental values and one focused solely on multiple community values. This demonstrates the multiple meanings and interpretations of 'integration' in the RSEA literature, whereby often 'integration' was made in reference to one or more research methods, or the merging of two or more environmental values (e.g. climate change and biodiversity goals).

Table 2. Domains of integration among a review of peer-reviewed articles focused on integrated RSEA (N=30)

		Domains of Values Integration			
	Total Articles	Environment + Community	Environment + Health	Community + Health	Environment + Community + Health
Integrated RSEA Case Studies	12	8	2	0	2
Methodological Innovation in RSEA	18	5	0	0	2

For example, the following themes related to 'integration' emerged from the methodological articles: geospatial analyses with various land-use planning processes (N=7); sustainability in its broadest sense as it relates to a SEA (N=2); climate change with biodiversity (N=1); and multidisciplinary expertise among environmental and sustainability disciplines (N=1). Articles focused on land-use planning highlighted the potential for integrating geospatial tools into assessment practices. They caution, however, that multiple impact assessment tools can also diminish the effectiveness of decision-making by introducing to much complexity, and may complicate the balancing of environmental sustainability with socioeconomic conditions. Our review did surface several articles focused on integrating environmental and community values (N=5) and others focusing on environment, community, health integration (N=2) (see Table 2).

The applied RSEA case studies demonstrate the significant influence of EU policy directives on driving values integration, with the majority of case studies attending to community-features relative to health. However, only two articles in each sample merged environmental, community and health values within a singular impact assessment architecture. Even in cases where diverse values integration occurred, environmental components remained the central focus.

3.2.1 Contexts, Mechanisms and Outcomes of Integration

The RSEA case studies (N=12) demonstrate a greater degree of values integration than methodologically innovative studies (N=18) (see Appendices 8.1/8.2). Nine articles noted that SEA protocols established by the European Union were the primary mechanism for driving integrated assessment, whereas in Canada and the United States, considering 'cumulative effects' was the driving factor—to account for multiple projects across time and space, and/or to engender a planning process that is attentive to multiple domains of impact (see Table 3).

Across the entire sample (N=30), health values are the least likely to be incorporated into SEA protocols, with two reviews highlighting how health is inadequately included, even under established EU protocols that call for health integration into RSEA (Diallo et al., 2018; Douglas et al., 2011). There is mixed-evidence to suggest that a sustainability focus in SEA can drive the incorporation of more-than environmental values. That is, sustainability oriented articles occasionally address community values through a triple bottom line incorporating labour and economics. However, most focus explicitly on the integration of environmental values.

Trust, social participation, and engagement of diverse sectors and stakeholders (including 'experts' and those with significant lived experience) are viewed as central to RSEA. Cost-benefit or multiple-criteria analysis (e.g. where values are weighted against one another and against the strategic goals of the assessment) were common practices. However, there is limited evidence among our sample that SEA is particularly effective at balancing values or establishing clear trade-offs and thresholds for values to enable transparent decision-making (Appendix 8.1). Also, the scholarly literature is particularly light on how decisions are/were made in situations defined by complex interconnections among diverse land-use values and priorities.

There appears to be disagreement in almost all practice-based case studies around whether the selection of alternative development pathways was successful, adding additional impetus to evaluate practice-based reports and data that can clarify these evaluative elements. In particular, the peer-review literature makes few value judgements about success of the RSEA and who it was successful for. Moreover, SEAs have been critiqued for not being 'strategic' if they take a descriptive or emergent approach (Bidstrup & Hansen, 2014). The available practice guidance around RSEA strategy to date suggests staying as true to the value statement and intent of the SEA from the outset—in terms of establishing clear statements of values or principles for the assessment. Beyond this there is limited analysis of what success means in practical settings (i.e. in terms of methods, data, indicators, and analysis) notwithstanding considerable conceptual guidance on what SEA effectiveness 'ought' to look like. These topics will be a focus in Phase 2 of this research.

3.2.2 Methodological Opportunities for Improving the 'Mechanisms' of RSEA

We can glean some insights into practical innovations that may help achieve effective, integrative RSEA by looking at methodological contributions from our second sample of articles (N=18, Appendix 8.2). While the degree of values integration was also relatively low among the methodological articles, several themes did emerge.

First, quantitative indicators were central to all RSEA methods, but there is limited specification about how to balance indicator selection according to values domains to ensure an adequate spread of diverse values. We also found, likely because RSEA has emerged out of environmental impact assessment practice, a bias toward integrating ecosystem versus other values. Some studies utilize different characterizations or themes for indicator selection (e.g. drivers, pressures, states, impacts, responses as per Lynch, 2011), some studies use existing data sets rather than collecting new information (Mascarenhas et al., 2012), and some studies differentiate between vulnerabilities or threats to different values to bolster sustainability (Martinez-Grana et al., 2014).

Second, there is a growing focus in the RSEA literatures on how to account for the full life-cycle of a PPP, and life cycle assessment can assist robust decision-making (Bjorklund, 2012; Brandão et al., 2010). This includes the integration of multiple temporal impacts of a PPP and its alternatives, and an evaluation of economic costs and benefits of various actions on value domains of interest.

Third, among articles that had any degree of values integration, the focus was principally on integrating environment and community impacts (N=5). The methods advocated for to achieve such integration include: life cycle costing (Brandao et al. 2010); systems dynamics modeling, Bayesian networks, coupled component models, agent-based models and knowledge-based models (Kelly et al., 2013); directional distance functions to quantify the extent of maximizing desirable outcomes and mitigating negative outcomes (Macpherson et al., 2010); and dynamic and embedded evaluation procedures to build consensus among diverse stakeholder needs (Naddeo et al., 2013).

Fourth, methods used for the integration of values across our three domains of environment, community and health include: multi-criteria analysis and multiple standardized indicator scores for weighing tradeoffs around proposed PPP and their identified alternatives; ‘compliance analysis’ (Thompson et al., 2013); and the Drivers-Pressures-Conditions-Response framework into SEA to explicitly map the connections between ecosystem services and their connection and influence upon human communities (Harwell et al., 2019).

4.0 IMPLICATIONS AND DISCUSSION

A considerable body of peer-review scholarship on RSEA protocols and processes has been published in the past 10 years. In the Canadian context, SEAs are diverse and often disconnected from governance systems that direct integrated planning processes (Noble et al., 2019). Effectiveness of RSEA has been found to be strongly related to its compliance with strategic goals (Lechner et al., 2015). Practically, SEAs are largely *ad hoc*, and have limited provisions for public engagement, which was seen as a limitation on their effectiveness. Concerns about public engagement have been ameliorated In the Canadian context with the creation of the Impact Assessment Act (Joao & McLauchlan, 2014; Noble et al., 2019). Moreover, practitioner surveys indicate that for SEA to be truly strategic with long-term benefits it has to address indirect impacts early in the design process, and be adequately resourced (Acharibasam & Noble, 2014).

Despite growing calls for greater integration in environmental assessment (Chapman & Maher, 2014), we found limited practice-based papers attempting to integrate a variety of environmental, community and health components. In general, we note that despite the considerable body of peer-review scholarship on RSEA protocols and processes, there are few applied case studies to draw from, which limits the ability to assess the application of component selection, measurement and evaluation in real-world assessment settings. Most articles in our original sample focused on conceptual contributions to RSEA with limited practical guidance on how to carry it out. Authors signal the incredible complexity of indicator selection, and a growing focus on incorporating sustainability principles in SEA. There are also identified needs for effective methods that can simplify complex data to enable comparisons between diverse values to guide decision-making.

The most significant finding of this report is that the term 'integrated/integrative' is used and defined inconsistently. Some authors use these terms in line with the goals of the review—to incorporate broad land-use values into a single assessment architecture, while others describe it in relation to methodological tools, multiple environmental components, or for integrating across assessment types or spatial scales of assessment. Socioeconomic and health considerations are often incorporated less systematically than environmental considerations, and may be inconsistent and not clearly articulated.

Since the integration of multiple values is at the heart of this research, and given its prominence in the new legislation, it is worth briefly unpacking the assumptions of the goals and intent of integration in the context of RSEA. The broader strategic and spatial analysis of multiple land-use values can now be interpreted as necessary condition under the new *Impact Assessment Act*. Our literature review demonstrates the myriad interpretations of integration. Tardieu (2017) recently conceptualized integration according to several key domains of focus in the context of ecosystem modeling for impact assessment: multiple values, multiple ecosystems, multiple stakeholder perspectives, multiple disciplines and multiple temporal and spatial scales. Buse et al. (in press) recently expanded this notion, building on earlier contributions from Gillingham et al. (2016) to conceptualize the multiple integrated elements at play when considering the impacts of rapid environmental change (see Table 4). We contend that integration should, at a minimum, include spatial and temporal scale, and multiple land

use values. The incorporation of multiple land-use values therefore necessitates the involvement of multiple sectors, disciplines, approaches and senses into the assessment.

Table 4. Examples of Integrative Imperatives in Impact Assessment

Integrated Element(s)	Dimension	Examples
Multiple Scales	Spatial	Local, Regional, National, International, Planetary
Multiple Points in Time	Temporal	Past, Present, Future
Multiple Sectors	Sectoral	Industry, Healthcare, Public Health, Natural Resource Management, Planning, Social Services, Environment, Housing, Social and Economic Development, Military and National Defense
Multiple Land-use Values	Value-based	Environment, Community, Health
Multiple Methods/Approaches/Expertise	Disciplinary	Qualitative, Quantitative; Biomedical, Veterinary, Social Determinants, Political Science, Geography; Technical vs. Lived Experience
Multiple Senses	Sensory	Head, Heart, Hands

(Adapted from Buse et al. (in press), with permission)

Our review also highlights several limitations of RSEA practice at present. First, there is a significant bias in the existing research base towards quantitative analysis of easily measurable components. This can inhibit the selection of diverse values for assessment, and makes existing data bases (e.g. survey-based census information) a de facto data source for RSEA. While the comparability of these data sources is a key strength, they may not adequately capture important local values which require an established baseline in order to be evaluated moving forward. Broadening the participatory elements of RSEA can facilitate utilization of qualitative approaches for value selection and verification.

Second, in some cases, integrated impact assessment can be stymied by legalistic approaches which can retrench existing 'expert-based' planning over collaborative approaches. Moreover, whereas effective integration requires considerable multi-sector resources (Rehhausen, 2019), under-resourced agencies rely significantly on proponent reports to drive decisions. Even in light of EU directives for SEA and the Directive on Environmental Impact Assessment, many member states make limited use of these directives to support holistic assessments (Weingarten, 2010).

Third, RSEA has some notable disciplinary blind spots, and tends to be implemented using similar approaches as project-specific environmental impact assessment. This makes RSEA likely to fall prey to pitfalls of being overly reliant on a single project, being principally focused on valued ecosystem components, and potentially missing key dimensions of impact across time and space (Noble & Nwanekezie, 2017). Moreover, if RSEA is rooted in the logic of environmental impact assessment, it may miss opportunities to broaden the scope of values integration (Lobos & Partidario, 2014). The fact that RSEA is a product of environmental impact assessment as a field is not necessarily problematic. However, those practicing environmental impact assessment also have the opportunity to draw from established methodological approaches for understanding the social and health impacts of PPPs, including social and health impact assessment approaches.

What is clear from Phase 1 of this review is that socioeconomic dimensions are more readily being incorporated into RSEA practice than health dimensions. Also, most 'integration' is occurring through a melding of research methods or including a wide array of valued ecosystem components. For example, a review of socioeconomic integration into SEA found that the complexity of connections between PPPs necessitates multi-stage, iterative decision-making that accounts for systems emergence and which may be at odds with a 'strategic' approach (Tamosaitiene & Kaplinski, 2013).

Notwithstanding the potential capacity issues associated with the time and resources required to truly work across sectors, the lack of health uptake in SEA has been explained by the siloed nature of the health and land-use governance sectors, and the need for more holistic planning processes (Bond et al., 2013; Fischer et al., 2010). However, even in jurisdictions with strong policy guidance on the assessment of health, in cases where health is included, it is narrowly defined as the effects of projects on physical health (Diallo et al., 2017). Moreover, even when health is being considered, a full range of health impact assessment is rarely leveraged in practice, where health impact assessment methods have been found to more comprehensively assess health impacts relative to SEA protocols (Gray et al., 2011). This means that there is an analytic requirement for other values, but health especially, to be part of integration in the context of RSEAs more generally, and to move beyond conventional definitions of health that privilege direct, biophysical risks, and is expanded to encompass indirect health risks and impacts to the determinants of human health and well-being.

5.0 CONCLUSION AND FUTURE DIRECTIONS FOR RESEARCH

This report explores the interface of environmental, community and health impacts in RSEA to draw attention to the integrative imperatives of holistic impact assessment processes. Integration currently has many interpretations in the contemporary literature, and greater guidance and clarity is required, particularly when integrating across multiple land-use values that are impacted by PPP across a variety of spatial and temporal scales. Our review surfaces several key knowledge gaps. First, a key challenge for integrated impact assessment, particularly in an era of increasing natural and anthropogenic environmental change, is how best to promote effective action across multiple sectors to support healthy and just outcomes for environmental sustainability, community economic development and the promotion and protection of human health (Parkes et al. 2019).

The methods outlined here, and the interim results from phase 1 of this study provide ample opportunities to further RSEA in the Canadian context, and subsequent research will more thoroughly detail the contexts, mechanisms and outcomes of integrated RSEA case studies to inform study protocols and methodological innovation to support the *Impact Assessment Act*. We aim to strengthen this work and meet this knowledge gap through the continued use of realist review methods as we transition to Phase 2 of this project.

Second, increased focus on health and community (e.g. socioeconomic, heritage, culture) values will necessarily draw increased research attention to the equity dimensions of who is impacted by what PPP. Many of the environmental impacts that precipitate impacts to local economies, cultures and health are not distributed equally among all members of society, and may disproportionately impact people who already bear the brunt of impacts from past land uses. The fact that these considerations did not factor into any of our reviewed articles suggests further policy guidance on promoting equitable and sustainable transitions in the context of RSEAs are greatly needed to drive just outcomes. This is particularly relevant to Canada's colonial context, it's history of physical and cultural violence against Indigenous peoples, or where known vulnerable groups are differentially exposed to environmental harms under unjust land-use policies. How to ensure fair, just and equitable outcomes in RSEA is an area ripe for further investigation. Finally, the *ad hoc* nature of RSEA implementation lends itself to deploy diverse research and analysis methodologies. This signals the need for capacity-strengthening efforts that promote understanding of the multiple meanings of integration in RSEA in order to clarify strategic intent, and to use clarity about strategic intent to effectively match goals with appropriate research methods. We will continue to explore these methodological connection points in Phase 2 of this project.

6.0 KNOWLEDGE MOBILIZATION ACTIVITIES

Building evidence-informed practice through a review of the practice-based evidence is central to developing effective social policy (Green, 2008; Green, 2006). The realist review methodology provides an excellent opportunity to understand how assessment approaches and policies can be targeted to counter an ever-changing landscape of interrelated ecological, socioeconomic and health issues associated with the future of Canada's natural resource industries. As the project continues to unfold, we will mobilize the knowledge acquired through our review through publications, presentations and workshops with key stakeholders, with the goal of elaborating on how this review can spur additional participatory projects among government, industry and academic knowledge users interested in the deployment of RSEA in their own jurisdictions. This is in line with recommendations on how RSEA must be coupled with innovative approaches to governing project approvals, including commitments to intersectoral learning and adaptive management.

6.1 OVERVIEW OF KNOWLEDGE MOBILIZATION STRATEGY

Co-investigators Buse and Hanna will draw on diverse resources to mobilize the knowledge generated through the realist review, and benefit from established networks of both lead researchers as well as project collaborators. The team is actively involved with several national and international knowledge networks that create multiple opportunities for knowledge exchange, including:

- **The Centre for Environmental Assessment Research (CEAR):** The CEAR at UBC brings substantial knowledge mobilization experience to this project. The CEAR supports an existing professional development and training workshop series, issues extension materials and reports for government and other practitioners, and maintains a network for information and knowledge exchange with provincial, federal, Indigenous, and other organizations. The CEAR Advisory Table, composed of people from outside academe, provides a key mechanism to reaching out to the *diverse communities of impact assessment* practice. CEAR will provide logistical support (design, internet hosting, editing, and event coordination) to support the production of print, digital, and face-to-face communication and dissemination of project outcomes. For more information, see:

- **The Environment, Community, Health Observatory (ECHO Network):** Launched in 2017, the ECHO Network is a five-year pan-Canadian project that brings together university researchers and local research partners who have identified a need to better understand and respond to the health, environment and community impacts of resource development. As the project has unfolded, the need for integrative approaches to impact assessment such as RSEA have been identified as a clear priority, including expressed interest across four regional cases of researchers and partners, for specific knowledge exchange opportunities that will enhance

understanding of and capacity to apply integrative assessment processes. For more information, see: https://www.echonetwork-reseauecho.ca

To ensure that the findings from our review are distributed across scholarly, practice-based, and research-partner audiences within and beyond these networks, our knowledge mobilization strategy will utilize and combine (a) scholarly publications and reports, (b) scholarly presentations, and (c) partner-engaged workshops and events.

Scholarly Publications and Policy Briefs. We anticipate a minimum of three publications sharing results from the review in high-impact journals. Each journal article will be accompanied by a short (e.g. 1-2 pages) policy briefing note that will be distributed to colleagues at CEAA and the BC Environmental Assessment Office, and posted in the resources section of the CEAR and ECHO webpages.

Delivery of Scholarly Presentations. We anticipate several opportunities to present our findings to scholarly audiences. We will attend SSHRC-sponsored knowledge mobilization events held in Ottawa to share our findings with other recipients of knowledge synthesis funding that are responding to important questions about the continued development of Canada's natural resources and their implications for Canadian people, communities, environments, and economies.

Leveraging from the research networks described above, we have also identified multiple opportunities to benefit from regularly scheduled research presentations, brown bag lunch discussions, and formal symposiums that are undertaken by institutions in which we work. Of particular note is a commitment of the Western Node of the Canadian Community of Practice for Ecosystem Approaches to Health (co-led by Buse and Parkes, see: www.ecohealthkta.net) to utilize their 'webalogue' platform to share research results, and opportunities to present this work at the UBC Department of Community, Culture and Global Studies' Speaker Series. We will also support our graduate RAs to travel to a relevant national or international conference to share research results.

Delivery of Workshops and Events co-designed with collaborators. The ECHO and related networks are each in the process of identifying workshops and events that create opportunities to share and profile the work of this realist review. As described in the budget, we are committing financial resources to this grant to facilitate a special session that brings together audiences from across the Networks noted above. This will include a future invited workshop held at the UBC-Okanagan Campus which will simultaneously be publicly webcast. Invitees will include collaborators and interested colleagues from the ECHO and CEAR Networks, as well as provincial and national ministries (broad inclusion of environmental, socioeconomic and health sectors), impact assessment practitioners, Indigenous community members, and industry proponents to support the implementation of the *Impact Assessment Act* and BC's Environmental Assessment Revitalization process.

Reports, publications, policy briefs, and slide decks will all be shared on the CEAR and ECHO websites and distributed through annual reporting. Further, the ECHO Network's mandate is to foster dialogue and solicit input from research partners about the use of

integrative assessment approaches to address the cumulative environmental, community, and human health impacts of various forms of resource development. We will use our ongoing interactions across the four ECHO regional cases as an opportunity to solicit broad researcher and partner input on the design of workshops and events to optimize the impact and utility of the findings of our realist review. Informed by these interactions, the ECHO Network team will create additional knowledge mobilization opportunities through pre-existing mechanisms, including: 1) knowledge-to-action workshop activities that are hosted by regional cases, where there is already significant interest to deliver a workshop or presentation on RSEA and related topics for the Northern BC Regional Case (of which, Buse is a co-lead); and 2) annual cross-ECHO learning and exchange events which engage the networks broad array of civil society and government partners to share information and learn about the cumulative impacts of resource development.

These workshop and activity sessions will be co-designed to share findings from the realist review, while also adapting the structure and processes to reflect the values and place-based priorities of different contexts. These sessions will explore findings with participants, serving to share knowledge from the synthesis, validate information from the review, identify further research gaps not identified by the review, and to foster dialogue in the pursuit of bolstering Canada's commitments to integrated impact assessment. The value of these workshops will be to generate new research questions that are rooted in and responsive to diverse local, provincial and federal needs. Using our existing networks, we will be able to connect directly, formally and informally, with government, Indigenous organizations, civil society, industry and consulting, and the research community to better. This strategy enhances the potential for ongoing partnerships that foster solutions-oriented research and practice.

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8.0 APPENDICES

8.1 CONTEXT-MECHANISM-OUTCOME RELATIONSHIPS FOR EXAMPLES OF APPLIED RSEA CASE STUDIES IDENTIFIED FROM A SYSTEMATIC REVIEW OF THE LITERATURE (N=12)

Author(s)/ Year	Context	Mechanism(s)	Outcomes	ECH Integration
(Carvalho et al., 2017)	3 Case studies of high-speed rail (Portugal, UK, Lithuania-Latvia)	EU SEA Directive: Public participation, timing of SEA, interactivity between SEA and other planning processes, legal foundation, scope and objectives of assessment, tools and techniques, disclosed uncertainties, monitoring and follow-up.	In all studied cases, SEA would have been most beneficial if completed before projects to determine alternatives and enhance sustainability objectives.	EC
(Diallo, 2018)	Variety of EIAs, SIAs and SEAs (11) to determine integration of health into impact assessment at the canton of Geneva in Switzerland.	Direct and indirect health outcomes are mandated under a 2001 EU directive for SEA.	Health is not adequately integrated into impact assessment. Lack of clarity between Swiss and EU legislation limits full aspirations of EU SEA protocols. Organizational capacity and improved jurisdictional collaboration is required. Health may be challenging to integrate if it conflicts with economic project goals.	EH
(Douglas, 2011)	Review of 62 consecutive SEA reports in Scotland to understand integration of health in project appraisal.	SEA is required under Scottish and EU legislation, where health is one identified factor to be included. Analysis focuses on health-related environmental problems, health-related objectives of SEA and identification of differential impacts on different populations.	Considerable variation in the measurement of health across SEAs, and typically not clear what evidence had been used to inform what decision. Limited assessment of actual differential impacts or engagement with health equity within this sample of documents.	EH

(Franks et al., 2010)	Three regional assessments of coal mining areas in eastern Australia to understand interface of environmental impacts and impacts to regional communities.	Cumulative effects analysis based on industrial activity, measuring activity-specific impacts and their interaction with project-related and exogenous factors. Cumulative effects are required part of project appraisal in Australia.	Despite the requirements to consider cumulative impacts in project approvals the treatment of these impacts is mixed, there are often limited mentions in EIS, the authors note that proponents face data and capacity challenges for CEA and promote strategic assessment as a way to more effectively account for cumulative impacts.	EC
(Kirchhoff et al., 2011)	A SEA of regional infrastructure planning in York Region of Canada which is facing significant development pressure, countryside to urban conversation, population growth and significant growth demands on infrastructure.	The SEA evolved from project-based EA and was merged with protocols for sustainability assessment. Authors focus on SEA as a tiered approach to studying multiple impacts, SEA as a communication tool to multiple jurisdictions and audiences, and as a driver of sustainability.	The SEA supported the regional plan that instilled 9 principles in future development: long term perspective; evaluate using the triple bottom line (social, economic, environment); culture of continuous improvement; identify short term achievable actions; set targets and monitor; foster partnerships and engagement; create a spirit of stewardship; raise sustainability awareness and education; promote sustainable lifestyles. Authors emphasize that the plan falls short in addressing equity/social well-being, ongoing decision-making across multiple jurisdictions remains a challenge, SEA primarily succeeded as a communication tool for EA and in charting higher expectations for project specific EA.	EC

(Cooper, 2011)	Uses 8 UK case studies of SEA and sustainability assessment to understand how cumulative effects were addressed in Regional Spatial Planning Strategies, with detailed evidence on two development plans for specific neighbourhoods.	Cumulative effects and SEA are required under UK law. Authors specify that SEA in UK is principally environmentally focused, while sustainability appraisal tend to incorporate economic and social issues.	Regional scales enable assessment of cumulative effects and the means to integrate social, environmental and economic considerations into planning. Identifying sustainability goals was seen as pragmatic and necessary to establishing clear values and objectives.	EC
(Miralles I Garcia, 2017)	Uses the case study of metropolitan and coastal planning in Valencia Spain post 2008 economic crisis, to re-evaluate process of urban expansion and tourism possibilities that leave legacies for environmental, social and economic conditions.	Operating under the EU SEA directive, authors created three zones: zones that do not present limitations for urban use, zones that present limitations for urban use but at a reasonable cost, ad zones that present strong limitations. Upon mapping these zones, they classified them based on vulnerability in terms of irreversible destruction to natural capital from development activities, weighed against the economic cost of offsetting impacts.	Limited evidence of success is provided in the paper, but authors indicate that merging understandings of capability of existing ecosystems versus future vulnerability can be effective for creating alternative development pathways.	EC
(Moran et al., 2013)	Uses a SEA/Cumulative Effects framework to establish a structure to select appropriate regional indicators relevant to the mining and grazing industries in New South Wales, Australia, and to redress identified constraints for monitoring cumulative impacts at a regional scale.	A capitals framework is introduced based on multiple understandings of diverse capitals and how they 'flux' between reservoirs. Specific values are natural capital (including renewable and non-renewable capital); manufactured capital; social capital (networks, social organization, cooperation and trust); human and financial capital.	A capitals framework can provide a useful framework to indicator selection in contexts where "the connections between components in a region are as important as the state of the elements themselves" (p.733). However, more research is required to systematize this process and create a formal mathematical methodology.	EC

(Partidario & Coutinho, 2011)	Following 40 years of indecision and controversy over the location of a new international airport in Portugal, a SEA was undertaken to identify potential alternative sites.	Under an EU directive, the SEA analyzed seven factors deemed critical to analysis: safety for air navigation and transportation, natural resources and associated risks, biodiversity and nature conservation, accessibility, spatial planning, social and economic competitiveness and financial feasibility. Using these strategic objectives and by deploying cost-benefit analysis, the SEA was ultimately independent, transparent, had open terms of reference, focused on critical environmental factors only, and narrowly scoped assessment criteria from physical, ecological, social, economic, and political interests.	The approach deployed ensured adequate direction in a highly complex assessment situation, and successfully avoided pitfalls that would have otherwise been marginal or secondary to the strategic nature of the assessment. The SEA resulted in the selection of a new location for the airport, and while disagreement persisted, there was "a general feeling of acceptance" (p.366) of the decision.	EC
(Rocchi, 2012)	A SEA of the Trasimeno Park in the Umbria Region of Italy was initiated to plan and protect the environment and social and economic plans for the park moving forward.	There are broad Italian and EU policy requirements for SEA. This SEA deployed stochastic multi-criteria acceptability analysis to assist decision-making for landscape-level planning in a sensitive park area. The method involves stakeholder and decision-maker preferences along several decision-criteria: water protection, political acceptability, governance challenges, traditional production activities, tourism development and environmental/biodiversity.	The method arrived at a "most acceptable alternative" scenario to inform future planning activities. The method is most helpful in cases with multiple decisionmakers who do not want to immediately clarify their preferences while still arriving at an appropriate solution.	EC

(White & Noble, 2012)	A quantitative SEA framework is applied to the electricity planning sector in Saskatchewan, Canada in an attempt to operationalize principles of sustainability, and to operationalize sustainability in the context of long-term development which is characterized as a "complex and often fuzzy PPP issue" (p. 285).	Utilized expert-based assessment panel and 8 assessment criteria with the goal of operationalizing sustainability principles. The analysis focused on employment and income values, Indigenous rights, and public health and safety to identify a set of electricity policy alternatives, and multi-criteria analysis to analyze results and develop a preferred development pathway.	The method purports to be flexible and sensitive to its context and SEA principles. The method also enables replicability and confidence in results due to participatory involvement and flexibility in scoping project alternatives.	ECH
(Finnan et al., 2012)	Utilizes the EU SEA framework to quantify the impacts of proposed alternatives for biomass power generation for environmental and social receptors in Ireland. Ireland is attempting to replace 30% of peat with biomass in three powering stations.	Under the EU SEA directive, this project evaluated 4 alternatives according to EU SEA protocols and under the directive of 8 environmental receptors: climate, air, water, biodiversity, soil, material assets, landscape, population and human health and cultural heritage.	The quantitative assessment of development alternatives indicated that biomass importation has greater (global and domestic) environmental impacts than those which included growing biomass in close proximity to the generating station.	ECH

8.2 PEER-REVIEWED ARTICLES DEPLOYING INNOVATIVE, INTEGRATIVE METHODOLOGICAL STRATEGIES TO SUPPORT SEA PRACTICES FROM A SYSTEMATIC REVIEW OF THE PEER-REVIEWED LITERATURE (N=18)

Author/Year	Method	Methodological Contribution	E-C-H Integration	Integration Conceptualization
(Bjorklund, 2012)	Life Cycle Assessment	LCA is a methodology that evaluates environmental impacts of a PPP through its entire lifecycle ('cradle to grave'). When integrated with other EA tools and protocols, LCA can assist in robust decision making by adequately integrating a variety of temporal impacts into RSEA.	E	LCA + Public participation + Scenario planning
(Brandão et al., 2010)	Life Cycle Assessment	Life cycle costing is applied to an integrated environmental and economic assessment of food, energy and timber industries to compare options for managing and using agricultural land. Deploys a combination of life cycle analysis to measure impacts of development strategies on climate change and ecosystem services; and life cycle costing of the economic cost of various actions. This tool can analyze potential disproportionate impacts on different groups and is environmental justice informed.	E-C	Environmental + Economic domains of life cycle analysis
(Choi & Lee, 2016)	Planning Support Systems-Based Spatial Plan Alternatives	This GIS-based planning system incorporates a series of 'what if' models to create predictive scenarios as a means to improve public awareness and involvement through digital visualization, and to support e-governance systems.	E	Population dynamics + Spatial land use policies
(Cooper, 2010)	Network Analysis	In the context of ecosystem services, network analysis can be utilized to define ecosystem services, understand relationships among land-use and impacts to those services, and to engage stakeholders in identifying related issues.	E	SEA + Cumulative effects + Sustainability + Green space planning
(Croal et al., 2010)	Decision-Makers Tool	The DM Tool is designed to recommend alternative actions based on clearly articulated goals/issues, apply sustainability criteria to decision-making, and evaluate feasible alternatives by recognizing trade-offs and residual risks to decision-makers	E	SEA + Sustainability

(Diez-Rodríguez et al., 2019)	Group-Spatial Decision Support System	Utilizes interdisciplinary consensus process among multidisciplinary experts to analyze historical data without depending primarily on spatial analysis of any one sectoral or disciplinary 'cognitive stance'. The method proposes spatial locations for energy transition infrastructure to communicate feasibility of alternative development pathways.	E	Multidisciplinary Expertise
(Floris & Zoppi, 2015)	Social Media-Related Geographic Information	Utilizes a variety of 'big data' points from social media sources to surface user practices and preferences regarding service and infrastructure use. Incorporating such spatial data into the planning process can help to build scenarios for a variety of sustainable development and tourism strategies.	C	Multiple community values of end-user services
(Garcia-Montero et al., 2010)	Two environmental screening tools to support the screening phase of SEA	Screening effectiveness tools to support fast and simple decision-making in the early processes of SEA, with a particular focus on integrating climate change and biodiversity goals.	E	Climate change + Biodiversity
(Harwell et al., 2019)	Gulf Ecohealth Metris Initiative	A conceptual framework for SEA to develop indicators and measures for characterizing the health of diverse ecosystems and their connection to human communities. The framework adapts the Drivers-Pressures-States-Impacts-Response framework to "Drivers-Pressures-Conditions-Responses" that includes a hierarchical reporting structure to communicate information with relevant audiences.	E-C-H	SEA + DPSIR framework
(Kelly et al., 2013)	Review of 5 modeling approaches for integrated environmental assessment	Systems Dynamics Modeling, Bayesian Networks, Couple Component Models, Agent-Based Models and Knowledge-Based Models, culminating in a framework to assist modellers select an appropriate methodology for an integrated assessment	E-C	Biophysical + Social + Economic processes

(Lynch, 2011)	Threat and Disturbance Categorization	Detailed categorization method to label threats and disturbances to link human activities to natural ecosystem impact. The method uses a driver-pressure-state-impacts-response framework to develop a detailed threat and categorization approach encompassing a variety of levels of hierarchical detail on a range of anthropogenic and natural processes to link short and long-term consequences of development activities.	E	Ecological assessment + Environmental management
(Macpherson et al., 2010)	Regional Environmental-Economic Directional Distance Function	Characterizes the relative efficiency of spatial units according to key indicators to produce multiple positive and negative impacts on socioeconomic and environmental values. The model makes no assumptions about relationships among variables, but quantifies the extent of maximizing desirable outcomes while contracting undesirable outcomes. The model where inclusion of socioeconomic indicators demonstrate increased efficiency in management relative to environmental indicators alone.	E-C	Environmental Assessment + Economic Assessment
(Mascarenhas et al., 2012)	Indicator-based Regional Spatial Plan Monitoring Systems	Utilizing a conceptual framework to link regional spatial plans with SEA and related indicators, incorporates existing monitoring systems in the geographic scope of analysis, and defines specific indicator selection criteria across relevant data sets.	E	SEA + Regional environmental planning
(Martinez-Grana et al., 2014)	Environmental Vulnerability Measures as an Opportunity to Integrate SEA with EIA	GIS mapping procedures are deployed to quantify environmental impacts, and checklists and matrices were utilized to assess attributes and provide a characterization of vulnerability. Emphasis was primarily on biophysical components (air, water, soil, etc.), but also included socioeconomic values of impacts to visual landscape and heritage areas. Quantitative and qualitative assessments were coupled to measure the incidence and magnitude of vulnerabilities, resulting in 5 classes of vulnerability depicted cartographically.	EC	SEA + Environmental Assessment

(Naddeo et al., 2013)	Dynamic and Embedded Evaluation Procedure for SEA	A robust process for incorporating stakeholder engagement to build community consensus by ensuring appropriate indicator selection and ensuring goals align with environmental sustainability.	E-C	Social license to operate + Environmental sustainability
(Rozas-Vasquez et al., 2014)	Scenario Modeling	Landscape metrics and dynamics were measured in relation to spatial plans and different development scenario impacts on wetlands. Scenario modeling can understand multiple spatial impacts to wetland cover by modeling diminishing and fragmented areas under different development pathways.	E	Spatial modeling + Landscape planning
(Thompson et al., 2013)	Compliance Analysis	This method utilizes Likert Scale evaluation scores to compare alternatives for decision-making and analysis. The scales compare intentions of the approved plan with alternatives across six sectors (air quality, climate change, health, noise, socioeconomic, transport) finding that alternatives were typically better aligned with social, economic and environmental sustainability than the approved plan. The compliance analysis method is offered as a 'watchdog' tool in weighing trade-offs between proposed plans and alternatives.	E-C-H	Environment + Community + Health
(Vukicevic and Nedovic-Budic, 2012)	GIS-based Multicriteria Analysis	GIS model to determine most sensitive areas, and to shift weights of difference valued components to reflect alternative development pathways. This method can evaluate and compare different types of data to identify n indicator that represents significant importance to the overall model.	E	SEA + Formal land-use planning processes

Cover Photo

Wildflowers in the Canadian Arctic (Victoria Island, Nunavut) (K. Hanna)

In the Canadian Arctic, the Beaufort Regional Environmental Assessment (BREA) addressed priority gaps in science and generated regional environmental and socio-economic research to gather new information of value to regulatory decisions for future oil and gas exploration and development in the Beaufort Sea. More recently, a Strategic Environment Assessment in Baffin Bay and Davis Strait the SEA was done to support decision-making on whether, where, or when companies could be invited to bid on parcels of land for oil and gas exploration licenses in the Canadian waters of Davis Strait and Baffin Bay.